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Dear Readers,

The Editorial Committee of the Reserve Bank of India Occasional Papers has been reconstituted with Dr. Balwant Singh and Dr. Michael Debabrata Patra as members and the undersigned as the Chairman. The team of Associate Editors comprise Dr. Rajiv Ranjan, Shri Sanjay Hansda and Dr. Sunando Roy. The new team endeavours to achieve and maintain the high standards of the Reserve Bank of India Occasional Papers which has been a flagship publication for dissemination of research papers produced by the staff of the Reserve Bank of India. We are committed to further improving the quality of the Occasional Papers.

It is expected that the backlog in publication would be cleared soon with two combined issues for 2001 and 2002 to be published over the next few months.

Yours Sincerely,

(Narendra Jadhav)
Chairman, Editorial Committee
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The Price of Low Inflation

Muneesh Kapur and Michael Debabrata Patra*

Any society that desires to lower the inflation rate may suffer output losses in the interim period. Even independent central banks have to contend with such output losses, given the inertia in inflation expectations and credibility constraints. Presenting estimates of the sacrifice ratio for India, this paper argues that the slope of the aggregate supply curve in India is flattening and this may raise the output costs of reining in inflation when the upturn of overall economic activity takes root. Accordingly, estimates of the sacrifice ratio are going to become more valuable than before. A low inflation regime may have continuous benefits which may be enough to offset the initial output losses. This is the relevant trade-off that society faces: whether the present generation is willing to suffer some hardships for the benefits that will accrue to future generations.

Introduction

Currently, inflation in many parts of the world is lower than in half a century. In crisis-affected Asia, economies continue to contend with disinflation and hesitant recovery. In the last bastions of growth in Asia - China and India - there is a clear slackening of momentum. Consumer price inflation which turned negative in China in 1998 and 1999 is expected to remain negative in 2002 (-0.4 per cent); in India, year-on-year changes in wholesale prices – the official measure of inflation – were trailing a little above 1 per cent in early 2002 with inflation in terms of manufactured product prices touching zero. Over the rest of 2002, inflation has remained weak, with average inflation rate sliding downwards from its level a year ago.

Recent evidence from industrial countries, particularly from the US in the 1970s, 1980s and early 1990s, suggests that disinflation has been a major cause of recession. The decade-long co-existence of near zero growth and falling prices in Japan has raised the spectre of deflation over the global economy. In industrial countries, policy interest rates have eased to levels which seem to indicate that monetary policy is approaching a zone of

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ineffectiveness. In the Euro area, sentiment has begun to flag and apprehensions of a moderation in the strength of the anticipated recovery are beginning to surface. There is the growing danger that even if economies continue to expand over the next year, growth may not be strong enough to prevent the onset of deflation in several countries including the world's three biggest economies (The Economist, 2002).

This paper undertakes an assessment of the lessons gathered from this close encounter with the threat of deflation. Although fears of deflation and its extreme manifestation – depression – receded in the second half of the twentieth century, the paper argues that it is unwise to disregard Keynes' pronouncement on the inexpediency of deflation being worse than the injustice of inflation (Keynes, 1932). In particular, the paper cautions against a generalised easing of the resistance to deflation which has occurred in the closing decades of the twentieth century as price stability (in terms of keeping inflation permanently low) gained primacy as an objective of monetary policy. The commitment to price stability has been reinforced by radical changes in the institutional apparatus of monetary policy through legislative empowerment and institutional reform. While the benefits of price stability are well known, it is important to recognise that there may be some sacrifice in the movement from high/medium inflation to a low inflation on a permanent basis. Just as inflation in the higher reaches has harmful effects on growth, monetary policy action moving inflation to lower levels inevitably involves a cost in terms of output foregone. The slope of the aggregate supply curve has a crucial bearing on the magnitude of the output cost of disinflation. The flattening out of the aggregate supply curve which has occurred in this unprecedented era of low inflation, coupled with the presence of nominal wage rigidities, has tended to enhance the output costs of lowering inflation. This is because economic agents are forced to adjust to slowing output, not through reduction in nominal wages which are particularly rigid during low inflation, but through cutbacks in employment and sacrifice of potential output. Therefore, a tightening of monetary policy, should it become necessary, would have stronger real effects than in the past.

Estimation of the sacrifice ratio – the loss of output (or employment) due to a lowering of trend inflation – is the main objective of this paper. In recent years, there has been a proliferation of empirical estimates of the sacrifice ratio, mainly following the seminal contribution of Okun (1978). Interest in the subject has spurred the employment of alternative methodologies which are dealt with in this paper. Furthermore, estimation of sacrifice ratios has generally been confined to industrial countries. For developing countries, and particularly India, estimation of sacrifice ratios is rarely attempted, the only known effort being the work reported in the Report on Currency and Finance (RBI, 2002a).

The rest of the paper is organised into four sections. The following section addresses definitional issues and select contributions to the literature on the sacrifice ratio with a view to shedding light on common grey areas in the interpretation of sacrifice ratio estimates. Section II sets out the methodology adopted in this paper and the analytical refinements necessary in the conventional approach to make the sacrifice ratio meaningful in the context of a country like India. Section III presents an analysis of the results. The final section contains concluding observations.

Section I

Sacrifice Ratio in the Literature

Since the 1950s, the debate on the trade-off between inflation and growth has arguably focused on higher inflation as the cost of higher growth and reduction in unemployment. Even the Friedman (1968)-Phelps (1969) critique on the trade-off in the long-run pointed to the inflation consequences of attempting to lower unemployment below its natural rate. In large measure this was the consequence of the Keynesian-type conduct of monetary policy and its institutional framework which imparted a bias towards inflation. Before the Great Depression, however, inflation and deflation were treated as roughly symmetric; the conventional wisdom of the 1920s, exemplified in Keynes early writings, warned that ‘the fact

of falling prices injures entrepreneurs; consequently the fear of falling prices causes them to protect themselves by curtailing their operations' (Keynes, 1923). After the Great Depression, a near consensus emerged that the effects of inflation and deflation were asymmetric and that it was deflation which had led to an unprecedented macroeconomic holocaust. The fear of deflation in the literature of the 1930s was stoked by the monetary policy ineffectiveness produced by the zero bound on the nominal interest rate – deflation can generate further increase in real interest rates and cause perverse wealth transfers – and the danger of financial fragility turning systemic due to the impairment of debtors' portfolios. The international effects of the threat of deflation were drawn out in terms of competitive deflationary policies, including exchange rate depreciation spirals (De Long, 1999).

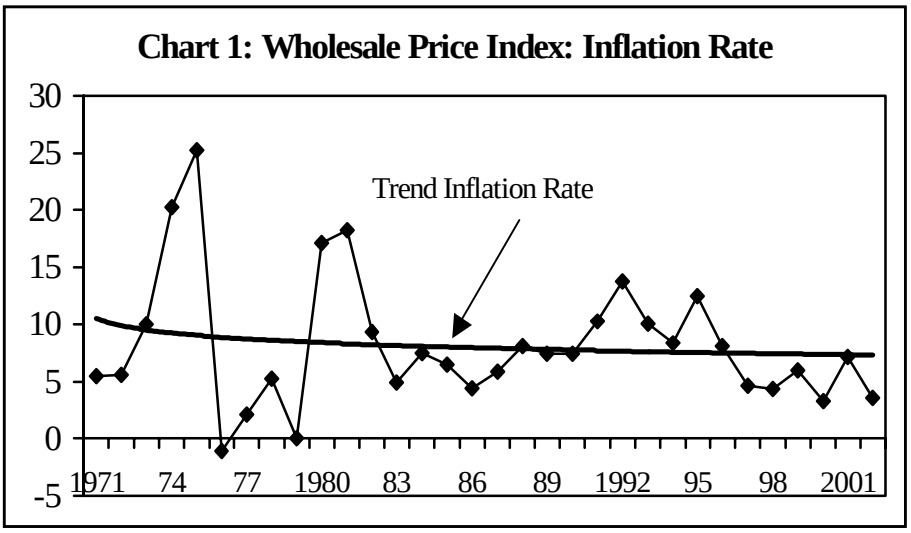
Back to the present. Why has the disinflation since the late 1990s resurrected the spectre of deflation? This is mainly on account of a dissipation of the inflation bias associated with monetary policy as well as rising output gaps in the major economies. In significant measure, the easing of the inflation bias reflects the reforms that have occurred in the institutional framework of monetary policy. Following the seminal work of Kydland and Prescott (1977), the issue of time-inconsistency of monetary policy and proximate resolutions has proliferated in the literature, mainly focusing on the reputational constraints on monetary policy – the preference for rules over discretion (Friedman, 1977); appointing a conservative central banker with a relatively low (or no) time preference and a high preference for price stability (Rogoff, 1985) which provides a rationale for an independent central bank; contracts between the principal (government) and the agent (monetary authority) with the tenure of the contract linked to the performance of the agent in delivering low inflation (Walsh, 1995); constrained discretion through target and instrument rules (Taylor, 1993; Svennson, 1999); and reforms in monetary-fiscal coordination emphasising clarity of roles, responsibilities and objectives, open processes of policy formulation and public accountability (IMF, 1999). These developments have had a fundamental impact on the institutional infrastructure of

monetary policy and improved the technical skill with which monetary policy is being conducted, even to the extent of eliminating the inflationary bias. Indeed, this has led to an extreme view that the probability of deflation is so small that worrying about it is a waste of time (Perry, 1998). On the other hand, it can be argued that the risks of deflation have increased significantly, in view of the widening output gaps coupled with the fact "many of today's central bankers, brought up to believe that their job is to fight inflation, seem to be underplaying the risk" (The Economist, 2002a).

The fear of disinflation turning into deflation is fuelled by the limits it imposes on the effectiveness of monetary policy. Too low inflation is not just a disincentive for production decisions; it can also delay consumer spending in anticipation of further fall in inflation and damp demand at a time when its revival could have been critical for triggering the upturn. Low inflation also imparts inflexibility to nominal wages and labour markets, causing higher unemployment and deepening the recession. Signals from financial prices turn ineffective and with the real burden of debt increasing, financial distress can threaten the health of the financial system. Systematic evidence turned in on the presence of downward rigidity in wages indicates that in a period of falling inflation the ability of firms to make adjustment in real wages is severely constrained and this leads to inefficiency in the allocation of resources and a rise in unemployment (Akerlof, Dickens and Perry, 1996). The ability of the monetary policy to counter deflation is also exacerbated by the long time lags – at least 18 months or so – in its taking effect on its final targets. This weakness is further compounded by the failures to produce consistent and reliable forecasts of inflation over a time horizon that correspond with the effective range of monetary policy (DeLong 1999); this view is, however, contradicted by others (Sims, 1999). Simulations for Japan to assess the impact of a zero interest rate floor show that the probability of a deflationary spiral which is nil for an inflation target of two per cent and above increases to 11 per cent when the inflation target is zero (IMF, 2002). This leads up to the diagnosis that good monetary policy should aim for a rate of change in the price level

consistently on the high side of zero (DeLong, 1999) or an inflation target in the range of 1.5-4.0 per cent (Akerlof *et al* 2000). A more radical view is that strict inflation targeting is not the promised panacea as fixation with short-term price stability can lead to neglect of important signs of financial imbalances which can cause deeper recessions and even a future risk of deflation (The Economist, 2002b).

In the Indian context, the average inflation rate (on the basis of movements in the wholesale price index, WPI), has been around 8 per cent per annum over the last three decades. A decade-wise comparison reveals that the inflation rate has been quite stable: it averaged 9.0 per cent per annum during the 1970s, 8.0 per cent during the 1980s and was 8.1 per cent during the 1990s (Chart 1). Since the latter half of the 1990s, however, there is a perceptible lowering of the trend inflation, abstracting from the supply shocks. The current low inflation reflects both demand and supply factors; accordingly, periods of low inflation for a year or so may not break public's inflation expectations, given the role of adaptive expectations. Moreover, recent monetary policy statements have projected indicative targets for money supply based on an assumption of the inflation rate in the vicinity of 4-5 per cent. Against this background, the costs of a further permanent reduction in inflation rate to the levels prevailing in industrialised nations may need careful consideration. Furthermore, the edging down of trend inflation suggests a flattening of the aggregate supply curve in India as in many other countries bound by the downturn. The stance of monetary policy in India has been accommodative with policy interest rates at their three decade lows. There are indications that the inevitable tightening of monetary policy to stabilise the upturn will be postponed well in to 2003. Given the shape of the aggregate supply curve, the output effects of the imminent change in the stance of the monetary policy may warrant a close scrutiny.



Some Conceptual Issues

The sacrifice ratio encapsulates the output costs of lowering inflation. It has generally been employed in the recent literature in association with disinflationary settings of monetary policy – the US disinflation overseen by the Fed Chairman Paul Volcker in the early 1980s is viewed as the best episode for testing the validity and information content of the sacrifice ratio. The sacrifice ratio has been described as one of the subjects in macroeconomics that is at the heart of many practical policy discussions but, at the same time, rarely finds its way into serious academic publications (Mankiw, 1994). The size of the sacrifice ratio has been regarded as a guidepost in determining the speed of disinflation to be engineered by monetary policy action. The potential costs include lost output, higher unemployment, and related social ills. Only with accurate measures of both can monetary policy in the quest of price stability be assessed (Filardo, 1998). In this sense, the sacrifice ratio becomes relevant not merely in assessing policy effectiveness in a one-time transition from high inflation to low inflation but also in the context of the ongoing policy rule.

The concept of sacrifice ratio quantifies in a single number the extent of the output-inflation trade-off and, as such, distils complex economic phenomenon into a fairly simple, yet informative, cost

measure (Filardo 1998). The sacrifice ratio is defined as the cumulative output losses that an economy must endure to reduce average inflation, on a permanent basis, by one percentage point. A few aspects of the definition are worth underscoring. First, the focus of sacrifice ratio estimations so far is on reducing inflation on a permanent basis as a deliberate strategy by the monetary authority; temporary reductions in inflation on account of other reasons, say, beneficial supply shocks are not the focus of the exercise. Secondly, the concept of sacrifice ratio is relevant for all values of inflation. Thus, although there are long-term gains from inflation reduction for an economy whose inflation rate is above its 'threshold', the process of reducing the inflation towards the threshold would nonetheless involve output sacrifice since inflation expectations will continue to be dominated heavily by the immediate past behaviour of inflation. Hence, the concept of sacrifice ratio is consistent with the concept of threshold inflation. Thirdly, the sacrifice ratio refers to cumulative output losses, *i.e.*, output losses occur over time and not in a single period and the output losses are measured as deviations from potential output. The output losses decay over time and are not recurrent for a given disinflation episode. Over time, the actual output approaches its potential level in a gradual manner. At the same time, the concept of sacrifice ratio is consistent with a long-run Phillips curve. Once the lower inflation target has been achieved, the economy gradually returns to its potential output path; in the long-run, the natural rate of unemployment (or potential output) can be associated with any average rate of inflation.

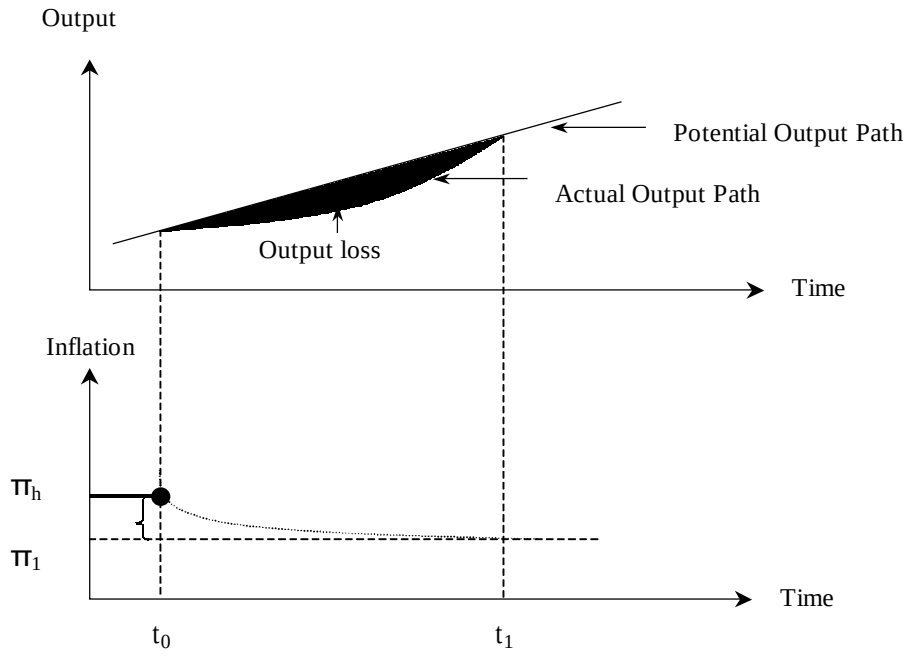
The nature of the output-inflation trade-off and the concept of sacrifice ratio can be easily illustrated in an expectations augmented Phillips curve:

$$\pi_t = \pi^e + a(y_t - y_t^*) \qquad (1),$$

where, π_t, π^e, y_t^* and y_t denote actual inflation, expected inflation, potential output and actual output, respectively. Equation (1) indicates that, given the potential output level, any attempt to reduce inflation requires either a reduction in expectations or a

reduction in current period output. Available evidence strongly suggests that inflation expectations exhibit inertia, being largely adaptive (Mankiw 2001). Consequently, a tighter monetary policy can reduce inflation only by depressing economic activity (a lower y_t). Over time, as inflation starts falling, inflation expectations also adjust downwards and the output approaches its potential level. In the long-run, therefore, monetary policy reduces inflation through a lowering of expectations and, hence, the Phillips curve is vertical in the long-run. The concept of sacrifice ratio is illustrated in Chart 2; the shaded area in the chart represents output losses associated with disinflation and the sacrifice ratio may be calculated as the shaded area divided by the size of disinflation.

Chart 2 : Sacrifice Ratio



Source **:** Filardo (1998).

One of the factors determining the size of the sacrifice ratio is the shape of the Phillips curve. If the Phillips curve is linear, then

the slope of the Phillips curve is constant and, therefore, independent of the business cycle and the speed of disinflation (Filardo, *op cit*). In contrast, a non-linear Phillips curve would imply that the sacrifice ratio would depend upon the current stage of the business cycle and the aggressiveness of the disinflation. For instance, a concave Phillips curve would be flatter and, hence, the sacrifice ratio would be higher as compared with that computed from a linear one. The opposite will hold in the case of a convex Phillips curve. Theoretically, a concave Phillips curve would be consistent with an economy where firms have pricing power (*i.e.,* not purely competitive) and the convex curve with an economy subject to capacity constraints.

Sacrifice Ratio versus Benefits of Low Inflation

The concept of sacrifice ratio does not dispute the need for a low and stable inflation rate. Lower inflation is beneficial to growth as it may, over a period of time, offset the output losses suffered in the process of disinflation (Mayes and Chapple, 1994). Disinflation produces a net benefit and the output losses associated with a typical US disinflation are made up in 10-20 years, *i.e.,* output losses can be recovered in less than one generation (Neely and Waller, 1996). What the concept of sacrifice ratio stresses is that attempts to reduce the inflation rate will inevitably involve output losses in the interregnum or 'painless disinflation is impossible' (Buiter and Grafe, 2001). The question, therefore, is whether gain from reducing inflation to zero is worth the sacrifice in output and employment that would be required to achieve it (Feldstein, 1996). Some studies suggest that low to moderate inflation of about 10 per cent or less does not have any adverse impact on growth (Barro, 1995 and Fischer, 1993). Other studies suggest that there may be welfare losses even under low inflation and, therefore, favour price stability. These studies have, in particular, focused and quantified the distortions under an imperfect indexed tax system and distortions to money demand even when inflation is low. For the US, reduction in inflation by 2 percentage points could generate welfare benefits of 1 per cent of GDP per year forever (Feldstein, *op cit*). For the UK, the benefits from a

same order of reduction in inflation are estimated at 0.2 per cent of GDP per annum forever (Bakshi *et al.* 1997). All studies of this genre, however, obtain their estimates of benefits under a number of *ad hoc* assumptions. Moreover, these distortions can be eliminated by changes in the tax code and, therefore, there is no strong case for a zero long-run inflation target (Mishkin and Schmidt-Hebbel, 2001).

Sacrifice Ratio: Estimates for Industrial Countries

The literature on the sacrifice ratio owes its origins to Okun (1978) who examined a family of Phillips curve models for the US to find that 'the average estimate of the cost of a 1 per cent reduction in the basic inflation rate is 10 per cent of a year's GNP, with a range of 6 per cent to 18 per cent'. Gordon and King (1982) refined Okun's methodology, using traditional and vector autoregression models within the assumption of a linear Phillips curve model, to obtain estimates of the sacrifice ratio in the range of 0 to 8 per cent.

These early efforts assumed a linear Phillips curve. This constrains the output-inflation trade-off to be the same during disinflation as during increases in trend inflation or temporary fluctuations in demand. Accordingly, Ball (1994) employed an atheoretical approach to estimating the sacrifice ratio by circumventing the assumption of linearity. The procedure consisted of identifying disinflation episodes and measuring the sacrifice ratio as the sum of output losses over the episode divided by the change in trend inflation. The estimate of the sacrifice ratio at 3.1 was in reasonable proximity of the earlier work. Ball's episodic approach has a reasonable following (Debelle 1996, Zhang 2001).

Intuitively, it is argued that Ball's method of focussing only on disinflationary episodes is acceptable only if there were a well-established asymmetry in the impact of monetary policy on output and prices (Cecchetti and Rich, 2001). Non-linear Phillips curve models were employed by Filardo (1998) to estimate sacrifice ratios which were sensitive to the initial strength of the economy, the

intended timing of monetary policy action – whether preemptive or disinflationary - and the size of the potential inflation change. Accordingly, the output cost and the stance of policy have to be evaluated on a case-by-case basis. On the other hand, Gordon (1997) did not find any empirical evidence for a non-linear Phillips curve. Cecchetti and Rich (*op cit*) estimated a generalised Phillips curve relationship through structural vector autoregression models to get estimates of the sacrifice ratio for the US in the range of 1.3 to 10 per cent of a year's GDP for a permanent one percentage point reduction in inflation. The need for subjecting the estimates of the sacrifice ratio to robustness tests for statistical precision was emphasised, the underlying economic relationships being somewhat uncertain.

Andersen and Wascher (1999) represent an important contribution to the empirical literature on the sacrifice ratio in the context of the conduct of monetary policy in an environment of low inflation. Employing several methods of estimating sacrifice ratios, *i.e.*, slope of the aggregate supply curve, structural wage and price equations as well as actual developments in output and inflation, sacrifice ratios were found to have risen from 1.5 during 1965-85 to 2.5 during 1985-98 for 19 industrial countries. This suggested inflation inertia paradoxically stemming from enhanced credibility of monetary policy in conjunction with real and nominal wage-price rigidities. Consequently, lower rates of inflation have been accompanied by a flattening of aggregate supply curves. This leads to the key proposition that a tightening of monetary policy would henceforth have stronger effects on real output than in the past, with price adjustments occurring over a longer time span. At the same time, the cross-country evidence of sacrifice ratios being lower for countries that have flexible and competitive markets suggests that countries can undertake structural measures in their markets to offset the increasing sacrifice ratios.

Cross-country evidence corroborate these findings. The average sacrifice ratio for OECD countries, based on single equation estimates, was 3.2 with a range of 2-4, although outliers of 1.6 (Japan, Italy and the Netherlands) and 7 (Norway) were also

observed. System estimates yielded a common sacrifice ratio of 3.7 for 15 out of the 17 sample countries (Turner and Seghezza, 1999). The key characteristics emerging from sacrifice ratio literature (summarised in Table 1) is that estimates of sacrifice ratios are highly sensitive to the estimation methodology.

Table 1 : Estimates of Sacrifice Ratios

Study	Methodology	Coverage and Study Period	Estimates of Sacrifice Ratio (%)
1	2	3	4
Okun (1978)	Aggregate supply curve	USA	6-18
Ball (1993)	Actual developments in output and inflation	19 industrial Countries; 1960-92.	Average 5.8 per cent for quarterly data and 3.1 per cent for annual data. For annual data, the range was 0.9 (France) – 10.1 (Germany).
Debelle (1996)	Actual developments in output and inflation	Australia, New Zealand and Canada	0.4-3.5
Filardo (1998)	Aggregate supply curve (non-linear) in a VAR framework	USA	5.7 for a linear specification; 5.0 for a weak economy and 2.1 for an overheated economy@ for a non-linear specification.
Anderson and Wascher (1999)	Aggregate supply curve; structural wage and price equations; actual developments in output and inflation	19 OECD countries; 1965-98.	Average of 1.5 (1965-85) and 2.5 (1985-98).
Turner and Seghezza (1999)	Aggregate supply curve	21 OECD countries; 1963-97.	Average of 3.2 with a range of 1.6 (Japan, Italy and the Netherlands) – 7.0 (Norway).
Hutchison and Walsh (1998)	Aggregate supply curve	New Zealand; 1983:2-1994:2	4.5-6.0 for the entire sample.@@

Table 1 : Estimates of Sacrifice Ratios (Contd..)

Study	Methodology	Coverage and Study Period	Estimates of Sacrifice Ratio (%)
1	2	3	4
Zhang (2001)	Actual developments in output and inflation	G-7; 1960:1-1999:4	1.4 (without any long-lived effects); 2.5 (with long-lived effects)
Cecchetti and Rich (2001)	Structural VAR models	US; 1959:1-1997:4	1-10
RBI (2002)	Aggregate supply curve	India; 1971-2000.	2.0
Current Study	Aggregate supply curve: alternative specifications	India; 1971-2001	0.3-4.7

Note:
@ : Weak (overheated) economy defined as one with output 0.9 per cent or more below (above) the potential.
@@ : 2.7-3.4 for the first sub-sample (1983:2-1989:4, the period before central bank independence); and, 14.2-18.9 (albeit not significant) for the second sub-sample (1990:1-1994:2, the post-reform period).

The sacrifice ratio is influenced by a number of factors like credibility/independence of the central bank, the speed of disinflation, the initial level of inflation, persistence/hysteresis of output path, the approach to disinflation (deliberate versus opportunistic) and openness of the economy.

Central Bank Independence

An issue debated animatedly in the context of central bank independence (CBI) in an inflation targeting framework is the impact of credibility of the central bank on the sacrifice ratio, *i.e.*, whether increased CBI lowers the sacrifice ratio. In other words, is there a credibility bonus associated with independent central banks? *A priori* the public is expected to more readily believe the anti-inflationary pronouncements of an independent central bank and this, in turn, should lower output losses. The empirical results,

however, do not support the theoretical prediction of a credibility bonus (Debelle and Fischer, 1994; Fischer, 1994; and, Posen 1998).

Debelle (1996) compared the experience of New Zealand (where the central bank was provided legal independence) with that of a control set (Australia and Canada, *i.e.*, countries with a similar inflation history but with the central banks not having explicit independence at the time of the study). The results suggest that costs of disinflation were not lower in New Zealand as compared with the control set; moreover, the sacrifice ratio increased from 0.3 in the 1980-83 disinflation episode (period before central bank reform) to 2.6 in the 1989-93 disinflation which followed central bank reform (Table 2). "It is less clear that the adoption of an inflation target was in fact successful in reducing the costs of disinflation by reducing the inflation expectations of financial markets and the public – and this despite the fact that my senior colleagues and I devoted an enormous amount of effort to convincing the public of the seriousness of our effort" (Brash, 2002). Even the Deutsche Bundesbank and the Swiss National Bank, whose pursuit of low inflation over the last two decades has presumably given them maximum credibility, have been able to achieve inflation reductions only at high costs in lost output and employment (Bernanake and Mishkin, 1997). A comprehensive evaluation of the experience of 17 OECD countries did not yield any evidence that the costs of disinflation were lower in countries with independent central banks (Posen, 1998). On the contrary, the coefficient on CBI is found to be positive and highly significant. Moreover, the effect is also large: "going from a dependent central bank like the Bank of Belgium (central bank independence score of 0.19) to one like the Bundesbank (0.66) adds around 1.25 point-years of unemployment to the sacrifice ratio of an average disinflation" (Posen 1998). The available evidence, therefore, suggests that independent central banks, on an average, pay a higher output price per percentage point of inflation reduction.

Table 2 : Central Bank Independence and Sacrifice Ratios

Country	Disinflation Episode	Sacrifice Ratio
Australia	1974:2-1978:1	0.4
	1982:1-1984:1	1.6
	1989:2-1992:1	1.7
New Zealand	1980:2-1983:4	0.3
	1985:4-1993:1	1.2
	1989:4-1993:1	2.6
Canada	1974:2-1976:4	0.4
	1981:2-1985:2	2.0
	1990:1-1993:2	3.5

Source: Debelle (1996).

The observed increase in sacrifice ratio in the context of independent central banks may, however, be reflecting other offsetting phenomena. For instance, in the context of New Zealand, the CBI and structural reforms were initiated around the same time as is most likely to be the case in many other countries. Accordingly, the stance of fiscal policy and the loss in employment due to such concomitant reforms in public sector and privatisation could have been among the factors leading to an increase in the sacrifice ratio in New Zealand (Debelle, *op cit).* Another reason for the observed positive correlation between CBI and higher sacrifice ratios could be the possibility that the wage setting behaviour may be endogenous to the CBI. In a model with competitive firms, a monopoly labour union and a central bank, Hutchison and Walsh (1998) show that the degree of wage indexation chosen by workers' unions is inversely proportional to the weight put by the central bank on inflation in its loss function. Since increased CBI implies greater weight on inflation stabilisation by the central bank, it may lead to relatively longer nominal wage contracts, *i.e.,* a decline in the degree of indexation in the economy. This would increase the nominal rigidities in the economy and which, as empirical studies show, would be reflected in a higher sacrifice ratio. Hutchison and Walsh find empirical support for this proposition: while the estimated

inflation-output trade-off for New Zealand increased between the pre-reform and post-reform period, the increase in the trade-off was not discrete at the time of the Act providing independence; rather, the trade-off (*i.e.*, the sacrifice ratio) remained virtually unchanged for more than a year following the implementation of the Act and then rose steadily over a two year period.

As for the critical issue of disentangling the effect of CBI *per se* and the increased nominal rigidities induced by the CBI, Hutchison and Walsh find that greater CBI reduces the sacrifice ratio but the reduction is more than offset on account of higher nominal rigidity. On the other hand, Posen (*op. cit.*) does not find any statistically significant relationship between CBI and nominal wage rigidity in the cross-section study covering 17 OECD countries. Thus, central bank independence increases the costs of disinflation irrespective of wage-setting arrangements (Posen, *op cit*). It needs to be recognised, however, that accurate measures of CBI are difficult to obtain. The existing measures of CBI based on codings of legal provisions are believed to be imperfect and unreliable; the usual approach of relying on different measures of CBI is not helpful as "any combination of unreliable measures, no matter how elaborate, is still an unreliable measure itself" (Mangano, 1998). If this measurement error in CBI is not accounted for by the econometric methodology employed, then anomalous results can be obtained; with measurement errors in CBI, covariance structure analysis rather than OLS should be used (Brumm 2000).

In contrast to these studies, Chortareas *et al* (2002) examine a related aspect of central bank institutional design, *viz.*, monetary policy transparency and its influence on sacrifice ratio in a cross-section study covering 44 countries (comprising the OECD as well as the non-OECD countries). Focussing on two types of transparency, *viz.*, transparency in forecasting and transparency in decisions, for the sample as a whole, the sacrifice ratio with unemployment as the indicator of economic activity is lower for countries whose central banks are more transparent in their forecasts. The evidence, though, is weaker for non-OECD

countries. When output is used as an indicator for activity, the result is not robust even for the OECD countries.

Speed of Disinflation

An important influence on the sacrifice ratio is the speed of disinflation. One view stresses that gradualism is preferable so that wages and prices, which exhibit an inertial behaviour, can adjust smoothly to the tighter monetary policy (Taylor 1983). The opposing view holds that gradualism raises the probability of future reversals and may have no favourable impact on inflationary expectations; therefore, a cold turkey approach is less costly because expectations adjust sharply (Sargent 1983). A number of empirical studies support the latter view, *i.e.*, gradual disinflation leads to a higher sacrifice ratio compared to a cold turkey approach although it turns out that the results are sensitive to the shape of the Phillips curve (Ball, 1993; Filardo, 1998; Zhang, 2001). For G-7 countries, the sacrifice ratio was 3.8 if the reduction in inflation rate was 0.25 percentage points per quarter; the ratio would be almost one-half (1.8) if the speed of disinflation were to be increased to 0.5 percentage points per quarter (Zhang 2001). Similarly, estimates by Filardo for the US suggest that, with the economy at its potential output, the sacrifice ratio would be 9.8 if the objective of disinflation were to reduce inflation by one percentage point; the (average) sacrifice ratio would be lower at 7.0 if the disinflation objective were a reduction of two percentage points in inflation (Table 3). The preference for cold turkey reflected in these estimates is related to the Phillips curve being concave. If the Phillips curve turns out to be convex, gradualism could be the optimal approach.

Table 3 : Average Sacrifice Ratio and Speed of Disinflation

Size of Disinflation	Initial Strength of the Economy		
	0.45 per cent below trend	At trend	0.45 per cent above trend
1 per cent	7.0	9.8	12.6
2 per cent	5.6	7.0	8.1

Source: Filardo (1998).

Initial Inflation Rate

The sacrifice ratio may be inversely related to the initial inflation level. Higher initial inflation is expected to be associated with a lower sacrifice ratio due to lower nominal rigidities. For 19 industrial countries for which inflation rates had fallen from 8 per cent (1965-85) to 3.5 per cent (1985-98), an increase of almost 75 per cent in the sacrifice ratios from 1.5 to 2.5 was observed (Anderson and Wascher, 1999). The average sacrifice ratio for G-7 countries increased from 1.3-2.0 (1960-90) to 5.9 during the 1990s (Zhang, 2001) and, *a la* Ball (1994), the relationship between initial inflation and sacrifice ratio was found to be negative and statistically significant. Thus, if initial inflation decreases from 5 per cent to 4 per cent, the sacrifice ratio increases by 0.59 per cent; if initial inflation falls from 20 per cent to 19 per cent, the increase in sacrifice ratio is almost one-fourth (0.14 per cent). A negative relationship between inflation and slope of the Phillips curve is also documented by Dupasquier and Ricketts (1998) for Canada with the slope more than doubling between episodes of low/moderate and high inflation; the results are, however, sensitive to the measure of potential output.

Hysteresis

The sacrifice ratio may also depend upon the degree of hysteresis or persistent effects of monetary policy on potential output. Since the disinflation process forces the economy to deviate from its potential output path, the deviation itself may have an adverse effect on the economy's potential output path. The 'persistence' hypothesis holds that that the economy may take a fairly long time to return to its potential output path; in the extreme case, disinflation may have a permanent effect on output and the economy may display 'hysteresis', *i.e.*, the potential output path may itself undergo a parallel downward shift (Blanchard and Summers, 1986). The method of Ball (1994) which assumes that output returns to potential after a trough over some quarters may thus underestimate the sacrifice ratio. Studies that estimate sacrifice ratios from the slope of the Phillips curve are less susceptible to

this criticism although all type of methodologies may be subject to the hysteresis critique. Zhang (2001), who makes a correction for the possible persistence in output, estimated that the average sacrifice ratio for G-7 countries to be about 2.5, almost double that of 1.4 by the conventional method.

Deliberate Disinflation versus Opportunistic Disinflation

Once the transitional costs of disinflation are accepted, an important issue would be how to minimise such losses. A strand in the literature stresses an opportunistic approach to disinflation as opposed to a deliberate disinflation. The opportunistic approach waits for recessions and favourable supply shocks to lower inflation and hence, would take a longer time. The opportunistic approach is less costly only if credibility is exogenous (Bomfim and Rudebusch 1997); however, credibility is more likely to be endogenous to the performance of the policy maker. Once this endogeneity is taken in to account, deliberate disinflation is found to be preferable.

Openness

Another factor that can influence the sacrifice ratio is the openness of the economy. In a more open economy, a tighter monetary policy will tend to appreciate the exchange rate and this will lower imported inflation, thereby reinforcing the reduction in inflation. Thus, for a given monetary policy shift, the fall in inflation will be larger for a more open economy (Romer 1991); in other words, sacrifice ratios should be lower for more open economies. Using imports/GDP ratio as a measure of trade openness, Ball (1994) did not find any support for this proposition. Loungani, Razin and Yuen (2002), however, argue that sacrifice ratio should be higher for more open economies; the preliminary empirical evidence, using an index of openness of current and capital account, supports their proposition.

Section II

Methodology and Data

In the literature, three methodologies have generally been used to calculate the sacrifice ratio. One approach focuses on historical episodes of disinflation and calculates the sacrifice ratio as the output losses during that particular episode (Ball 1994; Zhang 2001). This approach has the advantage of not constraining the sacrifice ratio to be the same for all disinflation episodes. On the other hand, it focuses only on episodes of disinflation rather than both inflation and disinflation episodes and thereby ignores correlations at other points in the business cycle. The approach also does not provide for any controls for supply shocks. Moreover, it makes an *ad hoc* assumption that output returns to its potential within a few quarters (for instance, four quarters in Ball, 1994) of inflation recording a trough; this assumption may underestimate the sacrifice ratio if the output path indicates persistence and takes a longer time to return to the potential path. The second approach derives estimates of sacrifice ratios from a vector autoregression framework (Cecchetti and Rich, 2001); however, sacrifice ratios obtained from structural VARs are highly sensitive to the size of the model and the identification restrictions. The estimated effects of shocks can vary substantially as a result of slight changes in identifying restrictions. The degree of imprecision of the estimates of sacrifice ratios is found to increase with the complexity of the model used.

The third approach estimates sacrifice ratios from the slope of the aggregate supply curve, *i.e.,* the Phillips curve. This method avoids *ad hoc* assumptions of output returning to trend in some specified quarters; treats inflation and disinflation episodes symmetrically; and can control for supply shocks. Moreover, the data requirements are less intensive than a VAR-based framework and the problem of sensitivity to identifying restrictions is also avoided.

This paper estimates the sacrifice ratio using the Phillips curve approach from reduced-form specifications of the aggregate supply

curve. Within this framework, alternative specifications based on different underlying theoretical models are attempted. The simple expectations augmented Phillips Curve (Equation 1) can be reformulated to include supply shocks and adaptive expectations to obtain the 'triangle model of inflation' (Gordon, 1997). The phrase 'triangle' stresses that inflation depends on a tripartite set of basic determinants: inertia (in inflation), demand and supply shocks, *i.e.*,

$$\pi_t = a(L)\pi_{t-1} + b(L)Dt + c(L)zt,$$

where, $\pi_{t,}$ Dt, and zt denote inflation, a measure of excess demand (unemployment gap or output gap) and supply shocks (foodgrains prices or imported inflation), respectively and L is the lag operator. Excess demand is proxied by output gap (deviation of actual output from its trend). In view of substantial evidence on a possible unit root in inflation, the equation can be modified to take inflation in first difference form, following Turner and Seghezza (1999). Accordingly, the equation used for estimation is as follows:

$$\Delta\pi_t = a(L)\ \Delta\pi_{t-1} + b^*ygap_{t-1} + c(L)^*\ \Delta\pi s \qquad (2)$$

where, Δ is the difference operator, ygap is the output gap and πs is inflation due to supply shocks. The specification implies no long-run trade-off between the level of output and the level of inflation: a temporary increase in the output gap will lead to a permanent increase in inflation. The sacrifice ratio is computed as [(1-coefficients of lagged inflation)/coefficient of output gap].

The inflation-output trade-off, as stressed in the "new classical" literature, can also arise from misperceptions of agents in regard to relative prices. Based on a Lucas framework, the inflation-output trade-off can be obtained from the decomposition of changes in nominal income and its impact on inflation and real output. Following Hutchison and Walsh (1998), the aggregate short-run supply curve can be formulated as:

$$\pi_t = \lambda dx_t + \beta E_{t-1}\ \pi_t + \alpha(ygap)_{t-1} + \mu z_t \qquad (3),$$

where, dx is growth rate of nominal output and other variables are as defined before. The coefficient λ measures the proportion of the change in nominal aggregate demand that affects inflation in the short-run, given expected inflation, the state of the business cycle and supply shocks. The lagged output gap allows for the delayed effects of business cycle conditions on inflation. Since λ measures the change in prices, the term $(1-\lambda)$, therefore, captures the effect of the change in nominal demand on real output. The sacrifice ratio is then calculated as $[(1-\lambda)/\lambda]$. In the absence of explicit survey data on inflationary expectations, expected inflation can be proxied by lagged inflation (Andersen and Wascher 1999); this appears to be a reasonable assumption in the context of the observations of Mankiw (2001). Equation (3) can, therefore, be re-specified as:

$$\pi_t = \lambda dx_t + \beta\pi_{t-1} + \alpha(ygap)_{t-1} + \mu z_t \qquad (4)$$

The definition of sacrifice ratio used by Hutchison and Walsh is, however, not the only possible alternative since lagged inflation as well as the lagged output gap in the equation could also be sources of nominal rigidity. In that case, the sacrifice ratio could be calculated as α/λ or β/α. To remove these ambiguities, Anderson and Wascher suggest a constrained version of (4) by making use of the nominal income identity which imposes the homogeneity restriction $\alpha = \lambda$ (Equation 4a). In order to remove further ambiguity, they impose an additional restriction i.e., $\beta = (1-\lambda)$ for both 4 and 4a. The sacrifice ratio is then calculated, as before, as $[(1-\lambda)/\lambda]$.

$$\pi_t = \lambda(dx_t + ygap_{t-1}) + \beta\pi_{t-1} + \mu z_t \qquad (4a)$$

Finally, aggregate supply curve can also be derived directly from the explicit nominal income identity (Chand 1997). By definition, nominal income growth (dx) is the sum of the inflation rate (π_t) and the growth rate of real output (dq) as:

$$dx_t = \pi_t + dq_t$$

Let dq* be growth rate of potential output. Adding this term and re-arranging, we get

$$dx_t = \pi_t - \pi_{t-1} + \pi_{t-1} + dq_t + dq^* - dq^*,$$

or,

$$(\pi_t - \pi_{t-1}) + (dq_t - dq^*) = dx_t - (\pi_{t-1} + dq^*) \qquad (5)$$

The first term on the left hand side of equation (5) is the acceleration in the inflation rate while the second term captures deviations of real output growth from its potential growth path. The term within parentheses on the right side can be interpreted as the potential rate of growth valued at preceding period's rate of inflation. The right side of (5), therefore, denotes excess income gap (EIG), *i.e.*, excess of nominal income growth over the potential rate of growth valued at preceding period's rate of inflation. While (5) is an identity, economic theory can be used to postulate acceleration in inflation and the deviation of output - the left hand side terms of (5) - as dependent upon EIG to form behavioural equations:

$$(\pi_t - \pi_{t-1}) = a[dx_t - (\pi_{t-1} + dq^*)] \qquad (6)$$

$$(dq_t - dq^*) = (1-a)[dx_t - (\pi_{t-1} + dq^*)] \qquad (7)$$

The estimated coefficients 'a' and (1-a) will depend upon the structure and behavioural characteristics of the economy and should add up to unity to satisfy the nominal income accounting constraint. While the estimates of sacrifice ratio require estimation of 6 alone, we estimate (7) as well to see whether the adding up requirement is satisfied. As in previous cases, the equations 6 and 7 can be augmented to include supply shocks. The sacrifice ratio can be calculated as [a/(1-a)].

Data

Equations (2), (3), (4), (4a), (6) and (7) are estimated over the period 1970-71 to 2000-01 using annual data. Inflation is measured from the average wholesale price index. To test for robustness, an alternative indicator of inflation, *viz.*, the GDP deflator is also used

for Equations 3-5. On the other hand, for Equations (6) and (7), given the explicit derivation from national income accounting and the adding up constraint, only the GDP deflator is used. Output gap is defined as the deviation of actual real output from potential real output (as percent of potential output) where potential (trend) real output is the Hodrick-Prescott filtered real output. The supply shocks are captured by foodgrains prices in the WPI or imported inflation, the latter proxied by unit import values. A weighted measure of the import price inflation, *i.e.*, unit import prices weighted by the openness (imports as a ratio of GDP) is also tried. The inflation rate of these supply shocks enter the specification either in first differences or as relative to the overall inflation. The oil price shocks are controlled through the use of dummies. In view of significant structural changes in the Indian economy since the 1990s, all the equations are also estimated over the second half of the sample period (1984-85 onwards) to check the robustness of the estimates.

Section III

Estimates of Sacrifice Ratio for India

The definition of the sacrifice ratio assumes that inflation is not mean reverting, *i.e.*, non-stationary while output gaps are stationary. Examination of the stationarity properties of the variables employed becomes necessary for determining the appropriate model specification. Unit root properties are tested using the Augmented Dickey-Fuller (ADF) tests as well as the Phillips-Perron (PP) test. For the ADF tests, lag selection using both Akaike Information Criteria (AIC) and Schwartz-Bayesian Information Criteria (BIC) criteria was undertaken. By the AIC criteria, all variables, excepting inflation and nominal GDP growth, turned out to be stationary. As regards inflation, its first difference was stationary. By the BIC lag selection criteria, all variables entering the regressions were found to be stationary. Similarly, by PP tests too, all variables indicate stationarity. In brief, the various tests indicate that all series are I(0), except for some ambiguity on WPI inflation (Table 4). This ambiguity is addressed by testing alternative specifications with either inflation or its first difference as the dependent variable.

The estimates based on alternative supply equation specifications are set out in Tables 5-9. The estimated equations have a satisfactory fit and explain a substantial amount of variation in the dependant variable (with R-bar*2 usually in the range of 70-80 per cent and even more which can be considered satisfactory in view of the dependant variable being in first difference). The Jarque-Bera (JB) normality tests on residuals indicate that all residuals have normal disturbances. Based on the Ramsay RESET test of errors in specification, almost all equations appear to be specified correctly.

The results of the basic specification (equation 2) using WPI inflation rate (in first differences) as the dependant variable are in Table 5. The lagged inflation variables are significant indicating the presence of inflation inertia. The demand variable, proxied by output gap, is also significant and estimates suggest that, other things remaining constant, real output one per cent above potential output in the current year pushes up the inflation rate by around 60 basis points in the next year. Supply shocks emanating from variations in foodgrains prices are an important determinant of the inflationary process and are significant in all specifications. On the other hand, imported inflation is not significant in all specifications. Based on these specifications, the estimates of sacrifice ratio lie in the range of 1.9 to 2.7 for the full sample period. The estimates are fairly close to that of 2.0 in RBI (2002).

With GDP deflator as the measure of inflation, the estimates of sacrifice ratio are somewhat higher at 2.6-3.5 (Table 6). As another robustness check, we restrict the sample size to the period 1984-85 onwards; in view of the sample size and lower degrees of freedom, the results should be interpreted as only indicative. The sacrifice ratio is estimated at 2.0 when the WPI inflation is used and 4.7 when the GDP deflator is used for the truncated sample period. This can be seen as evidence of the flattening of supply curve.

The results for WPI inflation under specifications 4, 4a and 4b are in Table 7. Based on unconstrained specification (i.e., Equation 4), the estimated sacrifice ratio is 1.9 (but not significant) for the full sample period when computed solely from the coefficient of

the change in nominal GDP; however, as indicated earlier, alternative measures of sacrifice ratio are possible from this specification with widely varying results, including estimates as low as 0.5. The results are broadly the same when GDP deflator is used as a measure of inflation (Table 8). As in the case of the specification 2, the sacrifice ratio estimates based on the period 1984-2000 turn out to be higher; for the constrained specification, the estimated sacrifice ratio is 1.1 (with WPI inflation) and 1.0 (with GDP deflator).

Finally, the results of the specification 6 derived from explicit nominal income accounting and using the GDP deflator inflation are presented in table 9. The table provides estimates of the responsiveness of the inflation acceleration term as well as the cyclical output growth to the excess income gap. The coefficients sum to unity, satisfying the adding up requirement with minor shortfalls as in Chand (1997). The sacrifice ratio is estimated to be 0.7 for the full sample.

Robustness Tests

One area of concern in the literature is the stability of the Phillips curve specifications from which the estimates of sacrifice ratios have been obtained. In the context of the US, a number of studies have documented instability in the coefficients of the estimated Phillips curve and, in particular, in the coefficients on lagged inflation. Although statistically significant, this instability does not seem to be quantitatively large, particularly in its effects on 12-month ahead forecasts (Stock and Watson, 1999). In view of such concerns, this paper undertakes and reports a variety of stability diagnostics and their probability values (Tables 5-9). A well-known test of parameter stability is the Chow's F-test; for this purpose, the paper breaks the sample period into two equal halves. The p-values in all tables are above 0.05 suggesting that the null hypothesis of parameter stability cannot be rejected. A weakness of the Chow test is that it requires definite knowledge of the break point, which is often difficult to know. This can be overcome by CUSUM and CUSUM sum of squares (CUSUMSQ) techniques to

detect gradual changes based on recursive residuals. While the usual approach to these tests is to examine their plots, a compact alternative is regression diagnostics based on the maximum values of the CUSUMs relative to their bounds or mean and the associated p-values. For example, if a p-value is less than 0.05, the CUSUM crosses the bound. As may be seen from Tables 5-9, almost all specifications (27 out of 32) have fairly high p-values supportive of parameter stability. Thus, based both on the CHOW tests and the CUSUM and CUSUMSQ tests, it can be concluded that the specifications are generally stable.

Another area of concern is that most studies have ignored the issue of statistical significance of the estimated sacrifice ratios. The only study that undertook such an exercise found the sacrifice ratio estimates to be imprecise, with the degree of imprecision increasing with the complexity of the VAR model used and forcing the authors to conclude that the estimates provide a very unreliable guide for assessing the output costs of a disinflation policy (Cecchetti and Rich, *op cit*). We, therefore, report the significance of the estimated sacrifice ratio (Tables 5-9). In contrast to Cecchetti and Rich, the sacrifice ratio estimates in this paper are generally highly significant statistically although it may be noted that the methodologies of the two papers are not comparable.

In sum, the estimates of the sacrifice ratio for India depend upon the theory underlying the specification, the measure of inflation used and the period of estimation. For most of the specifications, the estimates of sacrifice ratio based on the GDP deflator are higher than those derived from WPI inflation. The estimates are highly significant statistically and the wide range of estimates appears to be consistent with the existing studies in the literature. As noted earlier in the section, the unit root tests were somewhat ambiguous about the stationarity of the WPI inflation rate; amongst the various specifications, perhaps those using the first-difference of inflation as the dependent variable could be considered as more robust. Furthermore, as noted above, within the Lucas supply curve, alternative estimates of sacrifice ratio are possible.

Section IV

Concluding Observations

This paper has argued that any society that desires to lower the inflation rate may suffer output losses in the interim period. These output losses may arise on account of nominal and real rigidities in the system or on account of misperceptions of economic agents in distinguishing relative from aggregate price changes. A review of the literature reveals that even independent central banks may have to undergo such output losses, given the inertia in inflation expectations and doubts about the credibility. This paper presents estimates of sacrifice ratio for India which turn out to be in a wide range based on alternative short-run aggregate supply specifications, a feature consistent with empirical studies on the subject.

The estimated sacrifice ratio warrants a number of caveats in its analytical interpretation. The output losses, following the definition noted earlier, refer to cumulative output losses spread over a number of years associated with decline in trend inflation and not episodic fluctuations. The relevant rate of inflation used in the computation, as pointed out earlier, is the average annual rate of inflation. Thus, computation of output losses with respect to the prevailing point-to-point inflation rate is inconsistent with the underlying framework. For instance, during 2001-02, the average rate of inflation was 3.6 per cent as compared with 1.6 per cent based on a point-to-point inflation rate; the use of the latter measure obviously exaggerates the output losses. It is also crucial to understand the dynamics and sources of inflation; for instance, the low WPI inflation during 2001-02 was significantly enabled by the decline in international crude oil prices and the base effect of the sharp increase during 2000-01. The methodology adopted in this paper controls for such supply shocks and a distinction needs to be made between low inflation driven by positive supply shocks and that due to a tight monetary policy. As stressed in RBI (2002b), current liquidity and monetary conditions suggest clearly that the recent deceleration in inflation cannot be attributed to a tight monetary policy; rather, it reflects favourable supply shocks

and global disinflationary trends. In brief, the estimates of sacrifice ratio cannot be applied mechanically to the existing inflation rate and it is necessary to take into account the sources of inflation, the stance of monetary policy and the role of imported inflation. It needs to be recognised that the slope of the aggregate supply curve is flattening and this may raise the output costs of reining in inflation when the upturn of overall economic activity takes root. Accordingly, estimates of the sacrifice ratio are going to become more valuable than before.

The concept of sacrifice ratio argues neither the case for high inflation nor for low inflation and is in no way inconsistent with the views favouring a lower inflation rate in the economy. What the concept of the sacrifice ratio stresses is that there could inevitably be output losses in the process of transition from high inflation to low inflation, when such a low level of inflation is due to tight monetary policies rather than favourable supply shocks. As against these transitional one-time (though spread over a number of periods) output losses associated with a deliberate disinflation, a low inflation regime may have continuous benefits and which may be enough to offset the initial output losses. Perhaps, this is the more relevant trade-off that society faces: whether the present generation is willing to suffer some hardships for the benefits that will accrue to future generations.

Table 4 : Unit Root Tests *(t-values)*

Variable	Augmented Dickey-Fuller Test		Phillips-Perron (PP) test
	AIC Lag Selection Criteria	BIC Lag Selection Criteria	
INFLX	-2.50 [7]	-4.94* [3]	-3.89
INFGDP	-4.16* [3]	-4.61* [0]	-4.47
WPIFG	-4.67* [0]	-4.67* [0]	-4.49
DGDPN	-1.37 [7]	-3.97* [0]	-3.55
DINFLX	-4.11* [5]	-6.22* [3]	-6.59
DINFGDP	-4.24* [5]	-4.24* [5]	-8.32
DWPIFG	-5.95* [2]	-5.95* [2]	-7.66
UVMRELG	-3.89* [0]	-3.89* [0]	-3.94
DUVMGB	-7.19* [2]	-5.96 * [0]	-7.20
WPIFGRELG	-4.91* [2]	-4.91* [2]	-6.44
YGAP	-4.45* [3]	-4.45* [3]	-4.37

Note : For ADF tests, critical t-values are: 3.58 (1%), 2.93 (5%) and 2.60 (10%).
For PP tests, window size of 4 was used and critical value is 3.41 (5%).
Figures in square brackets indicate the number of lags used.
*, ** and *** indicate significant 1%, 5% and 10% level.

INFLX = WPI Inflation Rate
INFGDP = GDP Deflator
WPIFG = Foodgrains Inflation Rate
DGDPN = Growth in Nominal Income
DINFLX = First-difference of WPI Inflation Rate
DINFGDP = First-difference of GDP Deflator
DWPIFG = First-difference of Foodgrains Inflation
UVMRELG = Import Unit Values less WPI Inflation
DUVMGB = First-difference of change in import-weighted unit import values
WPIFGRELG = Foodgrains Inflation less WPI Inflation
YGAP = Output Gap (Actual output less Potential Output)

Table 5 : Estimates using WPI Inflation

	1976-2001	1976-2001	1973-2001	1985-2001
$\Delta \pi_{t-1}$			-0.28 (-2.9)	-0.28 (-2.4)
$\Delta \pi_{t-2}$	-0.22 (-1.8)	-0.43 (-5.5)		
$\Delta \pi_{t-4}$	-0.27 (-2.0)	-0.23 (-2.2)		
YGAP(-1)	0.56 (2.2)	0.87 (3.2)	0.47 (1.9)	0.63 (3.7)
DWPIFG	0.28 (4.0)	0.47 (8.5)	0.46 (8.0)	0.19 (6.0)
DUVMGB		0.55 (1.5)*	1.9 (3.9)	
DUM76	-13.2 (-5.0)			
DUM78		-13.3 (-5.4)		
DUM8081			7.29 (5.6)	
DUM83			-6.49 (-6.7)	
DUM88				3.71 (12.9)
DUM94		6.3 (6.9)		
DUM95				4.20 (6.5)
DUM97				-4.24 (-8.5)
Durbin's h/h-alt	-0.3	-1.0	-0.1	-0.7
R*2	78.4	81.0	80.4	76.1
Sacrifice ratio				
(1-a(L))/b	2.7	1.9	2.7	2.0
t-statistic	2.1	2.8	1.8	3.7

Table 5 : Estimates using WPI Inflation (Contd..)

	1976-2001	**1976-2001**	**1973-2001**	**1985-2001**
p-value	0.04	0.006	0.08	0.00
Diagnostic tests	P-values			
CSMAX	1.0	0.76	0.88	1.00
CSQMAX	0.01	0.71	0.34	0.28
CHOW	0.99	0.48	0.21	0.62
JB	0.59	0.57	0.55	0.94
RESET2	0.26	0.49	0.35	0.93

Figures in brackets are t-statistics.

*: not significant.

Note:
The table presents estimates for the specification (2)
$\Delta \pi_t$ = a(L) $\Delta \pi_{t-1}$ + b*ygap$_{t-1}$ + c(L)* Δ πs, where,
$\Delta \pi_t$ = First-difference of inflation rate,

For variables list, see Table 4.

Diagnostic tests CUSUM, CUSUMSQ and CHOW test for stability of parameters. CUSUM diagnostics are based on the maximum values of the CUSUMs relative to their bounds or mean; they provide a compact alternative to the plot; for example, if a P-value is less than 0.05, the CUSUM crosses a bound. For CHOW test, the sample is split in to two equal halves.

JB test (Jarque-Bera normality test) is a joint LM test of the residuals' skewness and normality.

RESET2 is Ramsey's RESET test, where the residuals are regressed on the original RHS variables and powers of the fitted values to check for missing quadratic terms and interactions for the RHS variables.

For diagnostic tests, p-values have been indicated; p-values higher than 0.05 suggest that the null hypotheses of parameter stability, misspecification and normal disturbances can not be rejected at the 5 per cent probability level.

Table 6 : Estimates using GDP Deflator Inflation
(*Specification As in Table 5)*

	1973-2001	**1973-2001**	**1973-2001**	**1985-2001**
$\Delta \pi_{t-1}$	-0.53 (-7.7)	-0.42 (-6.2)	-0.42 (-5.7)	-0.41 (-2.1)
YGAP(-1)	0.44 (2.4)	0.53 (2.5)	0.54 (2.7)	0.30 (2.2)
DWPIFG	0.37 (6.8)			
WPIFGRELG		0.61 (5.9)	0.61 (6.1)	0.27 (4.1)
DUVMGB	1.05 (3.3)			
UVMGRELG		0.006 (0.2)*		
DUM74	3.77 (4.0)			
DUM8081	4.46 (6.4)	5.69 (8.4)	5.70 (8.8)	
DUM00	-2.18 (-3.7)			-3.12 (-7.2)
Durbin's h/h-alt	-1.2	1.3	1.2	-0.7
R*2	85.4	80.1	80.8	58.5
Sacrifice ratio				
(1-a(L))/b t-statistic p-value	3.5 2.2 0.03	2.7 2.3 0.02	2.6 2.5 0.01	4.7 2.4 0.01
Diagnostic tests	P-VALUES			
CSMAX	0.96	0.97	1.00	0.57
CSQMAX	1.00	0.80	0.94	0.36
CHOW	0.09	0.15	0.14	1.00
JB	0.52	0.43	0.41	0.76
RESET2	0.07	0.02	0.03	0.22

See notes to Table 5.

Table 7 : Estimates with WPI Inflation

	1971-2001	**1971-2001**	**1971-2001**	**1971-2001**	**1985-2001**	**1985-2001**	**1985-2001**	**1985-2001**
Specification	4	CE	4a	CE	4	CE	4a	CE
Constant	-2.94 (-1.3)	-7.26 (-10.2)	-5.32 (-2.0)	-7.11 (-8.5)	-2.17 (-1.3)	-4.79 (-7.0)	-2.05 (-1.2)	-5.18 (-7.0)
dx_t	0.34 (2.1)				0.29 (2.7)			
		0.67 (6.9)				0.44 (4.9)		
dx_t + $ygap_{t-1}$			0.55 (2.9)				0.30 (2.7)	
				0.68 (7.8)				0.48 (5.1)
π_{t-1}	0.23 (1.9)		0.27 (2.2)		0.45 (3.3)		0.38 (2.7)	
YGAP(-1)	0.71 (2.4)	1.11 (5.2)			0.47 (2.6)	0.63 (3.6)		
WPIFG	0.46 (3.9)	0.35 (2.9)	0.40 (3.9)	0.35 (3.7)	0.25 (4.5)	0.20 (5.7)	0.29 (4.1)	0.24 (5.0)
DUM74	3.99 (2.6)	3.15 (2.2)						
DUM80			11.4 (10.7)	11.7 (13.2)				
DUM8081	9.08 (12.5)	8.79 (8.7)						
DUM95					4.25 (5.3)	4.44 (4.9)		
DUM97					-3.63 (-9.0)	-3.69 (-7.9)	-4.08 (-9.6)	-4.17 (-9.2)
DUM01	3.84 (4.8)	4.73 (7.3)	4.90 (4.8)	5.33 (7.2)	3.88 (5.2)	4.74 (13.8)	4.04 (6.0)	5.09 (19.4)
DW/Durbin's h/h-alt	0.5	1.7	-0.06	1.9	0.3	2.0	-1.1	2.6
R*2	77.8	83.9	72.3	81.5	76.8	73.2	66.2	61.6

Table 7 : Estimates with WPI Inflation (Contd..)

	1971-2001	1971-2001	1971-2001	1971-2001	1985-2001	1985-2001	1985-2001	1985-2001
Sacrifice ratio								
$(1-\lambda)/\lambda$	1.9	0.5	0.8	0.5	2.4	1.3	2.3	1.1
t-statistic	1.4	2.3	1.3	2.4	1.9	2.8	1.9	2.6
p-value	0.16	0.02	0.18	0.02	0.05	0.01	0.06	0.01
β/λ	0.7		0.5		1.6		1.3	
t-statistic	1.4		2.2		2.1		2.0	
p-value	0.15		0.03		0.04		0.05	
β/α	0.3				1.0			
t-statistic	2.9				2.8			
p-value	0.003				0.006			
Diagnostic tests	P-VALUES							
CSMAX	0.51	0.86	0.40	0.41	0.20	1.00	0.81	1.00
CSQMAX	0.16	0.43	0.05	0.09	0.04	0.24	0.11	0.10
CHOW	0.77	0.52	0.73	0.65	0.60	0.93	1.00	0.99
JB	0.44	0.45	0.53	0.55	0.98	0.65	0.77	0.73
RESET2	0.02	0.51	0.02	0.17	0.76	0.80	0.85	0.23

Note:
* = not significant; CE = constrained estimates
The table presents estimates for the specifications (4,4a)

$$\pi_t = \lambda dx_t + \beta\pi_{t-1} + \alpha(ygap)_{t-1} + \mu z_t \quad (4),$$
$$\pi_t = \lambda(dx_t + ygap_{t-1}) + \beta\pi_{t-1} + \mu z_t \quad (4a),$$

dx = Growth rate of nominal GDP; other variables as before. Both 4 and 4a are also estimated with the constraint $\lambda = (1 - \beta)$ and these estimates are shown under the column CE.

Also, see notes to Table 5.

Table 8 : Estimates using GDP deflator
(*Specification As in Table 7)*

	1972-2001	**1972-2001**	**1972-2001**	**1972-2001**	**1985-2001**	**1985-2001**	**1985-2001**	**1985-2001**
Specification	4	CE	4a	CE	4	CE	4a	CE
Constant	0.10 (0.1)	-3.84 (-7.8)	0.61 (0.3)	-4.08 (-9.2)	-1.30 (-0.8)	-2.96 (-4.4)	-1.24 (-0.8)	-3.23 (-6.0)
dx_t	0.43 (4.1)				0.40 (3.8)			
		0.65 (5.7)				0.46 (4.5)		
$dx_t + ygap_{t-1}$			0.45 (3.9)				0.43 (4.6)	
				0.75 (7.4)				0.50 (6.9)
$\pi_{\tau-1}$	0.24 (1.8)		0.17 (2.0)		0.43 (3.2)		0.39 (5.4)	
YGAP(-1)	0.60 (2.9)	1.02 (7.9)			0.50 (3.0)	0.60 (5.0)		
WPIFGRELG	0.35 (5.5)	0.27 (4.0)	0.27 (5.0)	0.18 (2.6)	0.22 (3.5)	0.21 (4.0)	0.21 (3.2)	0.19 (3.2)
UVMGRELG			0.04 (2.4)	0.02 (1.1)*				
DUM79			-3.08 (-5.0)	-2.52 (-3.7)				
DUM80			5.61 (6.5)	6.88 (9.5)				
DUM8081	4.43 (5.5)	4.22 (4.0)						
DUM94	3.71 (5.8)	4.07 (6.2)			2.99 (4.6)	3.11 (5.3)	2.70 (7.0)	2.67 (6.8)
DW/Durbin's h/h-alt	-0.4	2.0	0.1	2.1	-0.7	2.3	-0.7	2.4
R*2	81.3	87.4	82.2	87.4	66.5	60.7	68.8	62.3

Table 8 : Estimates using GDP deflator (Contd..)
(*Specification As in Table 6)*

	1972-2001	**1972-2001**	**1972-2001**	**1972-2001**	**1985-2001**	**1985-2001**	**1985-2001**	**1985-2001**
Sacrifice ratio								
$(1-\lambda)/\lambda$	1.3	0.5	1.2	0.3	1.5	1.2	1.3	1.0
t-statistic	2.3	2.0	2.1	1.9	2.3	2.4	2.7	3.4
p-value	0.02	0.04	0.03	0.07	0.02	0.02	0.01	0.00
β/λ	0.6		0.4		1.0		0.9	
t-statistic	1.6		1.9		2.1		3.8	
p-value	0.11		0.06		0.03		0.00	
β/α	0.4				0.9			
t-statistic	2.3				4.5			
p-value	0.02				0.00			
Diagnostic tests				**(**P-VALUES)				
CSMAX	0.69		0.87		1.00	0.73	1.00	0.86
CSQMAX	0.03		0.49		0.89	0.69	0.90	0.80
CHOW	0.91		0.59		0.57	0.52	0.62	0.39
JB	0.65		0.69		0.99	0.80	0.94	0.89
RESET2	0.33		0.75		0.60	0.29	0.63	0.33

See notes to Table 5.

Table 9 : Estimates using GDP Deflator

(Using Specification 6 and 7)

	1972-2001	1972-2001	1985-2001	1985-2001
	Dependent Variable			
	$(\pi_t - \pi_{t-1})$	$(dq_t - dq^*)$	$(\pi_t - \pi_{t-1})$	$(dq_t - dq^*)$
CONSTANT	-0.92 (-2.4)	0.50 (1.4)	0.01 (0.001)	-0.42 (-1.4)
$dx_t - (p_{t-1} + dq^*)$	0.58 (4.3)	0.35 (2.7)	0.63 (3.8)	0.32 (2.1)
WPIFGRELG	0.30 (3.7)	-0.29 (-3.7)	0.17 (1.8)	-0.16 (-1.8)
DUM72	4.15 (8.8)	-3.69 (-8.1)		
DUM77	6.68 (6.0)	-5.92 (-5.5)		
DUM80	10.3 (17.4)	-8.99 (-15.4)		
DUM89			-4.04 (-5.1)	3.81 (5.2)
DUM97			-2.43 (-6.0)	2.31 (6.1)
DW	2.3	2.3	2.2	2.1
R*2	84.4	53.0	57.1	55.3
Sacrifice ratio				
(1-a)/a t-statistic p-value	0.7 1.8 0.07		0.6 1.4 0.16	
Diagnostic tests				
CSMAX	0.14		0.03	
CSQMAX	0.002		1.00	
CHOW	0.95		0.17	
JB	0.72		0.78	
RESET2	0.01		0.01	

Note:

The table presents estimates for the specifications:

$(\pi_t - \pi_{t-1}) = c + a[dx_t - (\pi_{t-1} + dq^*)] + b(WPIFGRELG)$ (6)

$(dq_t - dq^*) = c + (1-a)[dx_t - (\pi_{t-1} + dq^*)] - b(WPIFGRELG)$ (7)

dqt = growth rate of actual real output;
dq* = growth rate of potential real output; other variables as before.

Also, see notes to Table 5.

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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

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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

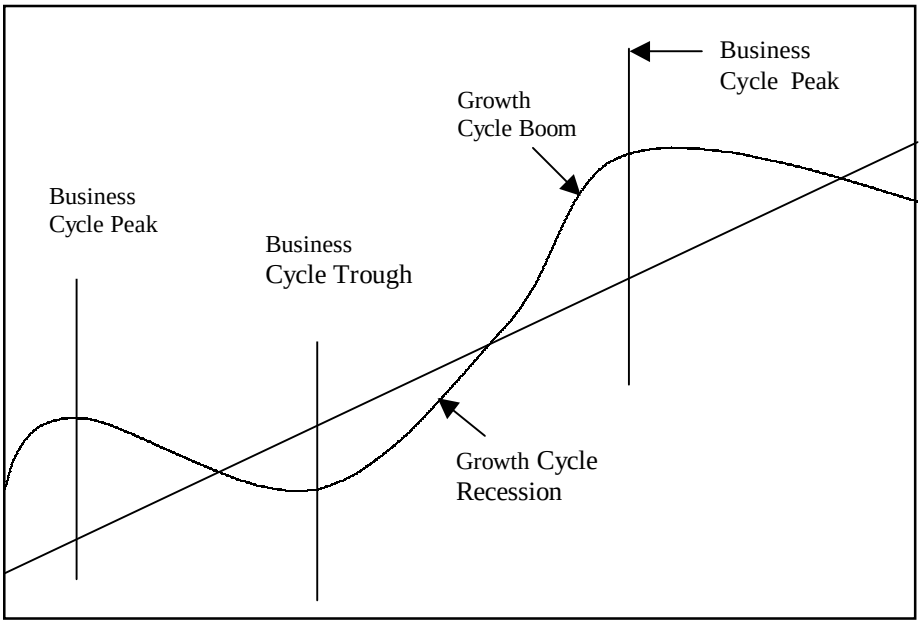
The classical business cycles are identified as recurrent phases of expansion and contraction in the levels of a large number of economic and financial time series[2]. Business cycles have been defined by Burns and Mitchell (1946) as "fluctuation found in aggregate economic activity of nations that organise 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.

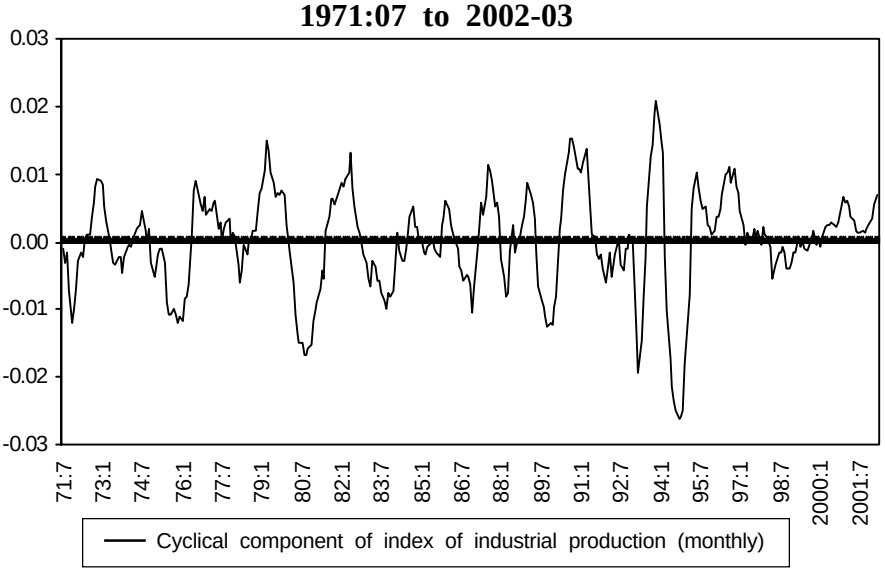
Table 1 : Growth Cycle Chronology for India : 1970-71 to 2001-02

(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. Furthermore, as the Indian economy has been opened up and is increasingly integrated with the rest of world, global business cycles

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



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 (λ) 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. However, this needs to be

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.

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

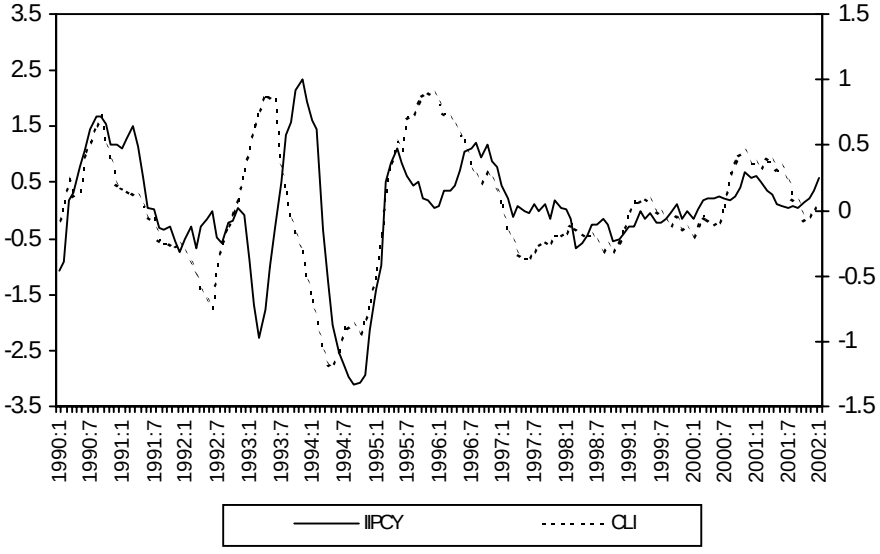
One important objective of the leading indicator analysis is to make short-term forecasts of the reference series. Knowing whether the economy is heading for a recession or boom is important for policy making. Since the major interest is in stabilisation, any significant fluctuation has to be predicted 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 $2\sqrt{n}$, 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:

$$y_t^c = \left[\frac{\lambda\ (1-L)^2\ (1-L^{-1})^{\ 2}}{1+\ \lambda\ (1-L)^{\ 2}\ (1-L^{-1})^2} \right] y_t$$

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

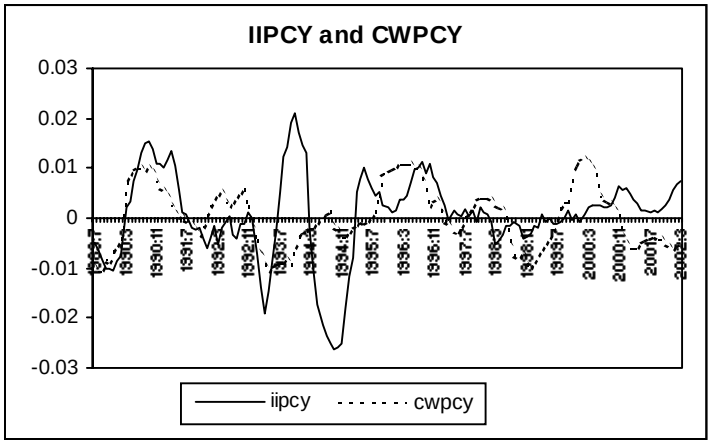
The Band Pass (BP) Filter

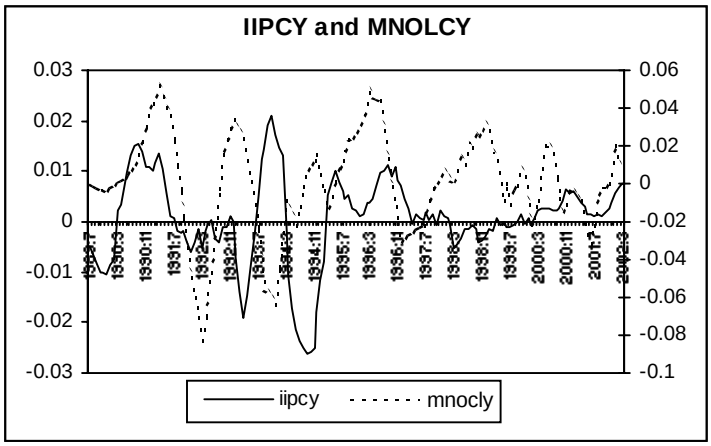
To isolate business cycle fluctuations in macro-economic time series, Baxter and King (1995) developed band pass filter, based on the definition of the business cycle suggested by Burns and Mitchell (1946). Relative to other perspectives on decomposing time series, the theory of spectral analysis of 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.

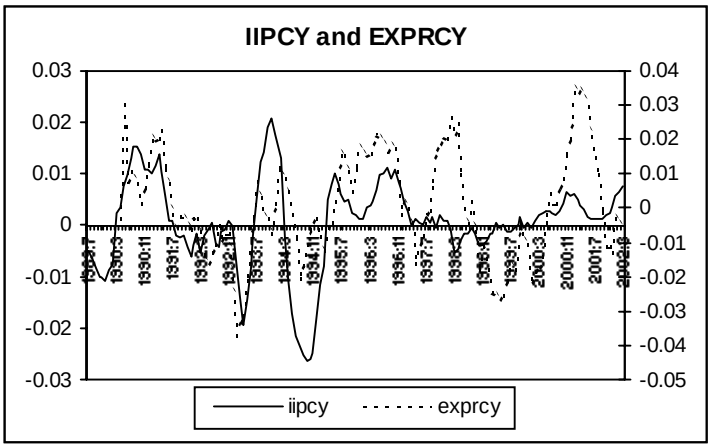
The band pass is a linear filter, which eliminates very slow moving (trend) components and very high frequency (irregular)

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.

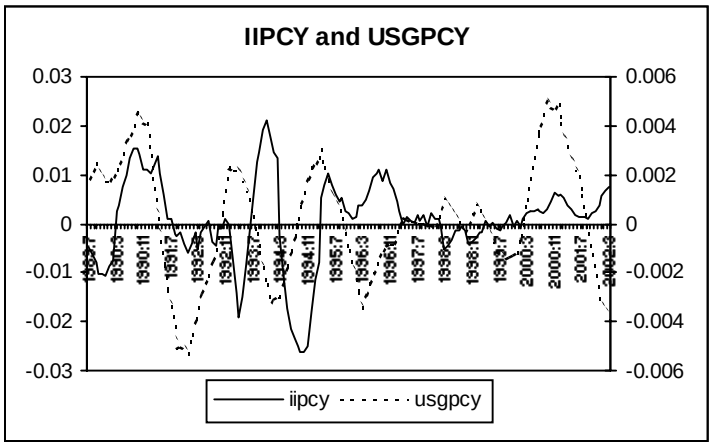
Appendix II : Cyclical Components of the IIP and the Leading Indicator Series (Contd.)

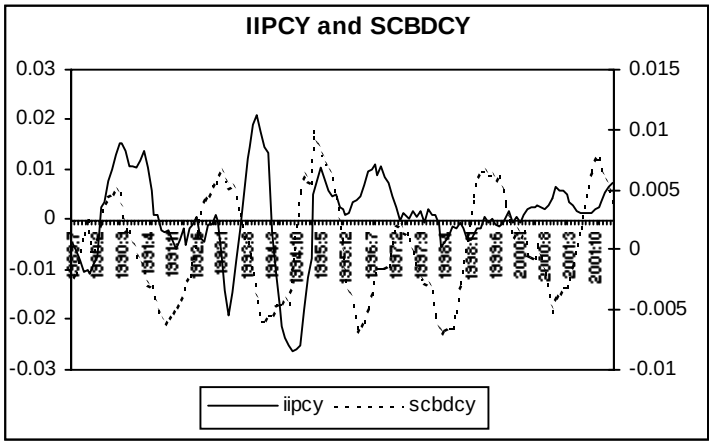


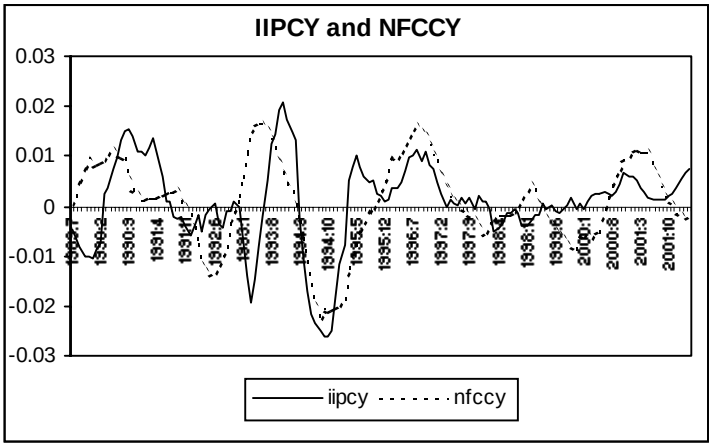




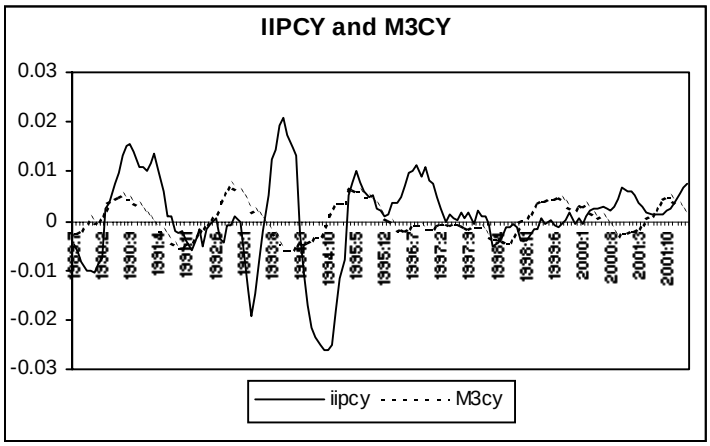
Appendix II : Cyclical Components of the IIP and the Leading Indicator Series (Contd.)

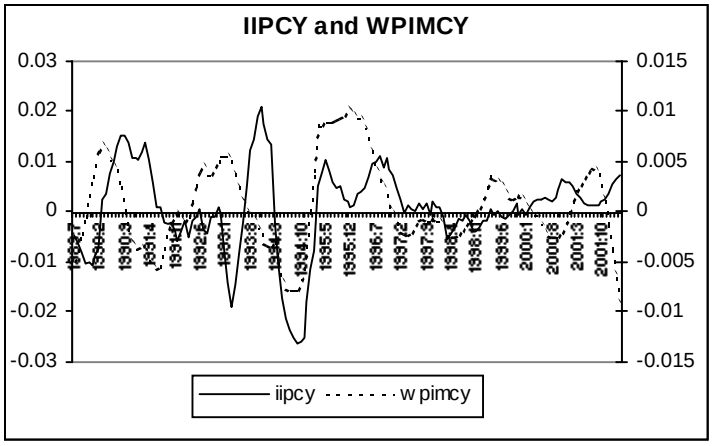


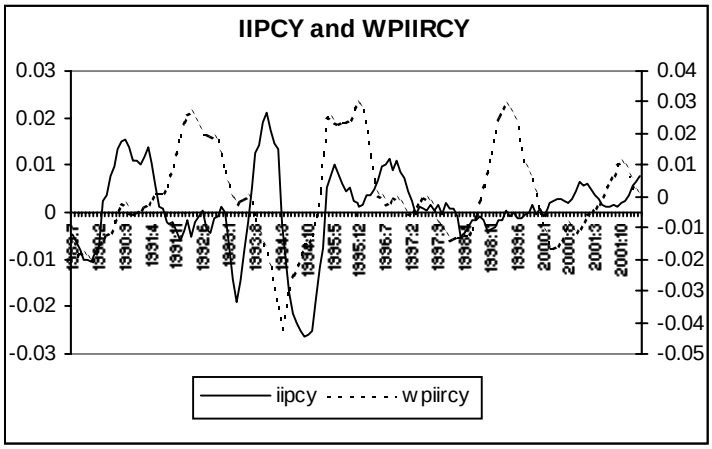




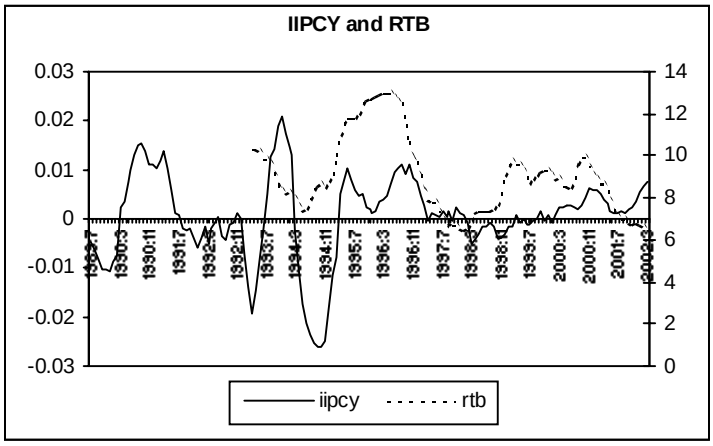
Appendix II : Cyclical Components of the IIP and the Leading Indicator Series (Contd.)

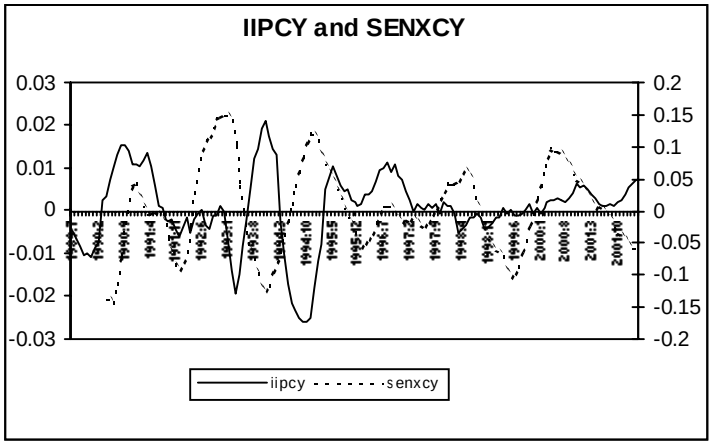


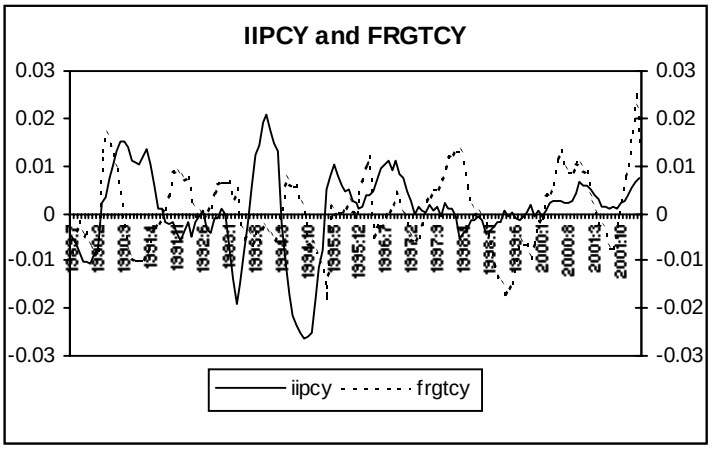




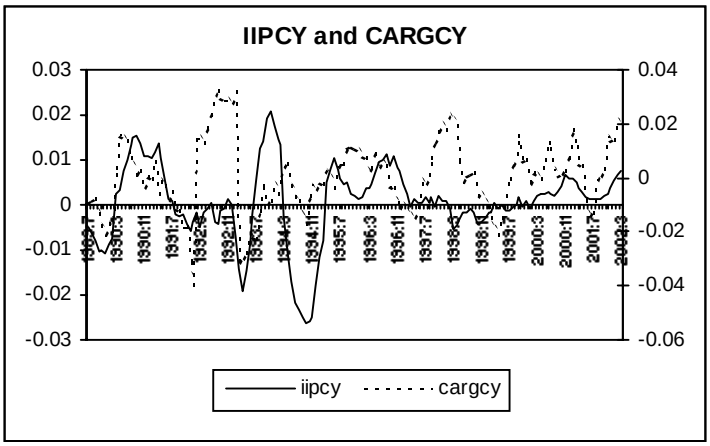
Appendix II : Cyclical Components of the IIP and the Leading Indicator Series (Contd.)







Appendix II : Cyclical Components of the IIP and the Leading Indicator Series (Concld.)



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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Government Deficit and Inflation in India

A. Prasad and Jeevan Kumar Khundrakpam*

This study covering the period 1951-52 to 1999-2000 finds that government deficit has been an important cause for long-run inflationary trend in India. The estimates in the study, however, suggest that there is an optimal level of monetisation for a given level of government deficit and refutes the concern that monetisation of deficit is always inflationary. This is not to suggest in any way that there is more scope to finance government deficit through monetisation. With the increase in capital inflows on which there is a certain degree of lack of control and the consequent predominance of net foreign exchange assets in reserve money, there is a need for greater fiscal restraint as well as monetary-fiscal coordination.

Introduction

Traditionally, monetarists argue that inflation is always and everywhere a monetary phenomenon. Fischer and Easterly (1990) while accepting the monetarists' view, however, note that a rapid money growth without an underlying fiscal imbalance is unlikely, implying that rapid inflation is almost always a fiscal phenomenon. History has often witnessed cases of governments' resorting to seignorage at times of fiscal distress. In the case of fiscally dominant regimes, persistent deficits have led to money creation. The standard account of this fiscally dominant regime goes something along the following lines. The size of government budget is determined by the fiscal exigencies and the shortfall that cannot be financed from its normal revenue and borrowing in the budget is assigned to the monetary authority to be generated through money creation, which could lead to inflation.

The present study is set around the theme of fiscally dominant mechanism of inflation in India. An issue that arises is : for a given level of fiscal deficit what would be the appropriate level of

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monetisation? This issue lies at the heart of policy inconsistencies between monetary and fiscal authorities in ensuring price stability. Against this backdrop, the present study attempts to explore the long-run relationship between fiscal deficit and inflation in India during the period 1951-52 to 1999-2000, taking into account the external shocks provided by oil price. Oil price shock is treated as an exogenous factor influencing inflationary trend notwithstanding the fact that impact of crude oil price increase in India was mostly absorbed by the oil pool account, which is an extra budgetary item. Domestic oil price being largely administered and sticky, the increase in external oil price which otherwise cuts the profit margin of oil refineries is neutralised by subsidising from the oil pool account. Thus, the full impact of external oil price increase is not passed on to the domestic prices[1].

In the next section, a brief review of the existing literature is undertaken, followed by a discussion on methodology and data source in Section II. This section is followed by an analysis of the estimated results in Section III and concluding remarks in Section IV.

Section I

An Overview of the Existing Literature

In the developed country context, fiscal policy is often thought to be unimportant for inflation determination as it is considered, at least on theoretical grounds, that the desire to obtain seignorage revenue plays no apparent role in the choice of monetary policy (Woodford, 2001). There are studies such as Lane (1995) and Click (1998), which do not consider fiscal balance to be a possible explanatory variable for inflation and seignorage. On the other hand, fiscal dominance is often a developing country phenomenon. Thus, fiscal-based theories of inflation are more common in the literature of developing countries; Aghevli and Khan (1978), Alesina and Drazen (1991), Cuikerman, Edwards, and Tabellini (1992) and Calvo and Vegh (1999), to mention a few.

The literature on inflation in the Indian context is also replete with fiscal based theories (see for examples Rangarajan and Arif

(1990), Buiter and Patel (1992) and Rao (2000)). This does not come as a surprise since Indian economy is indeed characterised by high fiscal dominance. The authorities often resort to inflation tax or seignorage to finance government expenditure as described above though these are under certain limits in recent times. Until as recent as end-March 1997, it took the form of automatic creation of *ad hoc* treasury bills (though some limits were imposed since September 1994 which paved the way for abolishing the mechanism of *ad hoc* treasury bills from April 1997) whenever there was a shortfall in receipts to finance government expenditure. Thus, fiscal deficit has been understood as one of the crucial factors explaining the inflationary process in India.

Another theoretical strand for explaining inflation is the fiscal theory of inflation in which price level is determined by the government budget constraint:

$$\frac{\text{nominal debt}}{\text{price level}} = \text{present value of real surpluses}$$

In this theory, money and nominal debt are essentially valued as equity claims on government. Here, increase in price level need not work in the standard quantity-theoretic mechanism of fiscal deficit leading to increase in money supply and consequently price. The mechanism in this theory is essentially through the effects of fiscal deficit on private sector budget constraints and thus on aggregate demand and the price level. In equilibrium, however, fiscal disturbances affect the growth of money supply, but the causality is not from fiscal deficit to money supply and to price. Rather, it is from fiscal deficit raising the price level which in turn affects money supply as a result of the monetary authority's passive accommodation to meet higher money demand caused by higher price [on fiscal theory, see for example Cochrane (1998) and Woodford (2001)].

Sargent and Wallace (1981) by incorporating the role of expectations about future policy show that when a government is constrained to finance its deficit through inflation tax, any attempt

to fight current inflation with tighter monetary policy works only temporarily. Eventually, it would lead to higher monetary expansion and inflation. This outcome, termed as unpleasant monetarist arithmetic (UMA), works out on the following lines. Given a budget constraint, reducing revenue from money creation currently means resorting to larger market borrowings, which at some point of time raises the real rate of interest above the real income growth, leading to unsustainable growth in debt to income ratio, threatening solvency in some cases. The solvency constraint eventually forces the government to resort to money financing at a much higher scale than what was required initially due to higher interest payments. They also show the plausibility of current tighter money policy leading to higher inflation not only in the future but also in the present. This would happen if the current rate of inflation depends on current and all anticipated future levels of money supply. Tight money now can then lead to anticipation for high rates of money creation in the future so that the current demand for money increases and raises the current inflation itself. The assumption crucial to the result of Sargent and Wallace's (SW) study is that the real interest rate on government debt is greater than the economy's growth rate. This condition has rarely been met in the Indian context, where interest rate on government borrowing was largely administered until the beginning of the 1990s. In the United States and Canada also, for most of the post-war period, the real interest rate has been below the growth rate. The recent literature, however, has shown that for the SW result to hold, it is not necessary that the real return on government debt exceeds the economy's growth rate. The proviso is that there exists a store of value with real return higher than the economy's growth rate (Bhattacharya and Haslag, 1999).

Further, there could be an optimal level of monetisation for a given level of fiscal deficit even though fiscal deficit inherently leads to higher inflation. Rao (2000) studying the Indian case suggests that theoretically for any given fiscal deficit, there exists an optimal level of monetisation at which both inflation and interest rate could be stabilised. Excessive monetisation could continue to increase inflation indefinitely, and insufficient monetisation leading to

excessive market borrowing could also lead to high inflation-high interest equilibrium. Using the data over the period 1990-2000 to estimate the values of parameters derived in the model, and applying it to the 2000-01 budget, Rao (2000) concludes that actual level of monetisation is much lower than the estimated optimum of 40.0 percent of deficit[2].

Section II

Methodology and Data Source

Two measures of inflation are considered in the study *viz.*, wholesale price index (WPI), which is the most common and headline measure of inflation in the country and compiled on a weekly basis; and consumer price index for industrial workers (CPI), compiled on a monthly basis. Both the measures are important in India as they are adopted for different policy and practical purposes. WPI is much broader in coverage than CPI. The former is closer to the producer's price while the latter represents more of the retail prices. Exogenous shocks such as oil price hike to domestic price may have differential impact on the WPI and the CPI. If the full impact of such shock is not being passed on to the consumer, increase in wholesale price may be more than consumer price. Owing to such differences in the nature of inflation measures, both the measures of inflation have been considered for studying their relationships with government deficit.

The deficit considered is of the Central Government only though a broader public sector deficit concept might be more appropriate. The use of the latter concept of measure of deficit is constrained by the lack of time series data spanning from 1951-52 to 1999-2000, which is the period under consideration. Further, at least directly, seignorage capacity of the government is mostly confined to the Central Government.

Two alternative measures of scaling deficits are tried out. First is the conventional measure of fiscal deficit as a ratio to GDP. The second, and important to the analysis, is to scale the fiscal deficit with money. Defining a long-run relationship between fiscal

deficit to money stock ratio and inflation has a theoretical foundation based on the shopping time dynamic model of Ljungqvist and Sargent (2000). Catao and Terrones (2001) extended this model to an open economy setting in which in steady state equilibrium, it postulates a linear function of inflation as follows[3] :

$$p = \beta \frac{FD}{M} \qquad (1)$$

where 'p' is inflation, 'FD' is fiscal deficit and 'M' is the stock of money and 'β' is a positive parameter. 'β' is postulated as a positive parameter implying that lower the stock of money for given level of fiscal deficit, the higher would be the long-run rate of inflation. The expansion in the monetary base, however, need not be necessarily due to monetised deficit. Conversely, a given level of monetised deficit need not lead to a corresponding expansion in base money and money stock, if base money increase is impounded through central bank policy measures such as raising of reserve requirements, which has been the Indian experience until recently[4]. In other words, there need not be one to one correspondence between monetised deficit and base money expansion. The proportion of seignorage revenue to finance deficit would, however, impact on the interest rate on government borrowing. In the Indian context, however, not much of a difference would have been made since there was captive borrowing under controlled interest rates regime until the beginning of the 1990s.

The right hand side (RHS) in (1) can be bifurcated into two components of fiscal and monetary variable by dividing both the numerator and denominator by gross domestic product (GDP) to obtain the following :

$$p = \beta \frac{FD}{GDP} * \frac{GDP}{M} \qquad (2)$$

The first term in RHS in (2) is the standard fiscal deficit to GDP ratio and the second term is the velocity of money. Thus, it becomes clear from this theory that a higher fiscal deficit to GDP ratio would lead to rise in inflation provided the velocity does not offsettingly decline. If it is, however, accompanied by a certain degree of money expansion or inflation tax base, inflation need not rise while a tighter monetary policy accompanying the rise in fiscal deficit to GDP ratio would lead to higher rate of inflation.

This theory postulating a positive coefficient of fiscal deficit to money ratio implies that given the level of fiscal deficit, monetary expansion even to the extent of financing the entire deficit through money creation would always lead to reduction in long-run inflation. This unbounded negative impact of money supply on inflation may appear to be counterintuitive, as one would expect the economy to degenerate into hyperinflation at some point. For economies with experience of very low budget deficit, it may be conceivable that financing the entire deficit through money creation is less non-inflationary in the long-run. But, this is less likely for economies with severe budget constraints. As Rao (2000) demonstrates, some optimal level of monetised deficit for such economies is also expected. Both lower and higher level of monetisation than this optimum level of monetised deficit could lead to more inflationary situation in the long-run. Hence, although the model we adopt hypothesises an unbounded negative relationship between inflation and money supply for given government deficit, we check for the possibility of a positive relationship when the relative degree of monetised deficit is high. This is done by identifying the time series on fiscal deficit to money stock ratio for instances with large decline. Decline in the ratio implies a relatively higher money stock for a given level of deficit or relatively higher money creation on account of deficit. The implication flowing from the model should lead to a decline in the long-run inflation for these instances. However, by creating a series through dummy, which is 1 for those years that show decline in the ratio by more than a randomly selected value and 0 otherwise, we check for statistically significant positive coefficient of the dummy. If such a statistically significant coefficient of the dummy exists, we infer that

there exists a limit to the extent of monetised deficit, which when exceeded also leads to higher long-run inflation.

In the literature, primary deficit is also used as an alternative to gross fiscal deficit in order to remove the endogeneity bias resulting from reverse impact of inflation on nominal interest. When inflation has impact on nominal interest, the estimate of the relationship defined by (1) would be biased since it cannot capture the reverse relationship appropriately. This reverse effect in India, however, would not be very strong, except in the recent times, as interest rates were mostly administered.

For each of the two measures of inflation, two forms of specification are considered: a) rate of change in the index (p); and b) log (1+ p). The second specification enables addressing the non-linearities problem in the fiscal deficit-inflation relationship. In the presence of non-linearity the response of inflation to deficit increases as inflation rises. This can be shown as follows:

$\ln (1+p) = \beta(GFD/GDP)$ which on taking derivative yields,
$\delta p/(1+p) = \beta\ \delta(GFD/GDP)$

or, $\delta p/\delta(GFD/GDP) = \beta\ (1+p)$ which shows that for a given estimate of β, the impact of a percentage change in fiscal deficit/ GDP ratio on inflation will be higher as p increases.

The notations are: FDM = gross fiscal deficit scaled to M_1; FDY = gross fiscal deficit to GDP ratio; CP = change in consumer price index; LCP = log (1+ CP); WP = change in wholesale price index; and LWP = log (1+ WP).

The following eight types of relationships are possible :

1. CP and FDM – between change in consumer price and gross fiscal deficit scaled by narrow money, M_1.

2. WP and FDM - between change in wholesale price and gross fiscal deficit scaled by narrow money, M_1.

3. CP and FDY - between change in consumer price and gross fiscal deficit to GDP ratio.

4. WP and FDY - between change in wholesale price and gross fiscal deficit to GDP ratio.

5. LCP and FDM – between change in consumer price in logarithm form and gross fiscal deficit scaled by narrow money, M_1.

6. LWP and FDM - between change in wholesale price in logarithm form and gross fiscal deficit scaled by narrow money, M_1.

7. LCP and FDY - between change in consumer price in logarithm form and gross fiscal deficit to GDP ratio.

8. LWP and FDY - between change in wholesale price in logarithm form and gross fiscal deficit to GDP ratio.

In the trivariate models, change in oil price is included in each of these relationships as an additional variable.

We adopt the autoregressive distributed lag (ARDL) approach advanced by Pesaran and Shin (1995, 1996) as the variables are integrated of different order. In this procedure, the dependent and the explanatory variables can enter the regression with different lags and need not be integrated of the same order. It involves two stages of estimation with the first investigating the existence of long-run relation and the second step estimating that long-run relation and its adjustment to equilibrium from the error correction model. The procedure may be explained as follows: Consider the following augmented ARDL structure where the dependent and the explanatory variables enter the regression with lags of order p and q, respectively.

$$Y_t = \alpha + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{i=0}^{q} \delta_i X_{t-i} + u_t \qquad (3)$$

where, Y_t is the explained variable at time t, α represents the fixed effects, and X_t is a (k´1) vector of explanatory variables including intercept, trend and dummies with fixed lags. Equation (3) can be re-parameterised and written in terms of linear combination of variables in level and first-differences:

$$\Delta Y_t = \alpha + \phi Y_{t-1} + \varphi X_t + \sum_{i=1}^{p-1} \beta^*_i \Delta Y_{t-i} + \sum_{i=0}^{q-1} \delta^*_i \Delta X_{t-i} + u_t \qquad (4)$$

where $\phi = -(1-\sum_{i=1}^{p}\beta_i)$, $\varphi = -\sum_{i=0}^{q} \delta_i$, $\beta^*_i = -\sum_{m=i+1}^{p} \beta_m$, $\delta^*_i = -\sum_{m=i+1}^{q} \delta_m$

with i = 1, 2, ..., p-1.

Grouping the variables in levels, equation (4) can be written as:

$$\Delta Y_t = \alpha + \phi [Y_{t-1} - \theta X_t] + \sum_{i=1}^{p-1} \beta^*_i \Delta Y_{t-i} + \sum_{i=0}^{q-1} \delta^*_i \Delta X_{t-i} + u_t \qquad (5)$$

where $\theta = -[\varphi/\phi]$ is a vector of the coefficients defining the long-run relationship between the variables involved and ϕ which is the coefficient of the error correction term $[Y_{t-1} - \theta X_t]$ is the speed of adjustment toward the long-run equilibrium.

The stability tests or tests for establishing the existence of long-run relationships between the variables are done by conducting F-test of adding one lag of the level variables to the ARDL equations of first differences *i.e.,* test the null :

$H_0 : \phi = \varphi_1 = .. . = \varphi_k = 0$ against $H_1 : \phi \neq \varphi_1 \neq .... \neq \varphi_k \neq 0$ in (4) and k denotes the number of explanatory variables.

In other words, the coefficient of the lag of level variables must be jointly different from zero. If the null is rejected, there exists a long-run relationship among the variables with the explanatory variables as the long-run forcing variables for the explanation of the dependent variable. This procedure can be repeated for each of the variable as the dependent variable in order to determine whether long-run relationship exist in the reverse directions. If the null is rejected for one direction and not in the reverse direction, there is only one unique long-run relationship between the variables.

In the second stage, the optimum lag for each of the variable based on various model selection criterions, such as R-bar Square, Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), and the Hann-Quinn Criterion is selected and the coefficient of the long-run relations and the error correction model (ECM) as represented by equation (5) is estimated.

The annual time series data covers the period 1951-52 to 1999-2000. Gross domestic product (GDP) at market prices is obtained from Economic Survey 2000-2001. Gross fiscal deficit data are obtained from Pattnaik *et al* (1999). Consumer price index for industrial workers (CPI-IW) is obtained from Chart Book on Financial and Economic Indicators and from the Handbook of Statistics on Indian Economy, Reserve Bank of India. Wholesale price index (WPI) has been culled out from Economic Survey and Handbook of Statistics on Indian Economy. Narrow money (M_1) is obtained from RBI sources. The change in crude oil prices in US dollar is obtained from International Financial Statistics, CD-ROM, July 2001.

Section III

Empirical Tests and Results

The stability tests for long-run relationship are conducted for all the eight formulations listed above using ARDL of order 3^4.

Table 1 : Stability Test for Bivariate Models

	Formulation	F-statistics	F-statistics
1.	CP and FDM	FDM←CP = 1.71	CP←FDM = 11.1*
2.	WP and FDM	FDM←WP = 1.42	WP←FDM = 10.5*
3.	CP and FDY	FDY←CP = 1.44	CP←FDY = 10.28*
4.	WP and FDY	FDY←WP = 1.50	WP←FDY = 9.42*
5.	LCP and FDM	FDM←LCP = 2.00	LCP←FDM = 7.54*
6.	LWP and FDM	FDM←LWP = 2.25	LWP←FDM = 11.2*
7.	LCP and FDY	FDY←LCP = 1.58	LCP←FDY = 7.03*
8.	LWP and FDY	FDY←LWP = 2.12	LWP←FDY = 10.1*

* denotes rejection of null at least at the 95% confidence level based on the critical value bounds computed by Pesaran *et al* (1996).

In Table 1, the arrow indicates the direction of causation. It can be seen that the F-statistics are significant in only one direction running from deficit to inflation in all the eight formulations. It may be interpreted that there exists a stable long-run relationship between inflation and deficit in India with the latter explaining the change in the former, and not *vice versa.*

The long-run coefficients and the associated ECMs were estimated for models with the highest R-bar square values[5]. It is seen from Table 2 that none of the long-run coefficients are significant. The ECM terms, however, are statistically significant and also have the correct signs. All the equations pass the diagnostic tests. The results presented in Table 1 and Table 2 may be interpreted as follows: A long-run equilibrium between deficits and inflation is indicated in all the specifications. The direction of influence flows from deficit to inflation and the speed of adjustment to their long-run equilibrium following deviation due to shock, which is measured by the coefficients of ECM terms range from 73 to 94 percent within a year. The estimated long-run coefficients, however, are not statistically significant. This may follow from omission of relevant variables.

Table 2 : Estimates of Long-Run Coefficients and ECM for Bivariate Models

Formulation	Long-Run Coefficient	ECM Coefficient and Diagnostic Test
1. CP and FDM	0.107 (1.26)	ECM = -0.93 (-5.52)*, R-bar ^{2}=0.41, F-stat = 11.38 DW = 2.05
2. WP and FDM	0.107 (1.02)	ECM = -0.73 (-5.12)*, R-bar ^{2}=0.36, F-stat = 14.0, DW = 1.79
3. CP and FDY	0.733 (1.24)	ECM = -0.92 (-5.57)*, R-bar ^{2}=0.42, F-stat = 12.0, DW = 2.05
4. WP and FDY	0.72 (1.00)	ECM = -0.74 (-5.35)*, R-bar ^{2}=0.38, F-stat = 15.0, DW = 1.80
5. LCP and FDM	0.109 (1.42)	ECM = -0.94 (-5.61)*, R-bar ^{2}=0.41, F-stat = 11.7, DW = 2.07
6. LWP and FDM	0.107 (1.11)	ECM = -0.74 (-5.13)*, R-bar ^{2}=0.36, F-stat = 14.0, DW = 1.79
7. LCP and FDY	0.75 (1.41)	ECM = -0.92 (-5.66)*, R-bar ^{2}=0.43, F-stat = 12.3, DW = 2.05
8. LWP and FDY	0.71 (1.19)	ECM = -0.74 (-5.25)*, R-bar ^{2}=0.38, F-stat = 15.1, DW = 1.80

Figures in the parentheses are the standard errors.
* denotes significance at least at 5% level.

Oil price in US dollar terms was, therefore, introduced as the third variable. The stability tests for the trivariate models are presented in Table 3. The F-statistics indicate only one long-run relationship in which inflation is explained by deficit and change in oil prices.

In these trivariate models, the positive coefficients of fiscal deficit on inflation are significant at least at the 10.0 percent level in all the formulations (Table 4). Oil price changes also has positive impact on all measures of inflation. All the equations pass the diagnostic tests and the estimates are far more precise than the corresponding bivariate models. The estimates show that exclusion of oil price change underestimates the impact of fiscal deficit on

inflation. This probably indicates that increase in external oil price impacts domestic inflation partly through the fiscal deficit channel, despite the operation of oil pool account as an extra budgetary transaction. The speed of adjustments towards long-run equilibrium following deviations from disturbances are also estimated higher, and range from about 90 to 100 percent within a year. Only in formulation (1) is the coefficient of ECM term marginally more than one indicating a possible case of instability in the equilibrium or tendency to over correct a deviation within a year.

Table 3 : Stability Test for Trivariate Models

Formulation	F-statistics	F-statistics	F-statistics
1. CP and FDM, OP	FDM←CP, OP = 1.18	OP←FDM, CP = 2.90	CP←FDM, OP = 6.77*
2. WP and FDM, OP	FDM←WP, OP = 1.85	OP←FDM, WP =3.17	WP←FDM, OP = 6.15*
3. CP and FDY, OP	FDY←CP, OP = 0.97	OP←FDY, CP = 3.05	CP←FDY, OP = 6.16*
4. WP and FDY, OP	FDY←WP, OP = 1.80	OP←FDY, WP = 3.31	WP←FDY, OP = 5.36*
5. LCP and FDM, OP	FDM←LCP, OP = 1.45	OP←FDM, LCP = 3.54	LCP←FDM, OP = 7.61*
6. LWP and FDM, OP	FDM←LWP, OP = 1.95	OP←FDM, LWP = 3.33	LWP←FDM, OP = 6.57*
7. LCP and FDY, OP	FDY←LCP, OP = 1.06	OP←FDY, LCP = 3.78	LCP←FDY, OP = 6.91*
8. LWP and FDY, OP	FDY←LWP, OP = 1.89	OP←FDY, LWP = 3.50	LWP←FDY, OP = 5.71*

* denotes rejection of the null at least at 95% confidence level based on the critical value bounds computed by Pesaran *et al* (1996).

Although the econometric estimates need to be interpreted with great deal of caution, particularly in drawing policy implications, we nonetheless infer the following: fiscal deficits bear a strongly positive and statistically significant long-run relationship with inflation. The change in world oil prices also plays a crucial role in the long-run inflationary trend. The higher the rate of inflation, the greater is the inflationary impact of the deficit. Similarly, higher the rate of inflation the greater is the impact of oil price on inflation. In the estimated long-run relationships, the coefficients of fiscal deficit to GDP ratio is about 6.5 times the coefficients of fiscal deficit to money stock ratio. These results appear consistent given that velocity of money (GDP to money stock ratio) has hovered around 5.6 to 7.2 with median value of about 6.5. Higher the level of money stock for a given level of deficit, the lower is the level of inflation in the Indian context.

Table 4 : Estimates of Long-Run Coefficients and ECM for Trivariate Models

Formulation	Long-Run Coefficient	ECM Coefficient and Dignostic Test
1. CP and FDM, OP	FDM = 0.187 (2.56)* OP = 0.084 (3.07)*	ECM = -1.03 (-6.52)*, R-bar ^{2}=0.53, F-stat = 11.2, DW = 1.89
2. WP and FDM, OP	FDM = 0.135 (1.76)** OP = 0.102 (3.15)*	ECM = -0.87 (-5.31)*, R-bar ^{2}=0.57, F-stat = 13.3, DW = 1.82
3. CP and FDY, OP	FDY = 1.23 (2.38)* OP = 0.108 (3.75)*	ECM = -0.98 (-6.54)*, R-bar ^{2}=0.54, F-stat = 14.5, DW = 1.89
4. WP and FDY, OP	FDY = 0.97 (1.80)** OP = 0.102 (3.15)*	ECM = -0.86 (-5.37)*, R-bar ^{2}=0.58, F-stat = 13.78, DW = 1.79
5. LCP and FDM, OP	FDM = 0.169 (2.48)* OP = 0.072 (2.83)*	ECM = -1.00 (-6.44)*, R-bar ^{2}=0.52, F-stat = 13.3, DW = 1.92
6. LWP and FDM, OP	FDM = 0.127 (1.80)** OP = 0.09 (3.14)*	ECM = -0.89 (-5.78)*, R-bar ^{2}=0.57, F-stat = 13.1, DW = 1.85
7. LCP and FDY, OP	FDY = 1.19 (2.50)* OP = 0.073 (2.84)*	ECM = -0.99 (-6.55)*, R-bar ^{2}=0.54, F-stat = 14.2, DW = 1.90
8. LWP and FDY, OP	FDY = 0.90 (1.83)** OP = 0.091 (3.13)*	ECM = -0.86 (-5.47)*, R-bar ^{2}=0.58, F-stat = 13.58, DW = 1.82

Figures in the parentheses are the standard errors.
* and ** denote significance at 5% and 10% levels, respectively.

The policy implications which seem to follow is that for a given level of deficit determined by fiscal exigencies, monetary expansion would keep inflation under check in the long-run. This implication, however, appears to be counterintuitive as some upper bound to the extent of monetary expansion is expected, beyond which inflation would increase in the long-run. Consequently, the time series on fiscal deficit to money stock ratio was investigated for instances that showed declines. During the reference period with 49 observations, the ratio declined in 21 instances with the rate of decline ranging from 0.14 percent to 16.2 percent. Of these declines, some random values were sequentially selected starting from the lowest and progressively moving upward. A dummy, equal to 1 for those years with declines in the ratio more than the randomly selected value, and 0 otherwise, was included in the estimates. Among the various randomly selected levels

of decline in the ratio, for decline in the ratio by more than 8.0 percent (there were five such instances during the period under review) the coefficients of the dummies were found to be positive and statistically significant in all the relevant models. This indicates that when the degree of monetised deficit exceeds a critical level it has a positive long-run impact on inflation. The results are presented in Table 5.

Table 5 : Estimates of Long-Run Coefficients and ECM for Trivariate Models Including a Dummy for Decline in Fiscal Deficit Money Ratio by More Than 8.0 Percent

Formulation	Long-Run Coefficient	ECM Coefficient and Dignostic Test
1. CP and FDM, OP	FDM = 0.173 (2.57)* OP = 0.075 (2.89)* D = 0.046 (2.02)*	ECM = -1.06 (-6.75)*, R-bar ^{2}=0.54, F-statistics = 11.7, DW = 1.95
2. WP and FDM,OP	FDM = 0.130 (1.93)** OP = 0.089 (3.11)* D = 0.052 (2.27)*	ECM = -0.94 (-5.67)*, R-bar ^{2}=0.60, F-statistics = 11.97, DW = 1.85
3. LCP and FDM, OP	FDM = 0.167 (2.67)* OP = 0.065 (2.73)* D = 0.042 (2.00)**	ECM = -1.06 (-6.70)*, R-bar ^{2}=0.53, F-statistics = 11.3, DW = 1.97
4. LWP and FDM, OP	FDM = 0.122 (1.94)** OP = 0.08 (3.10)* D = 0.042 (1.96)**	ECM = -0.94 (-5.63)*, R-bar ^{2}=0.58, F-statistics = 11.49, DW = 1.86

Figures in the parentheses are the standard errors.
* and ** denote significance at 5% and 10% level, respectively.

In Table 5 there are only four equations since the estimates pertain to fiscal deficit to money stock ratio only. The coefficients of the dummies are significant at least at the 10.0 percent level. It may also be noted that there are some improvements in the fit of the equations as compared to the corresponding estimates in Table 4. The coefficients of the ECM term for consumer price measure of inflation are more than one, indicating instability. Thus, it appears that there is a limit to the extent of monetised deficit which when exceeded raises the long-run inflation instead of lowering it. The results vindicate Rao's demonstration that there is some optimal level of monetisation for a given level of fiscal deficit.

Section IV

Concluding Remarks

Fiscal deficit has been an important cause for the long-run inflationary trend in India. Fiscal consolidation, therefore, appears to be a key requirement for price stability in the long-run. The Fiscal Responsibility and Budget Management Bill (FRBM) would have the salutary effect of bringing down the level of inflation in the long-run. While this is so, our estimates refute the concern that monetisation of fiscal deficit is always inflationary. This is not to suggest in any way that there is a greater scope to finance government deficit through monetisation. The study also indicates that excessive monetisation of deficit also leads to higher inflation. Thus, there is an optimal level of monetisation for a given level of deficit, which is, however, not estimated in the present study. The study also shows that rise in oil prices adds to inflationary impact. The study vindicates the need for greater monetary-fiscal coordination. Especially in the 1990s, the composition of reserve money has changed with net foreign exchange assets forming a predominant proportion of reserve money. Given the benefits of the reserve accretion to the country, and a certain degree of lack of control over capital inflows, it is all the more compelling that there is greater fiscal restraint and in that a tighter leash on net central bank credit to the government.

Notes

1. The Administered Price Mechanism (APM) for petroleum and diesel and Oil Pool Account were abolished with effect from April 1, 2002.

2. The Report on Currency and Finance 2000-01 of the Reserve Bank of India estimates the optimal degree of monetisation of fiscal deficit to be in the range of 20-25 per cent.

3. For a detailed derivation of the model, see Catao and Terrones (2001).

4. However, raising of reserve requirements need not always lead to decline in the money multiplier and, *ceteris paribus*, a decrease in money stock. Under certain range of values for CRR and currency deposit ratio, an increase in the CRR may lead to an increase in the money multiplier and hence an increase in the money supply.

5. The current values of the explanatory variables are excluded in the test as it is not known *a priori* whether they are the long-run forcing variables or not. Once the existence of the long-run relationship is established by this test, they are included in the second stage estimating the long-run coefficients and the error correction model (Peseran and Peseran, 1997). ARDL of order 3 was uniformly chosen as the maximum lag as it gave the highest F-statistics and the co-efficients of higher lags of the variables were not statistically significant.

6. It may be noted that as against the stability test which had a uniform maximum order of lag 3, the order of lags for different variables in the error correction models are not the same. The appropriate lags for each of the variable are selected based on the highest R-bar square criterion from the maximum lag order of 3.

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Anatomy of Liquidity Management

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The management of liquidity poses a major challenge to the conduct of monetary policy in an environment of financial liberalisation. Recent research has attempted to assess liquidity conditions in the market for bank reserves in terms of central bank balance sheet flows. This paper constructs the concepts of autonomous liquidity (AL) and discretionary liquidity (DL) in the Indian context and finds that there is a systemic response in the Reserve Bank's discretionary operations to offset 'autonomous' shocks to the market for bank reserves.

Introduction

The contemporary conduct of monetary policy has assumed a market orientation the world over, following financial liberalisation. A major challenge for any monetary authority today is to tune liquidity conditions in the financial markets consistent with the overall macroeconomic objectives, although monetary policy operating procedures vary according to the relative efficacy of the respective transmission channels. The key issue before central bank liquidity management is then to assess the demand in the market for bank reserves and initiate policy action in consonance with a targeted quantum or price of liquidity – or in many instances, a combination of both.

India, like several emerging market economies, embarked on a programme of financial liberalisation in the 1990s. This necessitated changes in the monetary policy framework to accommodate the resultant shifts in emphasis on monetary policy transmission channels and therefore, the information content of policy indicators (RBI,

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1998). The contemporaneous evolution of inter-linked money, government securities and foreign exchange markets improved the efficiency of monetary management, but also posed challenges arising out of the possibilities of rapid contagion (Jalan, 2000). The need to ensure orderly conditions in the financial markets has intensified the quest for an effective liquidity assessment framework.

Recent research has attempted to assess liquidity by partitioning bank balances with the central bank in terms of central bank balance sheet flows emanating from discretionary policy liquidity operations and other "autonomous" factors (Borio, 1998; ECB 2001; Schaechter *et al,* 2001). This paper examines their applicability in the Indian context. Section I introduces the conceptual framework. Section II attempts to construct such measures from the Reserve Bank balance sheet. Section III reviews the recent Indian experience. Finally, Section IV sets out some concluding observations.

Section I

The Framework

The market for bank reserves evolves largely through the dynamic interaction between the central bank and the banks, which are the principal financial intermediaries in an economy and the most important participants in financial markets. Autonomous liquidity (AL) aggregates the primary liquidity available to banks, stemming from regular central banking functions as the currency issuing authority and banker to banks and the government. In a stylised central bank balance sheet, this could comprise the claims on the Government and the rest of the world (RoW) netted for leakages from the banking system, such as currency. From Table 1,

$$AL = A1 + A3 - L1 - L3 \qquad \ldots(1)$$

Discretionary liquidity (DL), the balance primary money flowing to the banking system, arises out of the central bank's money market operations and captures the reaction of the monetary authority to autonomous changes in market liquidity,

$$DL = A2 \qquad \ldots(2)$$

Table 1 : A Stylised Central Bank Balance Sheet

Component	Source
1	2
L1. Currency	A1. Credit to Government
L2. Bank Reserves (=R)	A2. Credit to Banks
L3. Net Other Liabilities	A3. Net Foreign Assets
Total Liabilities	Total Assets

so that the supply of reserves (R^s) works out to

$$R^s = AL + DL \quad \ldots(3)$$

Central banks can - and often do - predict AL and the demand for bank reserves (R^d) (conventionally decomposed into required reserves (RR) and the demand for excess reserves (ER^d), inclusive of settlement balances, *etc.*). The net liquidity (NL), prior to central bank liquidity operations, could then be estimated, *ex ante*, as

$$NL = R^d (= RR + ER^d) - AL \quad ...(4)$$

If the central bank decides to maintain the existing liquidity conditions, it could bridge NL with DL (Bindseil, 2001). Alternately, interest rates would change to clear the market for bank reserves. For example, interest rates would harden (soften) if the central bank chose to 'short' (over-supply) the market. The realised liquidity in the market for bank reserves is simply the balances banks maintain with the central bank, in an *ex post* sense,

$$R = RR + ER = AL + DL = L2 \quad \ldots(5)$$

Employing the format of the central bank balance sheet presented in Table 1, suppose the Government draws Rs.100 as credit from the central bank to pay salaries to its employees who hold half the income in cash (Table 2). For the banking system, this results in a supply of funds of the order of Rs.50, since the currency component is a direct claim of the public on the Reserve Bank and therefore, does not impact bank liquidity (Table 3). Thus, AL amounts to Rs.50[1]. Assuming that the deposit is exempt from reserve

Table 2 : Autonomous and Discretionary Liquidity in a Central Bank Balance Sheet

	Component Flow	Rupees	Source Flow	Rupees
	1	2	3	4
L1.	Currency	50	A1. Credit to Government	100
L2.	Bank Reserves (=R)	0	A2. Credit to Banks	-50
L3.	Net Other Liabilities		A3. Net Foreign Assets	
	Total Liabilities	50	Total Assets	50
Memo Item				
Δ AL = A1+A3-L1-L3 = 100-50=50 Δ DL = A2 = -50 Δ R = L2 = ΔAL + ΔDL = 50-50 = 0			Δ NL = Δ R^d (=0, by assumption) - Δ AL= 0-50 =(-) 50	

requirements (RR) (without loss of generality) and that there is no change in the demand for settlement balances (*i.e.*, implicitly assuming that there is no mismatch between deposit mobilisation and credit offtake), there is, thus, an excess supply of bank reserves of Rs. 50. If the central bank contracts credit to banks, *i.e.*, DL, by the entire Rs. 50, there would be no change in liquidity (and hence interest rates) in the market for bank reserves. Note that in case of an incremental credit offtake of say, Rs. 50, which is fully held in cash, the AL generated by the Government's salary disbursement would be fully absorbed and therefore, the maintenance of existing liquidity conditions would not warrant central bank action. Secondly, in case of capital flows, of say Rs. 50, AL increases to Rs.100 and necessitates a withdrawal of Rs. 50 through DL to keep liquidity conditions intact. This discretionary action of the central bank to suck out liquidity can even take the form of imposing stricter reserve requirements.

Table 3 : Balance Sheet of the Banking System

	Source Flow	Rupees	Use Flow	Rupees
	1	2	3	4
1.	Deposits	50	1. Bank Reserves	
2.	Credit from Central Bank	-50	2. Bank Credit	
	Total	0	Total	0

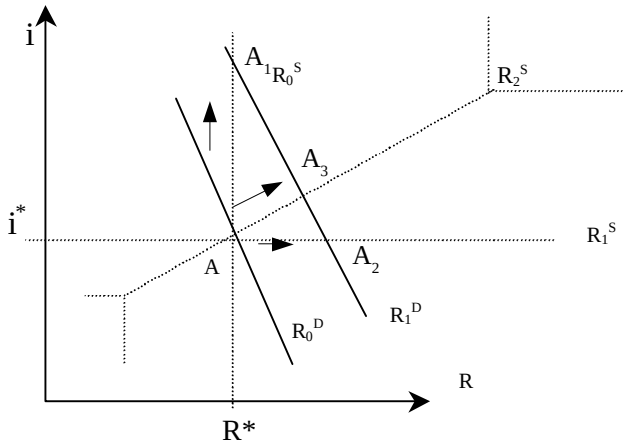
The supply of bank reserves can be, alternatively, decomposed into borrowed reserves (BR), - essentially standing facilities available at the central bank rate - and non-borrowed reserves (NBR). The critical point of difference is that while the AL-DL classification bifurcates bank reserves on the basis of the central bank's control over its balance sheet in general, the BR-NBR categorisation splits it in terms of the commercial banks' ability to access primary money on own account (Table 4).

Table 4 : Analysis of Supply of Bank Reserves

Central Bank Action	Exogenous to liquidity operations of		Accounted in			
	Central bank	Banks	AL	DL	BR	NBR
1	2	3	4	5	6	7
Monetisation of deficit	√	√	√			√
Foreign exchange operations	√	√	√			√
Cash issuance	√	√	√			√
Open market operations	√ (Offtake)	√ (Amount/price)		√		√
Standing facilities	√ (Utilisation)	√ (limit & price)		√	√	

The AL-DL framework is intuitively more appealing from the practitioners' perspective in case of central banks which i) combine internal debt and monetary management, ii) perform development functions, and iii) operate in economies in which cash remains a major medium of transaction. The critical importance of the AL-DL construct lies in the fact that it is operable in case of both quantity and interest rate operating targets as well as the intermediate regimes (Chart 1). In case of quantum targets, central banks could supply a pre-determined level of reserves (R^*), so that the interest rate i^* would clear the market, given the reserves demand curve R_0^D. In case of a shift of reserves demand from R_0^D to R_1^D, interest rates would have to rise along R_0^s to A_1 for market clearing, if the central bank sticks to the same quantum of reserves. In case of interest rate targets, central banks would adjust

Chart 1 : The Market for Bank Reserves



the liquidity at A_2 along the desired trajectory say, R_1^s, so that the interest rate is maintained at i^*, and the supply of liquidity accommodates the shift in reserves demand. In many economies, especially the emerging markets, both quantity and rate transmission channels usually operate side by side, and so central bank policy spans both the quantum as well as price of the supply of bank reserves along R_2^s, inducing a shift in the market equilibrium from A to A_3. Only in the extreme cases, need the central bank give up one target for the other.

Recognising that discretionary operations often encompass changes in the policy rates, the initial framework can be extended to a simple model of the market for bank reserves in which the central bank uses the entire array of instruments – quantum and rate - at its disposal for stabilising the price of liquidity. This is set out in Appendix I. In this scenario, the market interest rates depend on the autonomous liquidity generated and the discretionary operations of the central bank, including changes in policy rates. Given that i) an increase (decrease) in the quantum of discretionary liquidity softens (hardens) the market interest rate and that ii) an increase (decrease) in the price of discretionary liquidity similarly raises (lowers) the market interest rate, it is possible for the central bank to maintain orderly conditions in the financial markets through a policy of countervailing changes in the price and quantum of liquidity. This could, for example, include calibrated counter-

balancing of i) changes in the reserve requirements and the policy rate, ii) open market operations (OMO) and the policy rate and iii) reserve requirements and open market operations. The common "sufficient" condition, requiring that the market interest rate sensitivity of discretionary operations should be greater than that of autonomous factors, is derived in the Appendix I. This underscores the potency of the central bank's discretionary use of policy instruments in fine-tuning liquidity. Central banks with a credible reputation would, thus, be able to influence market conditions with the signalling effect (which is consistent from the market perspective) reinforcing the liquidity impact of policy measures.

Cross-Country Experiences

Most central banks adjust market liquidity pro-actively in pursuance of either a quantum target or a price target, or a mix of both (Borio, 2001; Table 5). The most common operating procedure appears to be a two-step process of i) working out the net demand for bank reserves (through a forecast of AL), and then ii) undertaking discretionary operations, as determined by the estimated liquidity effect to maintain interest rates consistent with macroeconomic objectives (Ugolini 2002; and Appendix 2). The European Central Bank (ECB), for example, manages liquidity conditions through a policy mix of OMO (including repos), marginal refinance facilities (both deposit and lending facilities) and changes in the policy rates based on estimates of the autonomous liquidity[2] of the banking system. The US Federal Reserve targets the inter-bank federal funds rate essentially through OMO guided by its estimates of the demand of bank reserves and the technical factors[3] affecting bank reserves. The Bank of Japan (BoJ) targets the outstanding balance of the current accounts with it through money market operations which are based on its projections of the autonomous sources of bank reserves[4]. Operating procedures of monetary policy in emerging market economies are also coalescing into similar strategies of liquidity management (Kamin *et al,* 1998). A number of central banks, including the BoJ and the ECB, publish their forecasts of autonomous factors.

Table 5 : Operating Procedures Of Liquidity Management

Country	Operating Target	AL forecast horizon, if any	Frequency of Market Operations	Key Instruments of Discretionary Liquidity					
				Quantum				Rate	Others
				CRR	OMO	Repo	Standing Facilities		
Brazil	Overnight inter-bank rate	1 month	Daily	√	√	√			Financial assis-tance for liquidity
ECB		1 month	Once a week *plus* once addi-tionally a month, on a regular basis		√	√	√	Policy rate	
Indonesia	Monetary base and REER	1 week	Daily	√	√	√		Discount rate	Moral suasion
Japan	Bank reserves	1 day	More than one per day		√	√	√		
Malaysia	Intervention rates, inter-bank rates	1 day	Daily	√	√	√			Selective credit and moral suasion
Mexico		1 day	Daily		√	√			
South Africa	Repurchase rate	1 to 6 months	Daily	√	√	√	√	Repo rate	Foreign cur-rency swaps
UK		1 day to 13 weeks	Daily		√	√		Repo rate	
USA	Federal Funds Rate	2 weeks	Typically one per day		√	√	√	Discount rate	

Section II

The Indian Context

The autonomous (ΔAL) and discretionary (ΔDL) liquidity flow measures adapt the standard literature with the caveat that the policy measures are "discretionary" and not "rule bound" (RBI 1999; RBI 2000a,b; RBI 2001a; RBI 2002a,b,c).

The ΔAL, in the Indian case, could be defined as the sum of the following:

i) the Reserve Bank's primary monetisation of the fiscal deficit, through a) ways and means advances (WMA), netted for the Government balances, b) net primary subscriptions to Treasury Bills, dated securities and non-marketable securities (such as *ad hoc* T-Bills funded into non-transferable special securities without any maturity, *etc.*) and c) holdings of rupee coins, (*i.e.*, the change in the net RBI credit to the Government, adjusted for secondary market operations);

ii) incremental claims on banks (other than credit to commercial banks);

iii) incremental claims on the commercial sector (other than credit to primary dealers (PDs), typically driven by development objectives;

iv) incremental net foreign assets;

v) *less* incremental liabilities (other than scheduled commercial bank and government balances with the RBI), which constitute a leakage from the banking system, comprising a) cash, governed by demand for transactions balances which, in turn, depends on the level of economic activity and on seasonal factors, such as harvests and festivals, b) balances maintained by co-operative banks, financial institutions and foreign central banks, and c) net non-monetary liabilities, mainly constituting the Reserve Bank's claims on itself.

The ΔDL, in quantum terms, could be the sum of i) the Reserve Bank's secondary market operations in the government securities market in the form of OMO (including repo), incremental credit to ii) commercial banks and iii) PDs at a pre-determined interest rate netted for iv) changes in reserve requirements.

The construction of ΔAL and ΔDL measures is judgemental and at best time-specific, especially in view of the on-going transition from direct to indirect instruments[5] of monetary control (Appendix III). For instance, the Reserve Bank often accepts private placement and devolvement of Treasury Bills/government securities auctions during tight liquidity and offloads them to the market when conditions ease. As the Reserve Bank is entrusted with the dual responsibility of internal debt and monetary management, the first leg is classified as ΔAL and the second leg as ΔDL. Secondly, the critical difficulty in case of policy instruments such as OMO and standing facilities is that while the Reserve Bank often determines either the price or the potential quantum and, at times, both, the response really depends on banks and PDs. In this case, the precise utilisation levels, are viewed as a function of the "enabling" conditions, in both price and quantity terms, set by the Reserve Bank and are hence classified as ΔDL. Finally, while there usually exists an inverse relationship between bank reserves and short-term interest rates (*i.e.*, the liquidity effect), it is necessary to adjust bank balances with the Reserve Bank for changes in required reserves in a regime of frequent CRR changes. While the impact of CRR changes is actually dynamic and best captured by constructing a series for adjusted bank reserves, the first round release of resources on account of CRR changes is taken in ΔDL as a first approximation in absense of a time series on required reserves (RBI, 2001a).

Section III

The Indian Experience

The Reserve Bank faces the monetary policy dilemma of funding both the Government and the commercial sector at reasonable cost without stoking inflationary pressures and at the same time maintaining exchange rate stability (RBI, 1998a). The Reserve Bank announced a multiple indicator approach in April 1998 to accord itself the necessary flexibility for drawing policy perspectives in the face of financial liberalisation. The array of indirect instruments of monetary control has been simultaneously expanded to ensure orderly conditions in the money and foreign

Table 6 : AL and DL - Select Operational Cases

Autonomous Factors	AL	Likely Liquidity Operations				Bank Rate	Adjusted Bank Reserves	Monetary Conditions	
		CRR	OMO (inc. repos)	Standing Facilities	DL			Interest Rates	Exchange Rates (Re/US$)
1	2	3	4	5	6	7	8	9	10
Cash demand	↓		↑	↑	↑		↔	↔	↔
Government demand	↑		↓		↓		↔	↔	↔
Capital outflows	↓	↑	↓@	↑#	↓#	↑	↓	↑	↓
On reversal,	↔	↓	↑$	↓*	↑*	↓	↑	↓	↔

@ Especially higher cost repos. # At higher cost. $ At higher prices. * At lower cost.

exchange markets. The liquidity management is now carried out by OMO (including repo operations) supplemented by direct interest rate signals through changes in the policy rates such as the bank rate and the Liquidity Adjustment Facility (LAF) rates, besides the traditional reserve requirements and standing facilities (Vasudevan, 1998; Reddy, 2001, 2002; Table 6). It is in this *milieu* of multiple objectives, indicators and instruments that partitioning bank reserves on the basis of liquidity management provides a useful tool for analysing central bank operations.

There are four stylised facts. First, ΔDL, more or less, offsets ΔAL[6] (Chart 2 and Table 7). Secondly, the Reserve Bank has

Chart 2 : AL & DL Flows and the Call Rate

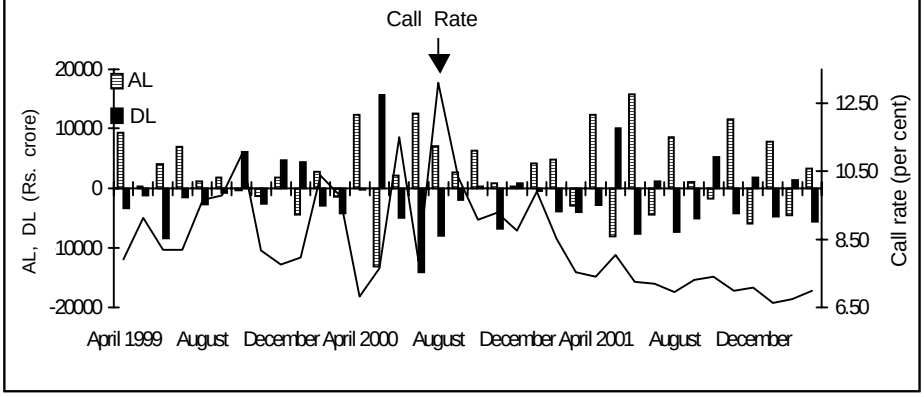


Table 7 : Measures of Volatility

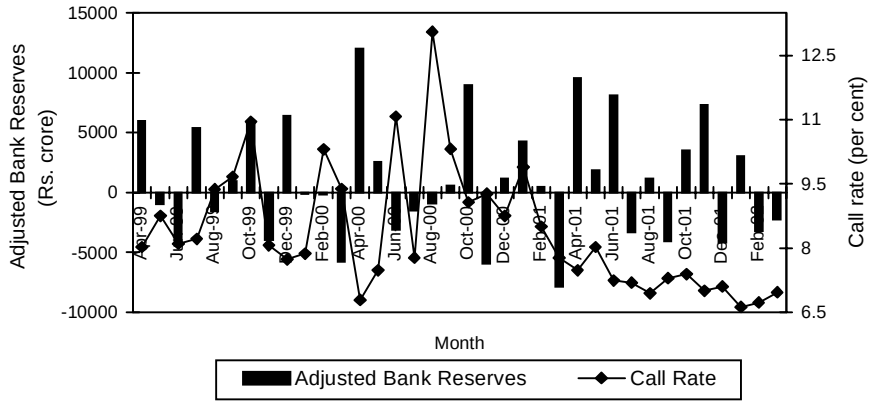
Variable	Monthly Flow Average (Rs. crore)	Co-efficient of Variation
1	2	3
AL	2,502	2.5
Currency in circulation	2,010	2.2
Monetisation of the Centre's Fiscal Deficit	2,223	3.1
Net foreign assets of the RBI	3,507	1.1
DL	-1,510	-3.8

Memo Item:

Variable/Co-efficient of Variation	1999-2000	2000-01	2001-02
Adjusted bank reserves (R^a)	0.06	0.07	0.07
Call rate	0.12	0.19	0.05
Exchange rate (Re/US $)	0.01	0.02	0.01

operated through different instruments[7] - quantum and rate – at different points of time to ensure orderly conditions in the money markets. Thirdly, there has been a gradual reduction in the volatility in the inter-bank call rates, without any appreciable change in the variability of bank reserves, adjusted for first-round CRR changes (Chart 3). Finally, ΔAL (and consequently ΔDL) is heavily influenced by seasonalities in cash demand and government payments.

Chart 3 : Adjusted Bank Reserves and the Call Rate



The Anecdotal Evidence

The recent monetary experience is best analysed in terms of phases of easy and tight monetary conditions (Chart 4 and Table 8). The fiscal year 1999-2000 provides a good starting point since the present operating procedure of liquidity management was, by and large, in place. The foreign exchange market saw excess demand conditions by early 1999-2000 emanating from a mix of domestic uncertainties, border tensions and bulk crude oil imports, depleting the foreign exchange reserves. This gap was funded by refinance drawals by commercial banks and PDs at the Bank Rate, which pushed up inter-bank call rates above central bank lending rate. The Reserve Bank continued its policy of private placements/ devolvements combined with subsequent OMO to deflect the pressures of Government borrowing. As a result, while ΔAL amounted to Rs. 14,228 crore, DL declined by Rs. 8,354 crore during June-October 1999 to constrain average monthly change in bank reserves (adjusted for CRR changes) (ΔR^a) to Rs.1,175 crore. During this period, the discretionary operations were essentially quantum based, in the absence of any change in the policy rates.

Capital flows revived after November, adding to the foreign exchange reserves. Given seasonal cash demand, AL increased by Rs. 12,603 crore during November 1999 to April 2000. The

Chart 4 : Phases of Liquidity

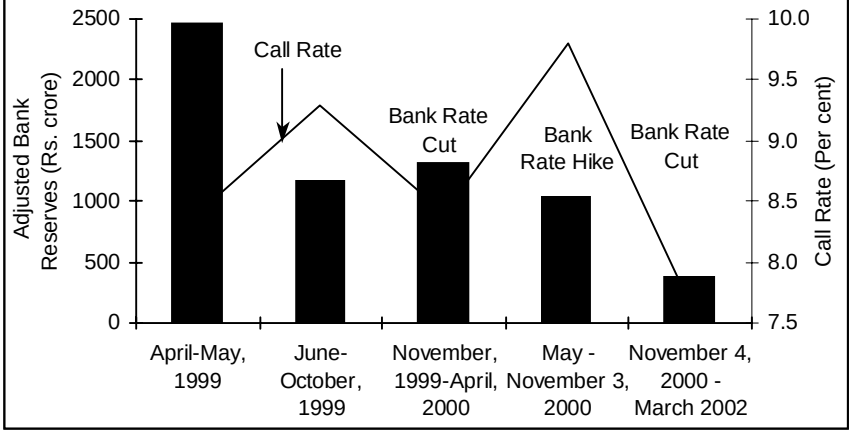


Table 8 : AL and DL – Phase-wise Analysis

Variable	April-May 1999	June-October 1999	November 1999-April 2000	May-November 3, 2000	November 4, 2000-March 2002
1	2	3	4	5	6
1. AL (1+2+3+4-5-6-7-8)	**9,184**	**14,228**	**12,603**	**7,804**	**44,103**
1.1 Net RBI credit to Government (other than OMO)	16,528	15,789	12,890	21,378	15,198
1.1.1 Primary subscription to dated GoI securities	16,000	11,000	0	30,149	26,679
1.2 RBI's claims on banks (other than credit to commercial banks)	-1,064	1,060	-224	383	337
1.3 RBI credit to commercial sector (other than PDs)	-36	-267	94	-367	-1,121
1.4 RBI's net foreign assets (NFA)	9,250	599	23,171	-4,581	97,811
1.4.1 net of revaluation	9,047	-2,893	27,554	-10,545	89,760
1.5 RBI's net non-monetary liabilities	1,678	4,757	6,329	2,554	28,735
1.6 Notes in circulation	14,894	-2,119	16,440	6,421	37,063
1.7 "Other" deposits with the RBI	-1,138	30	98	-262	-151
1.8 Bankers' deposits with the RBI (other than commercial banks)	61	285	462	296	2,475
2. DL (1+2+3+4)	**-4,234**	**-8,354**	**-4,722**	**-1,040**	**-37,613**
2.1 Open Market Operations	-11,301	-12,385	-12,749	-5,815	-47,717
2.1.1 Repo operations#	702	256	-1,984	0	-4,022
2.2 RBI's credit to commercial banks	2,066	2,382	-2,274	820	-2,272
2.3 RBI's credit to primary dealers	1,751	1,649	-3,155	4,155	-4,224
2.4 Release of resources through changes in CRR on NDTL of commercial banks	3,250	0	13,456	-200	16,600
3. Bank Reserves (adjusted for CRR) (R^a) (1+2 = 3.1+2.4)	**4,950**	**5,875**	**7,881**	**6,763**	**6,491**
3.1 Commercial bank deposits with the RBI	1,700	5,875	-5,575	6,963	-10,109
Memo item					
Average Inter-bank Call Rate	8.4	9.3	8.4	9.8	7.7

: Pertains to the LAF since June 2000.

Reserve Bank eased monetary conditions, reducing the CRR in November 1999 and April 2000 and cutting the Bank Rate and the fixed repo rate effective April 1, 2000, to ease average call rates to 8.4 per cent. The surplus liquidity enabled banks and PDs to

redeem their drawals from the Reserve Bank and revived interest in gilts, reducing DL by Rs. 4,722 crore. The average monthly ΔR^a amounted to Rs. 1,313 crore.

The foreign exchange market again saw excess demand pressures due to an increase in the oil import bill and the drying up of capital inflows, draining the Reserve Bank's foreign exchange reserves. The Reserve Bank initially conducted high-cost reverse repos under the newly-introduced LAF to bridge the liquidity gap and at the same time, stabilise the foreign exchange market. As the rupee continued to depreciate, the Reserve Bank raised the Bank Rate and the CRR and halved the refinance facilities available to banks on July 21, 2000. The Reserve Bank accepted private placements/devolvements of government paper (Rs. 20,151 crore during end-July-November 3) and simultaneously conducted aggressive repo operations (averaging Rs. 9,267 crore during August-October 2000) at attractive interest rates (14.5 per cent on August 14). During May-November 3, 2000, ΔAL worked out to be Rs. 7,804 crore while DL declined by Rs. 1,040 crore, on a point to point basis, limiting average ΔR^a to about Rs. 1,000 crore. The adjustment of liquidity was reinforced by strong interest rate signals, especially in terms of sharp changes in LAF repo rates.

Capital flows revived in November 2000, initially with the proceeds of India Millennium Deposits (IMDs), followed by strong portfolio inflows, resulting in an accretion of Rs. 89,760 crore (adjusted for revaluation) to the Reserve Bank's foreign currency assets between November 2000 and March 2002, enabling the Reserve Bank to ease monetary conditions pulling the average inter-bank call rates down to 7.7 per cent. During November 4, 2000-March 2002, ΔAL amounted to Rs. 44,103 crore while DL was tightened by Rs. 37,613 crore. As a result, average monthly ΔR^a amounted to about Rs. 400 crore.

An Empirical Exercise

We examine the dynamic inter-relationships among ΔAL, ΔDL and the changes in the call money rate (i_{mr}), through an

unrestricted vector auto regression (VAR) model, over the period April 1996 - March 2002. The exercise has been undertaken in two steps. First, the monthly interaction between ΔAL and ΔDL has been examined along with the policy rate (i_{pr}), proxied by the Bank Rate, as exogenous, in Model 1. Second, the interaction between ΔR^a and changes in the call money rate (Δi_{mr}) has been examined along with Δi_{pr} and a dummy representing the South-East Asian crisis as exogenous in Models 2 (on monthly basis) and 3 (on weekly basis). We follow the standard VAR methodology of model estimation, block-causality, impulse response and variance decomposition.

The underlying variables were first examined for stationarity with the lag length chosen by the appropriate model selection, *viz.*, Akaike Information (AIC) and Schwarz Bayesian (SBC) criteria. In the monthly data, all the series were found to be stationary at levels both in terms of DF and ADF tests (Table 9). In the weekly data, except for the call money rate, which is stationary at levels, all other series were found to be stationary at first-differences, *i.e.*, I(1).

We first test the causality between ΔAL and ΔDL (Table 10). It will be noted that the χ^2-tests, which measure the statistical significance of lags of other variables in predicting the left-hand

Table 9 : Unit Root Tests

Variable	Monthly Models I and II		Weekly Model III	
	Without Trend	With Trend	Without Trend	With Trend
1	2	3	4	5
ΔAL	-3.56 (4)	-3.80 (4)		
ΔDL	-3.52 (4)	-4.13 (4)		
R^a	-5.59 (10)	-5.59 (10)	-0.91 (1)	-9.73 (1)
i_{mr}	-5.25 (1)	-5.25 (1)	-8.87 (1)	-9.62 (1)
i_{pr}	-6.41 (2)	-6.37 (2)	-1.28 (1)	-2.88 (1)

Note: Based on Akaike Information Criterion (AIC). In case of the monthly models, the 95% critical value for the ADF statistic is –2.9023 for the regression without a trend and –3.4730 with a trend. In case of weekly data, the 95% critical value for the ADF statistic is –2.8710 for the regression without a trend and –3.4258 with a trend both at levels and first differences.

Table 10 : Test of Granger's Block Causality in a VAR Framework

Null Hypothesis	Test Statistic $\chi 2$	Accept/ Reject Null Hypothesis	Inference
1	2	3	4
I. ΔAL does not Granger cause ΔDL	8.10*	Reject	ΔAL Granger
ΔDL does not Granger cause ΔAL	1.91	Accept	causes ΔDL
II. ΔR^a does not Granger cause Δi_{mr}	5.42**	Reject	Bi-directional
Δi_{mr} does not Granger cause ΔR^a	8.69*	Reject	causality
III. ΔR^a does not Granger cause Δi_{mr}	16.6*	Reject	ΔR^a Granger
Δi_{mr} does not Granger cause ΔR^a	2.37	Accept	causes Δi_{mr}

Note : Models 1-2 and 3 are estimated with 12 and 4 lags of the endogenous variables, respectively.

* Significant at 1 per cent level. ** Significant at 5 per cent level.

side variables, in addition to own lagged variables, are equivalent to Granger (1969) causality involving non-stationary variables in a VAR framework. As expected, ΔAL causes ΔDL, without evidence of reverse causation, which is consistent with previous research (RBI, 2001). Note that the computed χ^2 test-statistic for the null hypothesis of no-causation running from ΔAL to ΔDL is highly significant at 1 per cent level.

We then turn to the causal relationship between market interest rates (i_{mr}) and adjusted bank reserves (R^a) to extend the existing research. We find that there exists bi-directional causality between ΔR^a and Δi_{mr} in terms of monthly data in Model II. An empirical verification of the liquidity effect in the Indian context is subject to a number of limitations of the data. For example, while the liquidity numbers are point-to-point flows between the monthly last reporting Fridays, the call money rate is taken as the weighted average lending rate of the month. Thus, in as much ΔR^a affects Δi_{mr}, intra-month Δi_{mr} influences the monthly ΔR^{a8}. It is difficult to match the periodicity between the two series since i) time series data on daily bank reserves are not available and ii) it would be inappropriate to work with point call data since call rates used to

fall to very low levels on reporting Fridays earlier. To reduce the gaps in the information content of the data, an exercise was also conducted on a weekly basis. In this case, a strong block Granger causality running from ΔR^a to Δi_{mr} is evident, while at the same time, the causality running from Δi_{mr} to ΔR^a has been rejected. The i_{pr} is taken as an exogenous variable and its presence in the model has been vindicated by a significant χ^2 statistic.

We used the unrestricted VAR model for analysing the impulse responses and forecast error variance in each of the three cases. In each equation, iterations are made till 12 lag periods by imposing a one-standard deviation shock to each variable in a generalised impulse response approach. This has the advantage of circumventing the problem of the dependence of the orthogonalised impulse responses on the ordering of the variables in the VAR (Koop *et al,* 1996).

In Model 1, in terms of impulse response, the response of ΔDL to ΔAL is immediate and pronounced in the first and second months, although the tendency to react continues up to 5-6 months (Charts 5-8). On the other hand, in Model II, the response of Δi_{mr} to ΔR^a is immediate and more pronounced with the impact lasting up to 8-9 months (Charts 9-12). In Model III, the response of Δi_{mr} to ΔR^a is similarly immediate and strong with the effect persisting for 8-10 weeks (Charts 13-16).

In terms of variance decomposition, in the Model I, about one-third of the total variation in ΔDL is due to the innovations in ΔAL. Similarly, about half of the total variation in Δi_{mr} is due to the innovations in ΔR^a in the monthly data. In terms of weekly data, almost the total variation in i_{mr} is due to the innovations in ΔR^a.

Chart 5 : Response of dAL to dAL

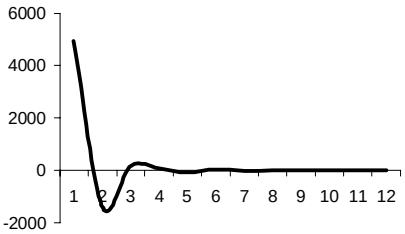


Chart 6 : Response of dDL to dAL

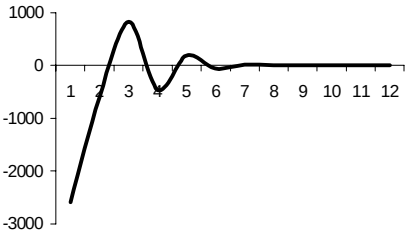


Chart 7 : Response of dAL to dDL

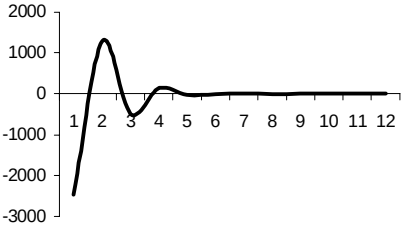


Chart 8 : Response of dDL to dDL

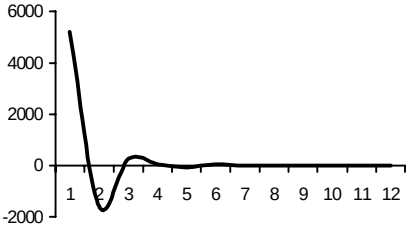


Chart 9 : Response of dR^a to dR^a (Monthly)

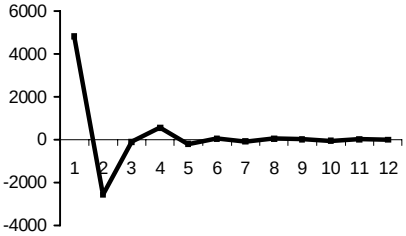


Chart 10 : Response of di_{mr} to dR^a (Monthly)

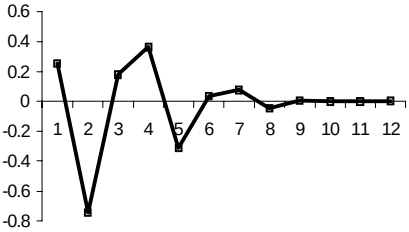


Chart 11 : Response of dR^a to di_{mr} (Monthly)

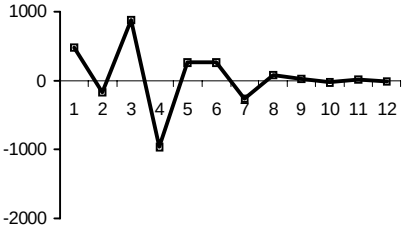
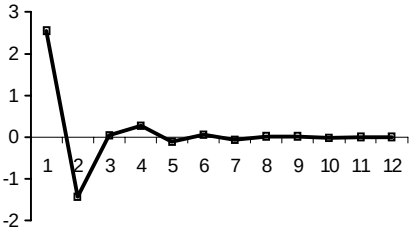
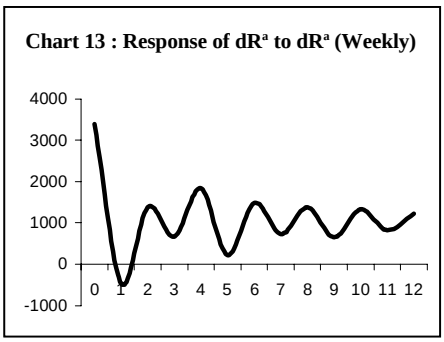
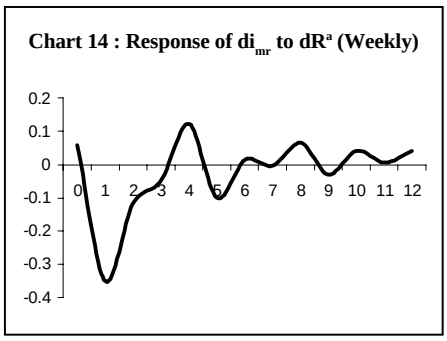
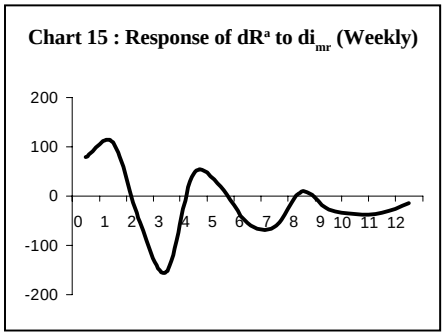


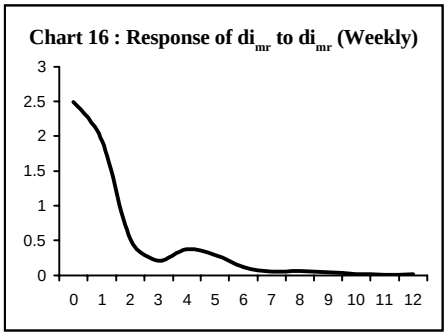
Chart 12 : Response of di_{mr} to di_{mr} (Monthly)











Conclusion

The management of liquidity in financial markets has emerged as a key policy issue in central banking. Given the large size of the fiscal deficit, sudden switches in capital flows and the seasonal character of cash demand, the Reserve Bank steers short-term liquidity conditions by a policy mix of adjustments in market liquidity through changes in reserve requirements, standing facilities and open market operations, reinforced by interest rate signals *via* changes in policy rates. This paper simply formalises this natural partition of sources of primary liquidity into the emerging reserve concepts of autonomous and discretionary liquidity. Given the empirical result that changes in bank reserves impact short-term interest rates, especially in the short run, we believe that the AL-DL dissection provides a reasonably good analytical framework for mapping the interaction of the central bank and participant banks in the market for bank reserves. This is buttressed by the fact that DL is empirically found to capture the policy response to the autonomous factors in the AL.

Further research could essentially proceed in two directions. First, there is a need to forecast autonomous liquidity. Second, it may be apposite to explore the impact of combinations of policy instruments on the stability of liquidity conditions to evolve useful feedback rules for monetary policy formulation. Empirical work, beyond the present modest attempt, is constrained by the shifts in the relationship between the money market rates and the instruments of DL, such as, refinance and repo operations, as a result of frequent changes in regulations in respect of average reserve requirements, on the one hand, and the lack of an acceptable representative policy rate in view of the infrequent changes in the Bank Rate and the intermittent character of repo auctions, especially in the pre-LAF years, on the other. These limitations of quantification, natural in transition, are likely to be ironed out with the evolution of the LAF as a principal operating instrument of monetary policy and the recent CRR stipulation of a daily minimum maintenance of 80 per cent of required reserves for commercial banks.

Notes

1. Following the Reddy Working Group, we divide the economy into six sectors, *viz.*, households (A), the Reserve Bank (B), the banking system in India (C), other financial corporations (D), general government (E) and the non-financial commercial sector (F), which interact within themselves and with the rest of the world (RoW) sector. It may be useful to work out the numerical example through the sectoral balance sheets of the economy, including the Government and the commercial sector, which comprises the other agents of the domestic economy. In case of the Government, the monetisation of the deficit to fund employees' salaries expands the balance sheet by Rs.100, generating an AL of a like amount in the first instance (Tables 2 and 11).

Table 11 : Balance Sheet of the Government Sector

Income Flow	Rupees	Expenditure Flow	Rupees
1	2	3	4
1. Credit from the Central Bank	100	1. Salaries	100
Total	100	Total	100

The net impact on AL, however, depends on the public demand for cash, which is a leakage from the banking system. In this case, since the commercial sector splits the

salary evenly into cash and bank deposits, net AL increases by Rs.50 (Tables 3 and 12). It is useful to mention that if there was an increase in the public's demand for currency, irrespective of the Government's salary disbursement, there would have been a drainage of liquidity from the banking system as deposits would have been drawn down and been substituted for by currency.

Table 12 : Balance Sheet of the Commercial Sector

Income Flow	Rupees	Expenditure Flow	Rupees
1	2	3	4
1. Salaries	100	1. Currency with the Public	50
2. Bank Credit to Commercial Sector		2. Deposits	50
Total	100	Total	100

2. Defined as the sum of the liquidity-injecting factors such as the purchases of net foreign assets by the Eurosystem, netted for liquidity-absorbing factors such as issuance of bank notes in circulation, government deposits with the Eurosystem and other factors (net) The ECB has published weekly forecasts of autonomous factors since June 2001, with a view to providing the counter-party public and private credit institutions in the Eurosystem a reliable basis for assessing its allotment decisions in variable tender auctions for central bank support.

3. Includes shifts in cash demand, size of treasury balances at Federal Reserve Banks and the volume of the Federal Reserve float.

4. Includes net issuance of bank notes and changes in treasury funds. The Bank of Japan releases projections of sources of changes in current account balances with it and market operations a day in advance.

5. For instance, the 14-day Treasury Bills (introduced June 1997) emerged as a key instrument for mopping up surplus liquidity generated by capital inflows during the first half of 1997-98 because they were more attractive than repos. In the latter half of the year, when external pressures on account of the South-Asian crisis warranted monetary tightening, the Reserve Bank raised the repo rates but left the 14-day T-Bill rates unchanged since the Government borrowing programme had already been completed (RBI, 1998a). The EPW Research Foundation adjusts the autonomous liquidity for Treasury Bill auctions in its monthly money market review in the Economic and Political Weekly.

6. The empirical test of the strategy of the AL-DL framework should ideally involve a verification of the relationship between the market liquidity gap (*i.e.*, net liquidity in (4)) and discretionary operations. The computation of net liquidity, however, is difficult given the lack of data on required reserves (or net demand and time liabilities relevant for CRR) necessary for a forecast of the demand for bank reserves (R^d). While this is undoubtedly a limitation, the difference may not be as material given the secular trend in long-run NDTL growth and adjustment of bank reserves for changes in CRR.

7. For instance, the Reserve Bank has adjusted liquidity (*i.e.*, rejected bids) 143 times and adjusted rates 20 times in the operation of the 1-day auctions under the LAF between June 2000-March 2002.

8. For instance, once the Reserve Bank tightened monetary policy on January 16, 1998, in the wake of the South-Asian crisis, inter-bank call rates shot up from 6 per cent on the reporting Friday of January 16, 1998 to 30 per cent per cent on January 17 and 70 per cent on January 24 before returning to 7 per cent on the next reporting Friday on January 30.

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Appendix I :
A Model of Autonomous and Discretionary Liquidity

We develop a simple model of the market for bank reserves using the AL-DL framework in which the central bank uses the array of instruments – both quantum and rate - at its disposal for stabilising the price of liquidity. The demand for reserves is based on required reserves ($\bar{R}^a$), immunised for changes in reserve requirements (r) (and hence, constant in the short run, *i.e.*, $d\bar{R}^a=0$) and "excess" reserves (inclusive of settlement balances), usually maintained as a precautionary buffer for unforeseen contingencies, depending on the opportunity cost, *i.e.*, the market interest rate (i_{mr}) and the cost of avoiding default, linked to the central bank policy rate (i_{pr}). Accordingly, the demand for adjusted bank reserves (R^{ad}) can be written as:

$$R^{ad} = R^{ad}(i_{mr}, i_{pr}, \bar{R}^a), \text{ where } R^{ad'}_{imr} < 0 \qquad \ldots (A.1)$$

DL depends on both the liquidity adjustment either through changes in r or open market operations (dQ), and the price (i_{pr}) at which funds are made available from the central bank, *i.e.*,

$$DL = DL\ (i_{pr},\ r,\ Q) \qquad DL'_{ipr} < 0,\ DL'_{r} < 0,\ DL'_{Q} > 0 \quad ...(A.2)$$

(Q is liquidity support arising out of open market (including repo) operations).

The supply of bank reserves (R^s), by definition, thus, works out to

$$R^s = AL + DL\ (i_{pr},\ r,\ Q) \quad \ldots(A.3)$$

Since the central bank stabilises the price of liquidity, the DL trajectory is determined by its reaction to the liquidity conditions in the market, *i.e.*,

$$DL\ (i_{pr},\ r,\ Q) = f[R^{ad}\ (i_{mr},\ i_{pr},\ \bar{R}^a) - AL] \quad \ldots(A.4)$$

The market interest rate, consistent with market clearing conditions, can, thus, be written as a function of i_{pr}, AL, $\bar{R}^a$ and DL, as

$$i_{mr} = g\ (i_{pr,}\ AL,\ DL\ (i_{pr},\ r,\ Q),\ \bar{R}^a) \text{ where } g'_{ipr} > 0,\ g'_{AL} < 0,\ g'_{DL} < 0,$$
$$g'_{\bar{R}^a} = 0 \text{ [as } \bar{R}^a = \text{constant]} \quad \ldots(A.5)$$

The total change in market interest rates can be worked out by totally differentiating (A.5),

$$di_{mr} = (g'_{ipr} + g'_{DL}DL'_{ipr})\ di_{pr} + g'_{DL}DL'_{r}\ dr + g'_{AL}dAL + g'_{DL}DL'_{Q}dQ \quad \ldots\ (A.6)$$

The following derivatives delineate the partial impact of changes in the determinants of liquidity conditions on the market interest rate. Besides, the possible alternative policy mixes of discretionary operations are analysed, which could be used for interest rate stabilisation.

From (A.6), the partial impact of i_{pr}, r, AL and Q on i_{mr} work out to:

$$(\delta i_{mr}/\delta i_{pr}) = (g'_{ipr} + g'_{DL} DL'_{ipr}) > 0 \text{ [assuming } dAL = dr = dQ = 0] \ldots (A.7)$$

which implies that an increase in the central bank policy rate, *ceteris paribus*, pushes up the market interest rate. Note that i_{pr} impacts on i_{mr} in two ways, *viz.*, the direct signalling effect (g'_{ipr}), which is instantaneous and the indirect liquidity effect ($g'_{DL} DL'_{ipr}$) as a result of the change in the cost of liquidity available from the central bank;

$$(\delta i_{mr}/\delta r) = g'_{DL} DL'_{r} > 0 \quad [\text{assuming } dAL = di_{pr} = dQ = 0] \ \ldots (A.8)$$

i.e., an increase in reserve requirements, *ceteris paribus*, hardens the market interest rate by impounding liquidity and reducing the supply of funds in the inter-bank market;

$$(\delta i_{mr}/\delta AL) = g'_{AL} < 0 \quad [\text{assuming } dr = di_{pr} = dQ = 0] \ldots (A.9)$$

so that an increase in autonomous liquidity, *ceteris paribus*, softens the market interest rate by augmenting the supply of reserves; and finally,

$$(\delta i_{mr}/\delta Q) = g'_{DL} DL'_{Q} < 0 \quad [\text{assuming } dr = di_{pr} = dAL = 0] \ \ldots (A.10)$$

which implies that an infusion (absorption) of liquidity through open market purchases (sales), *ceteris paribus*, softens (hardens) the market interest rate.

We now turn to the mechanics of interest rate stabilisation in the market for bank reserves. If the central bank offsets AL with a compensating DL, *i.e.*,

$$\text{if } dDL = -dAL \Rightarrow dR^s = 0 \quad \ldots (A.11)$$

the impact on i_{mr} can be derived from (A.6) using (A.11),

$$di_{mr} = [g'_{ipr} + (g'_{DL} - g'_{AL}) DL'_{ipr}] di_{pr} + (g'_{DL} - g'_{AL}) DL'_{r} dr + (g'_{DL} - g'_{AL}) DL'_{Q} dQ \quad \ldots (A.12)$$

This expression (A.12) can be used to analyse the impact of various combinations of changes in r, i_{pr} and Q on the stability of i_{mr} (market interest rates are stable when $di_{mr} = 0$).

Case I : Policy mix of changes in reserve requirements and policy interest rate

The central bank could, *ceteris paribus,* stabilise i_{mr} by changing r and i_{pr} in opposite directions, *i.e.*,

$di_{pr} = [(g'_{DL} - g'_{AL})DL'_r / \{g'_{ipr} + (g'_{DL} - g'_{AL}) DL'_{ipr}\}](-dr)$…(A.13, from A.12, assuming no OMO, *i.e.*, $dQ = 0$)

iff […] is positive. Given $g'_{ipr} > 0$, $DL'_r < 0$ and $DL'_{ipr} < 0$, a sufficient condition for […] to be positive is $(g'_{DL} - g'_{AL}) < 0 \Rightarrow |g'_{DL}| > |g'_{AL}|$ as $g'_{DL} < 0$ and $g'_{AL} < 0$, *i.e.*, if market interest rates are influenced to a greater extent by DL than by AL. Thus, central banks could stabilise liquidity conditions with a policy mix of injecting (withdrawing) liquidity by lowering (raising) reserve requirements and at the same time increasing (reducing) the cost of primary money by raising (lowing) the policy rate.

Case 2 : Policy mix of changes in OMO and policy interest rate

The central bank could stabilise i_{mr} through a combination of changes in i_{pr} and Q, *i.e.*,

$dQ = [\{g'_{ipr} + (g'_{DL} - g'_{AL}) DL'_{ipr}\}/\{(g'_{DL} - g'_{AL}) DL'_Q\}](-di_{pr})$ …(A.15, from A.12, assuming $dr = 0$, *i.e.*, there is no change in reserve requirements)

iff […] is negative. Given $g'_{ipr} > 0$, $DL'_{ipr} < 0$ and $DL'_Q > 0$, […] is negative if the sufficient condition mentioned above holds, *i.e.*, $|g'_{DL}| > |g'_{AL}|$, implying once again that the interest rate effect of DL should be stronger that of AL.

Thus, the central bank could influence market liquidity through a policy mix of open market purchases (sales) and a hike (reduction) in the policy rate.

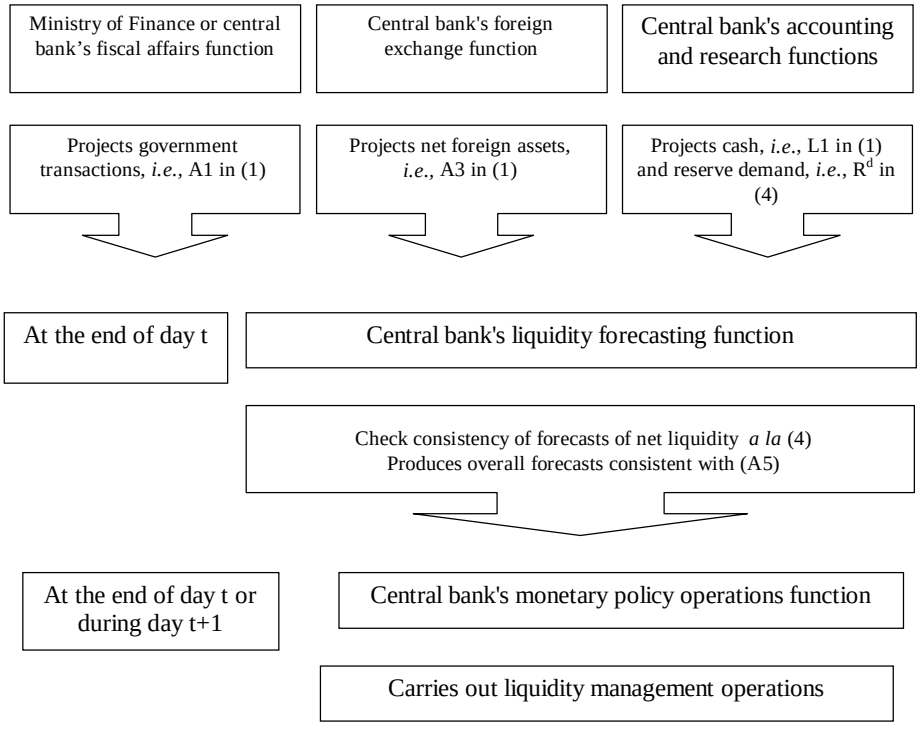
Case 3 : Policy mix of changes in reserve requirements and OMO

The central bank would be able to stabilise i_{mr} if changes in r and Q are unidirectional, *i.e.*,

$dQ = [(g'_{DL} - g'_{AL})\ DL'_r / \{(g'_{DL} - g'_{AL})\ DL'_Q\}](-dr)$ …(A.14, from A.12, assuming $di_{pr} = 0$, *i.e.*, policy rate is left unchanged)

iff […] is negative. Given $DL'_r < 0$ and $DL'_Q > 0$, the above condition is sufficient for the [.. ..] expression to be negative, Hence, the central bank could ensure orderly conditions in the money market with a policy combination that pares reserve requirements (perhaps with a view to phase out a "blunt" instrument) and neutralises the resultant liquidity through open market sales.

Appendix 2 : An Operational Scheme of Liquidity Management



Appendix 3 : Classification of Autonomous and Discretionary Liquidity Flows in the Reserve Bank Balance Sheet

Account	Nature of Flow		Claim of/on Sector	Select Remarks
	AL	DL		
1	2	3	4	5
Issue Department: Liabilities				
Notes held in Banking Department	√		B	
Notes in Circulation	√		Other than B	
Issue Department: Assets				
Gold Coin and Bullion	√		Sovereign asset	
(a) Held in India				
(b) Held outside India				
Foreign Securities	√		RoW	
Rupee Coin	√		E	
Government of India Rupee Securities	√		E	Secondary market transactions classified DL.
Internal Bills of Exchange and other Commercial Paper	√		A+D+F	
Banking Department: Liabilities				
Capital paid up	√		E	
Reserve Fund	√		B	
National Industrial Credit (Long Term Operations) Fund	√		B	
National Housing Credit (Long Term Operations) Fund	√		B	
Deposits				
(a) Government			E	
(i) Central Government	√			
(ii) State Governments	√			
(b) Banks			C	
(i) Scheduled Commercial Banks				Changes in required reserves for scheduled commercial banks under Section 42(1) classified DL.
(ii) Scheduled State Co-operative Banks	√			
(iii) Other Scheduled Co-operative Banks	√			

Appendix 3 : Classification of Autonomous and Discretionary Liquidity Flows in the Reserve Bank Balance Sheet (Contd.)

Account	Nature of Flow		Claim of/on Sector	Select Remarks
	AL	DL		
1	2	3	4	5
(iv) Non-scheduled State Co-operative Banks	√		C	
(v) Other Banks	√			
(c) Others	√		A+D+F	
Bills Payable	√		A+D+F	
Other Liabilities	√		B	
Banking Department: Assets				
Notes	√		B	
Rupee Coin			E	
Small Coin				
Bills Purchased and Discounted				
(a) Internal	√		A+D+F	
(b) External			RoW	
(c) Government of India Treasury Bills			E	
Balances held Abroad	√		RoW	
Investments				
Investments in Subsidiaries/ Associate Institutions	√		C+D	
Foreign Securities	√		RoW	
Government Securities	√		E	Secondary market transactions classified DL.
Loans and Advances to				
(i) Central Government	√		E	
(ii) State Governments	√		E	
Loans and Advances to				
(i) Scheduled Commercial Banks		√	C	
(ii) Scheduled State Co-operative Banks	√		C	
(iii) Other Scheduled Co-operative Banks				
(iv) Non-Scheduled State Co-operative Banks				
(v) NABARD	√		D	

Appendix 3 : Classification of Autonomous and Discretionary Liquidity Flows in the Reserve Bank Balance Sheet (Concld.)

Account	Nature of Flow		Claim of/on Sector	Select Remarks
	AL	DL		
1	2	3	4	5
(vi) Others		√	D	Liquidity support to primary dealers classified DL.
Loans, Advances and Investments from National Industrial Credit (Long Term Operations) Fund	√		D	
(a) Loans and Advances to				
(i) Industrial Development Bank of India	√		D	
(ii) Export Import Bank of India				
(iii) Industrial Investment Bank of India				
(iv) Others				
(b) Investments in bonds/ debentures issued by				
(i) Industrial Development Bank of India				
(ii) Export Import Bank of India				
(iii) Industrial Investment Bank of India				
(iv) Others				
Loans, Advances and Investments from National Housing Credit (Long Term Operations) Fund				
(a) Loans and Advances to National Housing Bank				
(b) Investments in bonds/debentures issued by National Housing Bank				
Other Assets	√		B	Includes gold.

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Infrastructure and Economic Growth: An Empirical Examination

Satyananda Sahoo*

This paper explores the relationship between the gross domestic product and stock of infrastructural services in India by estimating a vector autoregressive (VAR) model for the period 1970-71 to 2000-01. Various stocks of infrastructure *viz.*, transport, electricity, gas, water supply and communication facilities are included as inputs in the model whereas gross domestic product at factor cost is considered as output in a Cobb-Douglas production function framework. The estimated model is also used for forecasting by measuring the impulse responses of gross domestic product to one per cent standard deviation shock in the infrastructural sectors. From the impulse response analysis, it was found that though the initial impact of increase in the stocks of infrastructure is diminishing, it continues to have a positive impact on real output in the medium-to-long run. Among all the infrastructural sectors, electricity, gas, water supply and communication sectors play a key role in explaining the movements in the gross domestic product.

Introduction

The recent slowdown of the Indian economy has triggered serious concern among the policy makers while exploring the possibilities for revitalising growth. Though the slowdown of the Indian economy coincided with that of the major industrial countries as reflected in the global slowdown, the former was largely ascribed to its relatively domestic conditions, *i.e.*, demand slowdown, sluggishness in supply responses and supply side constraints, given the relatively low degree of openness of the Indian economy. Among the demand-side factors impeding growth are uncertain pace of investment demand, the relatively low requirement of bank credit, the decline in import demand and the high-carrying costs of inventories being incurred by some industries. The supply-side factors, on the other hand, are sluggish agricultural

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growth, absolute deficiencies in physical and social infrastructure and other structural constraints (Reserve Bank of India, 2001, p.125). Among the supply side factors, the role of infrastructure in the process of economic development in India is highly crucial.

Infrastructure services, *e.g.*, transport, electricity, gas, water supply, communication and storage facilities play an important role in economic development of a nation. Recognising their importance for the society as a whole, they are also referred as 'social overheads'[1] due to low backward linkages and high forward linkages. Initially, after independence, these sectors were reserved for the public sector whereas private participation has been allowed in these sectors recently.

In the production process, infrastructure facilities are considered to be intermediate inputs though they are output of their own industry. Their availability in adequate quantity and quality reduces input cost and raises the profitability, thus, permitting higher level of output, income and employment. Infrastructure has also a role to play in economic growth, poverty alleviation and environmental up-gradation. In this context, the World Development Report (1994) says, "infrastructure can deliver major benefits in economic growth, poverty alleviation, and environmental sustainability - but only when it provides services that respond to effective demand and does so efficiently" (p. 2). It further says, "infrastructure represents, if not the 'engine', then the 'wheels' of economic activity" (p. 14).

Against the backdrop of recent deceleration in economic activity, this paper makes an attempt to explore the interaction between the various stocks of infrastructure and GDP. The rest of the paper consists of four sections. The first section provides a brief review of the earlier studies on infrastructure and economic development. Section II discusses the various developments in the infrastructure sectors with special reference to the post-reform period. The third section discusses the methodology and presents the empirical findings. The final section offers a concluding remark.

Section I

Infrastructure and Economic Development: A Review of Literature

Evidence on the link between infrastructure and economic development is found to be sketchy in the literature. In the recent years, however, many attempts have been made both in econometric and input-output framework for estimating the link between productivity of investments in infrastructure and economic development. In the input-output framework, forward and backward linkages, and direct and indirect multipliers were estimated using the Leontief inverse, which captures both the direct and indirect effects of a unit change in final demand. On the other hand, the econometric approach considers output growth as the dependent variable and investment or stock of infrastructure along with labour and level of technology as the independent variables. Many economists, however, argue that a high growth in the economy may encourage more investment in infrastructure.

In the Aschauer's (1989a, 1989b) pioneering work, a Cobb-Douglas production function was estimated with stocks of various infrastructure as capital and labour as the other input. He found that military capital had insignificant relationship with productivity. However, the 'core' infrastructure such as streets, highways, airports, mass transit, sewers, water systems, *etc.*, had the most explanatory power for productivity.

Munnell (1990a, 1990b) examined the relationship between public capital and economic activity at the State level in the US. In the first analysis, public capital was found to have a significant and positive impact on output although the output elasticity was roughly one-half the size of the national estimate. In the second analysis, public capital was found to enhance the productivity of private capital, raising its rate of return and encouraging more investment. On the other hand, from the investors' perspective, public capital was looked upon as a substitute for private capital which crowded out private investment.

Shah (1992) estimated a *translog* cost function for the Mexican economy in a restricted equilibrium framework to examine the contribution of public investment in infrastructure to private sector profitability. Labour and materials were treated as variable inputs whereas private capital and public sector capital stock in transportation, communication and electricity were considered quasi-fixed inputs. The Mexican industrial structure was found to be characterised by increasing returns to scale, short-run deficiency in capital capacity, involuntary unemployment and declining productivity growth. A small degree of complementarity between labour and infrastructure, and capital and infrastructure was also detected. The factor demand response to input price changes was found to be quite limited with technical change being a capital-using and labour-saving variety.

Feltenstein and Ha (1995) examined the relationship between infrastructure and private output in 16 sectors for Mexico in terms of sectoral elasticities in a framework of *translog* production function augmented by the nominal stocks of infrastructure. They found that availability of better quality infrastructures in electricity and communication generally reduces the cost of production, but transportation infrastructure tends to increase costs of production. They further conclude that Mexican public expenditure on electricity and communications has enhanced the productivity of private production, but expenditure on transport might actually had detrimental effect on private output. In addition, general labour and infrastructure were found to be substitutes, however, in the case of electricity and communications, capital and infrastructure were complements. In the case of transport infrastructure, however, these conclusions were reversed.

There are few studies conducted at the regional level using cross-section data. Costa *et. al.* (1987) tested the relationship between public capital and regional output using *translog* production function for 48 States of the USA for the year 1972. Three sectoral aggregates were considered in the study *viz.*, all economic sectors, non-agricultural sectors and manufacturing. Labour and public capital were found to be complementary inputs

with diminishing returns. Some of the later studies by Duffy-Deno and Eberts (1989), Eberts (1986, 1990), and Eisner (1991) were also conducted at the regional level. All these studies found a positive relationship between infrastructure and economic growth.

In the Indian case, there are hardly any empirical studies undertaken to examine the impact of infrastructure on economic growth. Jha and Sahni (1992) have examined the efficiency of the gas, electricity and railways sectors by estimating *translog* cost functions. They have estimated the factor elasticities with respect to output, and cross elasticities among the factors of production. However, they have not examined the impact of these sectors either on industrial productivity or on economic growth.

The India Infrastructure Report (1996) [Chairman: Dr. Rakesh Mohan] brought out by the Government of India has made investment projections for the infrastructure sectors in the next decade. Assuming incremental capital output ratio (ICOR) reduces to 3.5 resulting in GDP growth rate of 6.2 per cent in 1996-97, rising to 7.5 per cent in 2000-01 and 8.5 per cent in 2005-06, the Report has estimated an investment requirement at around Rs. 4,000 billion to Rs. 4,500 billion (US $ 115 to US $ 130 billion) over the next five years (1996-97 to 2000-01) and this would rise to about Rs. 7,500 billion (US $ 215 billion) in the following five years (2001-02 to 2005-06). The Report has made an in-depth study of the investment requirements and regulatory practices in six major sectors, *viz.,* urban infrastructure, power, telecommunications, roads, industrial parks and ports. The Report has further provided sector-specific recommendations for their commercialisation.

Other studies such as Raghuraman (1995), Sankaran (1995), Somers (1995), Nair (1995), Amitabh and Rajan (1995), Purkayastha and Ghosh (1997), Ramanathan (1997), and Shah (1997), 3-I Network (2002) found the problems related to various infrastructural sectors in India. None of these studies have, however, empirically examined the impact of infrastructure on industrial productivity.

Most of the empirical studies reviewed in this section so far have all used non-stationary data and are, therefore, faced with certain limitations. The existence of common trends in the output and infrastructure data might have given rise to a spurious correlation. Critics like Aaroan (1990), Hulten and Schwab (1991), Hulten (1996), Jorgenson (1991), and Tatom (1991) suggest that one should estimate the regressions in first differences while dealing with non-stationary time series. The first-differencing specification, however, has its own problems. No one would expect the growth in infrastructure stock in one year to be correlated with the growth in output in the same year. In fact, equations estimated in this form often yield implausible coefficients for stocks of infrastructure and labour [Hulten and Schwab (1991), Tatom (1991)]. In addition, the first differencing destroys any long-term relationship in the data, which is exactly what one is trying to estimate. Instead of just first differencing, the variables should be tested for cointegration, adjusted and estimated accordingly.

To overcome the aforesaid limitations, Sahoo and Saxena (1999) estimated a Cobb-Douglas production function to measure the elasticity of various stocks of infrastructure with respect to output. Various stocks of infrastructure like railways, other transport, electricity, gas and water supply, communication and storage facilities along with total employment were included as inputs in the model, whereas gross domestic product at factor cost was considered as output. The transport, electricity, gas, water supply and communication sectors were found to be positively related to output, whereas storage was found to be inversely related with output. All the variables were non-stationary at levels and were first-differenced stationary or I(1). The existence of a long-run relationship was validated by using cointegration analysis in a multivariate framework. From the cointegrated model it was also found that there exists increasing returns to scale.

The time series model estimated through the cointegration approach, however, just establishes the long-run relationship between output and various stocks of infrastructure. The cointegration approach also does not talk about the historical behaviour of the

series and has poor predictive power. As first suggested by Sims (1980), vector autoregressive (VAR) model is used in this study in order to overcome the limitations associated with the traditional macroeconometric models.

Section II

Developments in Infrastructure in India – Stylised Facts

Power

Among the infrastructure facilities, electricity generation, transmission and distribution possess certain inherent advantages due to their commercialisation, marketability of the products and services, and availability of the basic organisational structures for such purposes. Till the introduction of the New Economic Policy during the early 1990s, production, provision and management of electricity was reserved for the public sector. Subsequently, it has been opened up for the private sector.

There has been a phenomenal growth in electricity generation and utilisation since independence. Electricity generation, which increased from only 4.1 billion kwh in 1947-48 to 467.4 billion kwh in 2000-01 recorded a growth of 3.7 per cent over 1999-2000. Power generation in April-December, 2001 at 383.2 billion kwh recorded a growth of 2.8 per cent over the corresponding period in 2000. The installed generating capacity which was only 1,362 mw in 1947, increased to 1,01,630 mw as on end-March 2001 and further crossed 1,02,907 mw as on October 31, 2001. The per capita consumption of electricity, which was less than 15 units at the time of independence, increased to about 314 units by 2000.

The State Electricity Boards (SEBs) have continued to incur high transmission and distribution (T&D) losses, which stood at 24.8 per cent in 1997-98 and further increased to 25.6 per cent in 1998-99. The T&D losses are due to a variety of reasons, *viz.*, substantial energy sold at low voltage, sparsely distributed loads

over rural areas, inadequate investment in distribution system, improper billing and high pilferage. Besides, the managerial and financial inefficiencies in the State sector utilities have in turn adversely affected future capacity addition and system improvement programme. On the other hand, the SEBs do not have enough resources to finance future programmes and their ability to raise investible funds from alternate sources is limited due to their poor financial and commercial performance.

The gap between demand and supply in the power sector has remained significant, notwithstanding the fact that several reforms, including private participation, have been undertaken to boost growth of the power sector. The demand-supply gap in power sector widened to 11.5 per cent in 1996-97 from 7.8 per cent in 1991-92, although there was some decline thereafter (Table 1).

Table 1 : Demand Supply Gap in the Power Sector in India

(Million kwh)

Year	Demand	Availability	Shortfall	Shortfall as % of Demand
1991-92	2,88,974	2,66,432	22,542	7.8
1996-97	4,13,490	3,65,900	47,590	11.5
1997-98	4,24,505	3,90,330	34,175	8.1
1998-99	4,64,584	4,20,235	26,349	5.9
1999-00	4,80,430	4,50,594	29,836	6.2
2000-01	5,07,213	4,67,401	39,812	7.8

Source : Annual Reports, Ministry of Power, Government of India, Various Issues.

The power sector has witnessed a series of reforms in the recent period in line with recommendations of the India Infrastructure Report (Chairman: Dr. Rakesh Mohan). The performance of the SEBs has been reviewed. In view of the paucity of resources with Central and State Public Sector Undertakings (PSUs) as well as the SEBs and the need to bridge the gap between the rapidly growing demand for and supply of

electricity, all the States have been encouraging private enterprises in the power sector covering areas of transmission and distribution besides generation.

In terms of institutional improvements and transparency practices, Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commission (SERC) have been established in 18 States so far, which is expected to ensure rationalisation of tariffs, fair competition and protection of the consumer interest. The SEBs have been unbundled/corporatised in 6 States. A comprehensive Electricity Bill, 2001 has been introduced in the Parliament. The Central Government took measures to accelerate the programme of reforms in SEBs anchored in Centre-State partnership on: (i) a time-bound programme for installation of 100 per cent metering, (ii) energy audit at all levels, (iii) commercialisation of distribution and (iv) restructuring of SEBs.

Transport

Railways

The Indian railways is one of the largest railways network in the world under a single management. It consists of an extensive network spread over 63,028 kilometres comprising 44,776 kilometres (71.0 per cent of total) on broad gauge, 14,987 kilometres (23.8 per cent of total) on metre gauge and 3,265 kilometres (5.2 per cent of total) on narrow gauge. The electrified network constitutes about 15,062 kilometres, accounting for 24 per cent of the total route kilometre. The railways employ more than 1.6 million people, which is about 6 per cent of the total employment in the organised sector. While staff productivity in terms of traffic units per worker, asset productivity in terms of net tonne kilometre per wagon day, wagon turn-around time, loco-utilisation, *etc.*, have improved over the years, they remain far from satisfactory.

The recent policy initiatives in railways include, among others, introduction of joint ventures with the State Governments in accelerating the process of building up rail infrastructure. RailTel

Corporation has become functional to harness the optical fibre network alongside the railway track. Commercial utilisation of land and airspace of railways has been initiated by identifying eight sites. More powers have been delegated to the General Managers of Zonal Railways to finalise the contracts as also the freight rate reducing power to quote station-to-station rates to attract the retail traffic on commercial consideration.

Road Transport

India has the third largest road network in the world with a network of 2.7 million kilometres. However, this network is inadequate for speedy and efficient transportation. The National Highways network of 34,298 kilometres at the end of 1995-96 constitutes less than 2 per cent of the total road network, but carries nearly 40 per cent of the total traffic. The share of roads in the movement of goods and passengers has increased significantly during the recent years. In 1950-51, roads carried only 12 per cent of freight and 25.8 per cent of passenger traffic. By 1991-92, it carried 53.4 per cent of freight and 79.2 per cent of passenger traffic. In 1995-96, the share of goods and passenger traffic has marginally increased to 60 per cent and 80 per cent, respectively, of the total traffic.

A number of initiatives have been taken to upgrade the road transport facility. The National Highways Development Project (NHDP) has been launched to achieve a turnaround in the road sector. The NHDP comprises the 6000 km long Golden Quadrilateral (GQ) connecting the four metros of Delhi, Mumbai, Chennai and Kolkata and the 7000 km long North-South and East-West corridors connecting Srinagar-Kanyakumari and Silchar-Porbandar, respectively. The GQ is expected to be completed by 2003 and the corridors by 2007. The Central Road Development Fund was revamped by crediting a cess of Rupees one per petrol and diesel and by enacting the Central Road Fund Act, 2000 in December 2000.

Water-Ways Transport

The Indian water-ways transport consists of shipping, ports and inland water transport. Almost 98 per cent of the India's overseas

trade in terms of volume are moved by sea. India has 11 major ports and 148 operable minor ports. Major ports are governed by the Major Port Trust Act, 1963, which enables them to conduct regulatory as well as commercial functions. The intermediate and minor ports are administratively under the State governments and are governed by the Indian Port Act, 1908, which delineates the regulatory powers of the port authority.

The major ports handled approximately 76 per cent of the total operations during 2000-01. During 2000-01, the total cargo handled at major ports was about 3 per cent more than the traffic handled during 1999-2000. About 83 per cent of the total volume of port traffic handled was in the form of dry and liquid bulk, while the remaining 17 per cent consisted of general cargo and containers. During April-November 2001, cargo handled by major ports registered growth of 2.3 per cent as compared with the corresponding period of 2000-01.

In terms of capacity utilisation, most of the Indian ports are operating at more than 100 per cent utilisation and are still inefficient as compared to the ports of the developed countries. Major ports at Madras, Kandla, Tuticorin, Marmugao, Paradip, Mumbai and Vizag have consistently handled more cargo traffic than their operated capacity. In terms of capacity, major ports have virtually reached the saturation point, however, the potential for future growth is still high. In terms of commodity traffic, as against the total capacity of 292 million tonnes on March 31, 2001, major ports have handled 281 million tonnes cargo during 2000-01 implying that there is a need to augment the port capacity.

The Indian ports, besides their excess capacity utilisation, have indicated improved performance and productivity in the recent years. The average pre-berthing waiting came down from 0.9 days in 1999-2000 to 0.5 days in 2000-01. The Average Ship Berth Output (ASBO) increased from 2,314 tonnes per day in 1984-85 to 6,488 tonnes per day in 2000-01. The Average Ship Turn Around (ASTA) has also fallen from 11.9 days in 1984-85 to 5.1 days in 1999-2000 and further declined to 4.3 days in 2000-01.

However, these indicators suggests the performance of Indian ports are quite low as compared to ports of other countries in the Asian region. The port's productivity also depends to a very large extent on the productivity of the entire logistic chain of other services to which the port is linked. For example, poor road-railway linkages and lack of adequate inland warehousing facilities may affect the port's productivity.

Telecommunication

The Indian telecommunications is one of the oldest systems in the world operating since 1851. Telephone services in the country were originally operated by private companies, which were taken over by the Government of India in 1943. Since then, telecommunications in India has been a public utility.

There has been a phenomenal growth in the telecommunications sector in the last two decades. The annual growth rates of providing new telephone connections have been increasing steadily from 14.5 per cent in 1991-92 to 22.3 per cent in 1995-96 and further to 29.8 per cent during April-December 2000. This impressive growth of connections was the outcome of substantial expansion in switching capacities and adoption of electronic exchanges. In terms of geographical spread, telecommunication infrastructure is more developed in the urban areas as compared to the rural areas.

In terms of institutional set-up, there has been a phenomenal change in the telecommunication sector. The two service providing Departments of the Telecom sector were corporatised, *viz.*, Department of Telecom Services (DTS) and Department of Telecom Operations (DTO). A Public Sector company "Bharat Sanchar Nigam Limited (BSNL)" has now taken up all service providing functions of these two Departments with effect from October 1, 2000.

The demand for telephone connections - aggregate of the lines installed and the waiting list - was 14.26 million as on end-March 1996. This was 19 per cent higher than the previous year. The demand for telephone connections increased at a rate of 11 per

cent during 1985-90. The growth in demand declined to 9.1 per cent in 1993-94. During 1994-95, though the waiting list continued to shrink, the demand moved up by 13.6 per cent. There have been sharp improvements in meeting the demand for telephone connections since 1993-94 with 84 percent attained in 1995-96 as against 82 per cent in 1994-95.

In terms of modernisation, telecommunication services in India have undergone tremendous changes in the recent years. The National Telecom Policy (NTP) was announced in May 1994. The policy affirmed the need to give the highest priority to the development of telecom services in the country and for the first time indicated the Government's intention to allow private sector entry into basic services. The Communication Convergence Bill, 2001 has also been introduced in the Parliament. Value added services like Electronic-Mail, Voice-Mail, 64 kbps Domestic Data Service using VSAT, Videotex, Video-Conferencing, Credit Card Authorisation, *etc.,* facilities have already been opened up for the private sector. There has been dramatic reduction in tariff rate for long distance Subscriber Trunk Dialling (STD) and International Subscriber Dialling (ISD). Fixed telephone lines have more than doubled over the last five years, apart from fast expansion of cellular services.

As a prelude to the vector autoregression (VAR) analysis, attempted in the next section, the co-movement between infrastructure and gross domestic product at factor cost (GDPFC) has been examined by tracking the share of infrastructure in the GDPFC and graphical exposition. It is observed that there has been a gradual increase in the share of real output from the various infrastructure sectors to the GDPFC during the last three decades. The share of total infrastructure comprising electricity, gas and water supply (EGWS); railways (RAIL); other transport (OTRANS); storage facilities (STORE); and communication (COMN), which was about 6 per cent in 1970-71 increased to 8 per cent in 1980-81 and further increased to about 9.8 per cent in 2000-01 as against about 8.5 per cent in 1990-91 (Table 2).

Table 2 : Share of Infrastructure to GDPFC

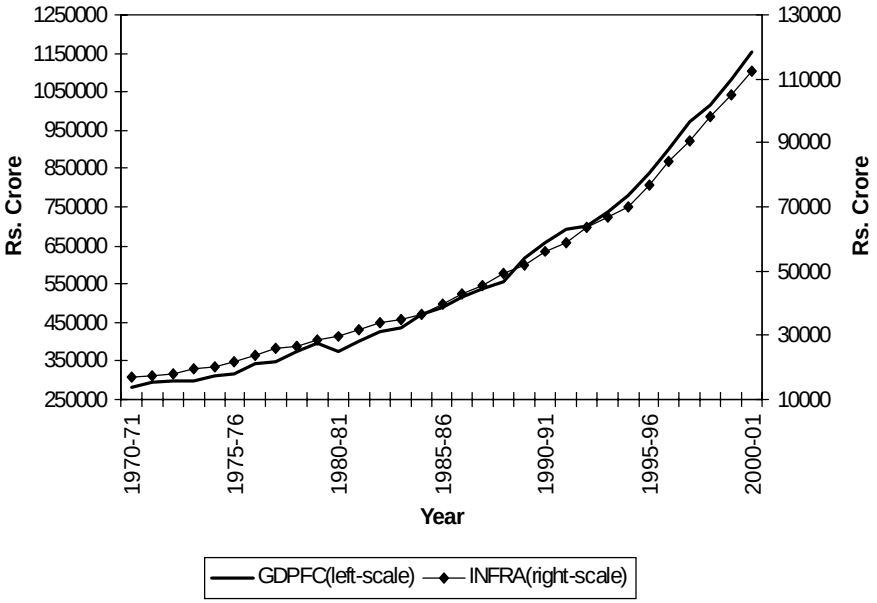
(Per cent)

YEAR	EGWS	RAIL	OTRANS	STORE	COMN	TOTAL
1970-71	1.2	1.5	2.5	0.1	0.7	5.9
1971-72	1.2	1.5	2.5	0.1	0.7	5.9
1972-73	1.3	1.5	2.5	0.1	0.7	6.1
1973-74	1.3	1.6	2.8	0.1	0.8	6.5
1974-75	1.3	1.4	2.9	0.1	0.8	6.4
1975-76	1.3	1.4	3.2	0.1	0.8	6.9
1976-77	1.4	1.5	3.2	0.1	0.8	6.9
1977-78	1.6	1.6	3.3	0.1	0.9	7.4
1978-79	1.5	1.5	3.1	0.1	0.8	7.1
1979-80	1.6	1.4	3.2	0.1	0.8	7.2
1980-81	1.7	1.5	3.6	0.1	1.0	8.0
1981-82	1.7	1.5	3.7	0.1	1.0	7.9
1982-83	1.7	1.5	3.6	0.1	1.0	8.0
1983-84	1.8	1.5	3.6	0.1	1.0	8.0
1984-85	1.8	1.4	3.5	0.1	1.0	7.8
1985-86	1.9	1.4	3.7	0.1	1.0	8.1
1986-87	2.0	1.5	3.7	0.1	1.0	8.3
1987-88	2.1	1.5	3.8	0.1	1.0	8.5
1988-89	2.2	1.5	3.9	0.1	1.0	8.8
1989-90	2.2	1.4	3.8	0.1	1.0	8.5
1990-91	2.3	1.4	3.8	0.1	1.0	8.5
1991-92	2.3	1.4	3.8	0.1	1.0	8.5
1992-93	2.5	1.4	3.9	0.1	1.1	9.0
1993-94	2.6	1.3	3.9	0.1	1.1	9.1
1994-95	2.4	1.2	4.0	0.1	1.2	9.0
1995-96	2.5	1.2	4.1	0.1	1.3	9.2
1996-97	2.5	1.2	4.2	0.1	1.4	9.4
1997-98	2.4	1.2	4.2	0.1	1.5	9.4
1998-99	2.5	1.1	4.3	0.1	1.7	9.6
1999-00	2.5	1.1	4.2	0.1	1.9	9.7
2000-01	2.5	1.1	4.2	0.1	2.0	9.8

Source: National Accounts Statistics, Central Statistical Organisation, New Delhi.

Sector-wise, the shares of the other transport sector (excluding railways) and the communication sector to GDPFC have increased substantially during the past three decades. The share of OTRANS to GDPFC increased from 2.5 per cent in 1970-71 to 3.8 per cent in 1990-91 and further increased to 4.2 per cent in 2000-01. The share of communications sector to GDPFC increased from 0.7 per cent in 1970-71 to 1.0 per cent in 1990-91 and further increased to 2.0 per cent in 2000-01. The share of the EGWS sector to GDPFC increased from 1.2 per cent in 1970-71 to 2.3 per cent in 1990-91 and marginally increased to 2.5 per cent in 2000-01. The share of the railways to GDPFC, however, declined to 1.1 per cent in 2000-01 from 1.5 per cent in 1970-71. The share of the storage facilities to GDPFC, however, remained at 0.1 per cent throughout the last three decades. A possible relationship between real output in the infrastructure sectors and GDPFC is exhibited by plotting the two (Chart 1).

Chart 1 : Infrastructure and GDPFC



Section III

The Empirical Model

Treating the various stocks of infrastructure and labour as inputs and the gross domestic product at factor cost (GDPFC) as output at the aggregate level, yields the following equation for the production function,

$$Y = f\ (K,\ L,\ t) \qquad \ldots(1)$$

where t stands for time trend. Assuming a generalised Cobb-Douglas form of technology yields a more specific relationship between inputs and output:

$$Y = AK^{\alpha}\ L^{\beta} \qquad \ldots(2)$$

Translating this equation into logarithms produces a linear function that can be estimated:

$$\text{In}\ Y = A + \alpha\ \text{In} + \beta\ \text{In}\ L \qquad ...(3)$$

where Y is output, K and L are capital and labour inputs, respectively, while α and β are the corresponding parameters measuring output elasticity of factor inputs. In other words, the coefficients indicate the percentage change in output for one percentage change in factor input. The estimated equation in the paper is:

$$LGDPFC_t = a_0 + LEGWS_t + LTRANS_t + LCOMN_t + LEMP_t + u_t \qquad \ldots(4)$$

Where TRANS is defined as total transport, EMP as employment and L denotes logarithm of the variables. The other variables have been defined earlier.

This study uses annual data for the period 1970-71 to 2000-01. Data on capital stock on infrastructure at new base (1993-94=100) are obtained from the various issues of National Accounts Statistics published by the Central Statistical Organisation (CSO), India. The employment data are obtained from the various issues of Economic Survey published by the Government of India. It may be mentioned that capital stock data taken for all the infrastructural sectors include both private and public capital.

Stationarity and Causality Analysis

The test of unit roots using the conventional Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) test statistics indicate that the series on GDPFC, EGWS, TRANS, COMN and EMP are all non-stationary and I(1), *i.e.*, their first differences are stationary (Table 3). As mentioned earlier, the non-stationarity involved in the data series prompted to use the cointegrating VAR analysis to avoid spurious estimates.

Table 3 : Unit Root Tests

Variable	At Levels		At First Differences	
	DF	ADF	DF	ADF
GDPFC	7.0448	4.8162	-5.3630	-3.7582
EGWS	1.4499	0.9919	-3.9701	-2.8366
TRANS	-1.7380	-1.6960	-5.2713	-3.7026
COMN	15.7172	2.5270	-2.5222	-1.9592
EMP	0.4212	0.4362	-5.2401	-4.55208

Note : The 95% critical value for the ADF statistic is -2.9665 for the regression at levels and -2.9706 at first differences.

Before going for the cointegration and VAR analysis, the direction of causality between GDPFC and various stocks of infrastructure was estimated. While examining the causal relationship between the GDPFC and each of the infrastructure variables, the equations were estimated in a multivariate VAR framework. It may be mentioned that χ^2-test of block causality in a VAR framework is equivalent to Granger (1969) causality tests. The χ^2-test for the dependent variable GDPFC shows that both the lagged terms of GDPFC and EGWS, TRANS, COMN and EMP are statistically different from zero. Similarly, in each case, at least one lagged gross domestic product has a positive and significant impact on the infrastructure variables. Overall, there exists a bi-directional relationship between GDPFC and infrastructure facilities (Table 4).

Table 4 : Test of Granger's Block Causality in a VAR Framework

	Null Hypothesis	Test-Statistic $-\chi^2$	Accept/ Reject Null Hypothesis	Inference
I.	EGWS does not Granger cause GDPFC	31.1968*	Reject	Bi-directional
	GDPFC does not Granger cause EGWS	23.5879*	Reject	causality
II.	TRANS does not Granger cause GDPFC	45.8715*	Reject	Bi-directional
	GDPFC does not Granger cause TRANS	23.5879*	Reject	causality
III.	COMN does not Granger cause GDPFC	45.4112*	Reject	Bi-directional
	GDPFC does not Granger cause COMN	23.5879*	Reject	causality
IV.	EMP does not Granger cause GDPFC	16.3277**	Reject	Bi-directional
	GDPFC does not Granger cause GDPFC	23.5879*	Reject	causality

* Significant at 1 per cent level. ** Significant at 5 per cent level.

Cointegration Analysis

Given the non-stationarity involved in all the data series, equation (4) was estimated in a multivariate cointegrating VAR framework, better known as the vector error correction model (VECM), in order to throw light on the long-run relationship between infrastructure and economic growth:

$$\Delta y_t = \alpha_{0y} + \alpha_{ty} t - \Pi_y z_{t-1} + \Sigma \Gamma_{ty} \Delta z_{t-1} + \in_t \qquad ...(5)$$

where z_t is a vector of jointly determined (endogenous) I(1) variables, t is the time trend and $\in_t$ is the error term.

Table 5 : Cointegration Results of the VAR Model

Null	Alternative	Statistic	95% Critical Value
	Based on Maximal Eigenvalue		
r=0	r=1	95.99	37.85
R<=1	r=2	39.23	31.68
R<=2	r=3	22.89	24.88
R<=3	r=4	11.04	18.08
	Based on Trace of the Stochastic Matrix		
r=0	r>=1	169.17	81.20
R<=1	r>=2	73.17	56.43
R<=2	r>=3	33.94	35.37
R<=3	r>=4	11.04	18.08

As shown in Table 5 there exists at least two cointegrating vectors. The first cointegrating vector is chosen due its significance at 1 per cent level. The identified cointegrating relationship between GDPFC as the dependent variable and the stocks of infrastructure along with employment as the independent variables is as follows:

$$LGDPFC_t = 0.1818 - 0.0723\ (LEGWS_t) + 0.2376\ (LTRANS_t) + 0.7387\ (LCOMN_t) + 0.1949\ (LEMP_t)$$

From this relationship it is observed that EGWS, TRANS, COMN and EMP have the elasticities -0.07, 0.24, 0.74 and 0.19, respectively. The negative elasticity (though very low) in the EGWS sector could be due to heavy transmission and distribution (T&D) losses in the power sector and subsidised gas and water supply. They are mostly in the public sector in India with a very low degree of commercialisation.

VAR Analysis

To measure the time profile of the effect of shocks on the future state of a dynamic system, we have made use of an unrestricted VAR model, first suggested by Sims (1980) where all the variables are assumed to be endogenous unlike in the traditional macroeconomic models. Taking two lag values of each variable on the basis of Schwartz Bayesian Criterion (SBC), the following five equations in an unrestricted VAR framework were estimated:

$$LGDPFC_t = \alpha_1 + \sum_{i=1}^{2} \alpha_{1i} LGDPFC_{t-i} + \sum_{j=1}^{2} \beta_{1j} LTRANS_{t-j} + \sum_{k=1}^{2} \theta_{1k} LEGWS_{t-k} + \sum_{l=1}^{2} \delta_{2l} LCOMN_{t-l} + \sum_{m=1}^{2} \phi_{1m} LEMP_{t-m} + u_{1t} \quad \ldots (6)$$

$$LTRANS_t = \alpha_2 + \sum_{i=1}^{2} \alpha_{2i} LGDPFC_{t-i} + \sum_{j=1}^{2} \beta_{2j} LTRANS_{t-j} + \sum_{k=1}^{2} \theta_{2k} LEGWS_{t-k} + \sum_{l=1}^{2} \delta_{2l} LCOMN_{t-l} + \sum_{m=1}^{2} \phi_{1m} LEMP_{t-m} + u_{2t} \quad \ldots (7)$$

$$LEGWS_t = \alpha_3 + \sum_{i=1}^{2} \alpha_{3i} LGDPFC_{t-i} + \sum_{j=1}^{2} \beta_{3-j} LTRANS_{t-j} + \sum_{k=1}^{2} \theta_{3k} LEGWS_{t-k}$$

$$+ \sum_{l=1}^{2} \delta_{3l} LCOMN_{t-l} + \sum_{m=1}^{2} \phi_{3m} LEMP_{t-m} + u_{3t} \quad \text{... (8)}$$

$$LCOMN_t = \alpha_4 + \sum_{i=1}^{2} \alpha_{4i} LGDPFC_{t-i} + \sum_{j=1}^{2} \beta_{4-j} LTRANS_{t-j} + \sum_{k=1}^{2} \theta_{4k} LEGWS_{t-k}$$

$$+ \sum_{l=1}^{2} \delta_{4l} LCOMN_{t-l} + \sum_{m=1}^{2} \phi_{4m} LEMP_{t-m} + u_{4t} \quad \text{... (9)}$$

$$LEMP_t = \alpha_5 + \sum_{i=1}^{2} \alpha_{5i} LGDPFC_{t-i} + \sum_{j=1}^{2} \beta_{5-j} LTRANS_{t-j} + \sum_{k=1}^{2} \theta_{5k} LEGWS_{t-k}$$

$$+ \sum_{t=1}^{2} \delta_{5l} LCOMN_{t-l} + \sum_{m=1}^{2} \phi_{5m} LEMP_{t-m} + u_{5t} \quad \text{... (10)}$$

The original equation estimated here is a Cobb-Douglas production function without any structural model therein. Since there exists a cointegrating relationship among the infrastructural variables and GDPFC, the VAR model has been estimated at levels. In terms of methodological aspects, an unrestricted VAR model involves model estimation, impulse response function and variance decomposition for each of the system under consideration. The impulse response function computes the response of the system to particular initial shocks. The variance decompositions measure the percentage of forecast error variance in GDPFC that can be attributed to innovations in a particular stock of infrastructure under consideration. The extraction of variance decompositions from a VAR model typically requires orthogonalisation of the errors from the reduced form equations. It should be noted that coefficient estimates and their standard errors are in general not analysed in detail in an unrestricted VAR model for two reasons. First, with a highly parameterised model and a limited data set, the number of degrees of freedom is small and coefficient estimates are uninformative. Second, because of the highly parameterised nature

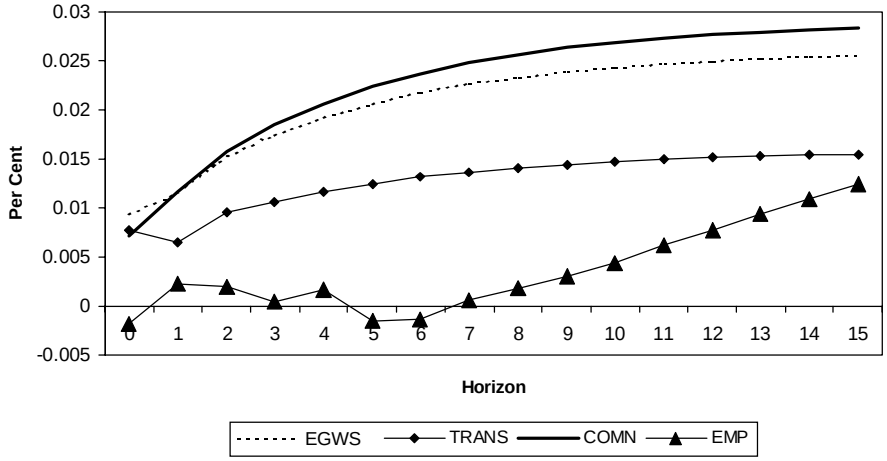
of the model, near-collinearity of the regressors may lead to very imprecise estimates of the short-run relationship. For a more sophisticated data analysis, tests to examine the variance decomposition and impulse response of the system were conducted.

Impulse Responses

In each equation, iterations are made till 15 lag periods by imposing one-standard deviation shock to each variable in a generalised impulse response approach first developed by Koop *et al.* (1996). The main advantage of the generalised impulse response function is to circumvent the problem of the dependence of the orthogonalised impulse responses on the ordering of the variables in the VAR.

In the impulse response exercise, there had been positive effect on GDPFC for one-standard deviation shock in the various stock of infrastructure (Chart 2). In the shorter horizon, *i.e.*, up to three years, the output effect of one per cent shocks in TRANS was found to be declining marginally or less than one. This diminishing effect of shocks in TRANS infrastructure on output in the initial years could be due to the gestation period. Since most of the

Chart 2 : Impulse Responses of GDPFC to Shocks in EGWS, TRANS, COMN & EMP



infrastructure projects are very long-term in nature, positive output may not be expected in the initial years. The shock to the employment variable, however, has a negative effect on the output in the initial years and positive in the long-run, which could be due to the large number of unskilled and abundant labour in India.

From the impulse response analysis, it could be seen that the percentage variation in the real output due to shocks in the communication sector is the highest, which is about double of the transportation sector and nearly close to the electricity, gas and water supply sector.

Variance Decompositions

The variance decomposition shows, for each variable, what proportion of the forecast error variance at different forecast horizons can be attributed to each shock in the model. More than two-thirds of the variance of the one-step forecast error in GDPFC were found to be due to the innovations in the electricity, gas, water supply (EGWS) and communications sectors, where EGWS has the highest share ranging from 0.03 to 0.65 per cent. In the EGWS sector, in the initial steps, a substantial amount in the decomposition pattern was explained by innovations in its own sector and GDPFC, however, in the successive steps the share of COMN increases. In the transport sector, much of the variance is explained by innovations in the GDPFC and in its own sector. Much of the variance in communications sector is explained by GDPFC followed by its own sector. On the whole, electricity, gas, water supply and communication sectors play a dominant role in explaining the variances not only in gross domestic product but also the variances in other sectors.

Section IV

Summary and Conclusions

This study estimates a vector autoregressive model to examine the relationship between gross domestic product and stocks of infrastructure using Indian data for the period 1970-71 to 2000-01.

The estimated model is also used for forecasting by measuring the impulse responses of gross domestic product to one per cent standard deviation shock in the stocks of infrastructure. In the shorter horizon, *i.e.*, up to three years, the output effect of one per cent shocks to infrastructure was found to be less than one. The diminishing effect of shocks in the case of a few stocks of infrastructure to output in the initial years could be due to the gestation period. Since most of the infrastructure projects are very long-term in nature, positive output may not be expected in the initial years. Among all the infrastructural sectors, electricity, gas, water supply and communication sectors were found to play a key role in explaining the movements in the gross domestic product.

Recognising the importance of infrastructure in fostering growth, the major concern for the policy makers is to remove the bottlenecks in supply. The success of delivering proper infrastructure in the country also depends on levying affordable and adequate user charges. For instance, in sectors like roads, telecommunications and ports, where Government has been able to identify and levy proper user charges, the growth in these sectors has been impressive. As the demand for infrastructure services continue to outpace supply, it warrants urgent new capacity build-up in almost all infrastructure sectors along with quality of services. While exploring the possibilities for revival of the economy, what is needed is to deploy the surfeit of liquidity in the financial system in 'supply-leading' strategy and that too for the badly needed railways development and other physical infrastructures in the new environment of administrative and financial reforms (Shetty 2001). In this context, a perceptive observation made by Dr. V.K.R.V. Rao (1981) two decades ago sounds valid, "The link between infrastructure and economic development is not a once for all affair. It is a continuous process; and progress in development has to be preceded, accompanied and followed by progress in infrastructure, if we have to fulfil our declared objectives of a self-accelerating process of economic development."

Notes

1. Development economists Rosenstein Rodan (1965), Ragnar Nurkse (1966) and Albert Hirschman (1965) have used this terminology.

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Special Notes

Insurance: The Indian Experience

Achamma Samuel*

As a part of the financial sector reforms, the insurance sector has been liberalised recently. With this, the stage has been set for major changes in the insurance market in India with regard to innovations in product, pricing and distribution. This will also necessitate effective regulation to meet the new challenges this sector is likely to encounter in the liberalised environment. In this context, the paper attempts to make an overview of the insurance system in India. The paper also attempts to evaluate the insurance penetration achieved in the country as compared to world standards and traces future scope for this sector as a facilitator for economic and financial development of the country.

Introduction

The economic reforms initiated in the country since mid-1991, have been aimed at increasing efficiency by expanding the role of the private sector along with inflow of investment and technology, while allowing a greater role of market forces. Insurance being one of the key components of the financial sector, reforms in the financial sector would encompass insurance sector reforms also. In the liberalised environment, with increased sophistication and innovation, insurance is seen as a key segment of the financial market. Insurance is therefore an area, which holds immense potential, especially for an emerging economy like India. A Committee on Reforms of the Insurance Sector (Chairman: R.N. Malhotra) was appointed by the Government of India in April 1993 to examine the regulation and structure of the insurance industry. Based on the Report submitted by the Committee in January 1994, concrete steps have been taken by the Government in 1999, after much deliberation, towards liberalisation of the insurance sector.

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The paper traces the evolution of the insurance market in India. Section I of the paper deals with the theoretical aspects of insurance. Section II traces the historical perspectives of insurance in India. Sections III and IV deal with the business and investments of life and non-life insurance in India, respectively. In Section V, an assessment of insurance penetration in India is made in comparison with world standards. Section VI discusses the role of insurance in financial savings of the household sector. Section VII covers regulation of insurance in India and Section VIII gives concluding observations.

Section 1

Theoretical Aspects of Insurance

From the definitional angle, the term insurance can be best understood by referring to the two important schools of thought on the subject *viz.*, (i) transfer school and (ii) pooling school. According to the transfer school, "Insurance is a device for the reduction of uncertainty of one party, called the insured, through the transfer of particular risks to another party, called the insurer, who offers a restoration, at least in part, of economic losses suffered by the insured" (Pfeffer Irving, 1956). On the other hand, according to the 'pooling' school, "…… the essence of insurance lies in the elimination of the uncertain risk of loss for the individual through the combination of a large number of similarly exposed individuals" (Manes Alfred, 1935). Thus, in the case of an individual, insurance is a transfer mechanism through which he passes on risk to the insurer. Whereas, for the insurer, insurance is a pooling mechanism by which he reduces risk in the context of his business.

Insurance markets are generally characterised by asymmetric or imperfect information. In such markets, there is uncertainty about the actual behaviour of the insured. The insured possesses better information about himself or his risk type than the insurer. The high-risk insurees have incentives to hide their true state and present themselves as low risk types. The difficult problem faced by the insurance companies is the exact evaluation of risk and to

adjust the premium accordingly at the time of signing of the insurance contract. In other words, the insurer will have to fix up the price and the amount of insurance the customer can buy at that price. Higher premium will attract a pool of more risky insurance applicants and will lead to the problem of 'adverse selection', while the applicants with small risks will drop out. Higher insured values may lead to 'moral hazard' problems, as it will create an incentive for the insuree to take increased risks than he would otherwise take. The problem of moral hazard, though unimportant in the case of life insurance (as no one would try to take his own life in normal circumstances), can be severe in the area of non-life insurance. It is therefore necessary for the insurance companies to strike a correct balance between the premium and the extent of risk covered.

Section II

An Historical Perspective

One of the main features of the pre-nationalised insurance sector was the utilisation of the insurance sector as a backup or extension by the well known industrial houses of India. There are mainly two forms of insurance in India *viz.,* life and non-life. Life insurance provides protection to a household against the risk of premature death of its income-earning member. Non-life insurance can be grouped under three heads *viz.,* fire, marine and miscellaneous insurance. Life Insurance Corporation of India carries on life insurance business and the General Insurance Corporation and its four subsidiaries deal with non-life insurance. After liberalisation of the insurance sector in 1999, private players have entered both life and non-life business in India. The Insurance Regulatory and Development Authority (IRDA) was constituted in April 2000 as an autonomous body to regulate and develop the business of insurance and re-insurance in the country in terms of the Insurance Regulatory and Development Authority Act, 1999.

Life Insurance

The life insurance business was first introduced in India by a British firm in 1818. Initially, higher premiums were charged for insuring Indian lives as against non-Indian lives. The Bombay Mutual Life Assurance Society, an Indian insurer, set up in 1871 was the first to charge same premium for both Indians and non-Indians. The decades of 1920s and 1930s witnessed rapid growth of life insurance in India. In order to regulate the life insurance business, the Indian Life Assurance Companies Act, 1912 was enacted. The enactment of the Insurance Act, 1938 introduced effective State control over the insurance business in the country. After independence, Indian companies came into their own. In 1956, the Life Insurance Corporation of India was formed when the Government of India brought together the insurance business of 245[1] Indian and foreign insurers and provident societies, under one nationalised monopoly corporation called Life Insurance Corporation (LIC). Since nationalisation, LIC developed a vast network of branches and expanded its business. LIC also extends pension cover to the insured apart from life cover. Acting on the recommendations of the Committee on Reforms in the Insurance Sector (1994), private players were allowed into the Life insurance business in 2000. During 2000-01, there were 6 registered private companies engaged in the business of life insurance.

General Insurance

The first general insurance company *viz.*, Triton Insurance Company Ltd. was established in Calcutta in 1850. Its shareholders were mainly British. The first Indian company for General Insurance business was the Indian Mercantile Insurance Company Ltd., set up in 1907 in Mumbai. The general insurance business in India was nationalised with effect from January 1973 by the General Insurance Act, 1972. As a result, 107 insurers (including both Indian and foreign companies) were amalgamated and grouped into four companies *viz.*, the National Insurance Company Ltd., the New India Assurance Company Ltd., the Oriental Insurance Company Ltd. and the United India Insurance Company Ltd.

General Insurance Corporation (GIC) was incorporated as a company in November 1972 and it commenced business on January 1, 1973. GIC has been acting as the Indian reinsurer[2] since then. GIC has also been accepting overseas reinsurance business. For regulation of product pricing of general insurance, a Tariff Advisory Committee (TAC) started functioning since 1968 headed by the Controller of Insurance. After the nationalisation of GIC in 1972, the management of TAC was delegated to GIC. Acting on the recommendations of the Committee on Reforms in the Insurance Sector (1994), private players were allowed into the non-Life insurance business also in 2000. During 2000-01, there were 4 registered private companies engaged in the business of non-life insurance.

Section III

Business and Investments of Life Insurance Companies

Since nationalisation of the life insurance business in India in 1956 and non-life business in 1972, rapid strides have been made in the development of the insurance sector. The Life Insurance Corporation has introduced different types of policies to suit different income groups and age groups over the years. These insurance policies include term, whole life, endowment, annuity, individual, group and pension plans. This has afforded reasonable variety of investment schemes to the investors. The number of offices of LIC increased from 889 in 1981-82 to 2048 in 2000-01 (Table 1). The number of policies grew from 3.7 per cent in 1981-82 to 12.0 percent in 2000-01. This growth, which peaked at 12.8 per cent in 1990-91, could not be maintained in the subsequent years. The growth in the sum assured which was 14.7 in 1981-82, peaked to a high of 27.4 per cent in 1989-90, but eventually declined to 20.3 per cent in 2000-01.

The rural new business of LIC as a percentage of its overall new business has grown well during the 1980s and 1990s. The penetration in the rural areas was more pronounced in the 1990s than in the 1980s (Table 1). The share of rural to total new business in terms of number of policies has increased from 32.8

Table 1 : Life Insurance Business of LIC

Business in Force				New Business			
	All India			All India		Rural	
Year	No. of Offices	No. of Policies (in Lakh)	Sum Assured (Rs. Crore)	No. of Policies (in Lakh)	Sum Assured (Rs. Crore)	No. of Policies (in Lakh)	Sum Assured (Rs. Crore)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1981-82	889	236.0	23,998	21.0	3,479	6.9	927
1982-83	958	243.8	26,264	22.3	3,974	7.3	1,038
1983-84	1,023	252.7	30,266	23.7	4,387	8.3	1,260
1984-85	1,107	264.8	33,785	27.0	5,376	9.5	1,570
1985-86	1,197	279.9	40,404	32.9	7,056	12.2	2,177
1986-87	1,280	298.0	47,906	38.7	9,068	14.8	2,916
1987-88	1,353	323.5	58,798	46.9	12,435	18.3	3,997
1988-89	1,427	360.8	74,129	59.8	17,223	24.1	5,818
1989-90	1,528	403.4	94,408	73.9	23,220	30.5	8,086
1990-91	1,651	455.1	1,18,651	86.5	28,139	36.8	10,295
1991-92	1,774	508.6	1,45,929	92.4	32,064	41.3	12,440
1992-93	1,906	566.1	1,77,268	99.6	35,957	44.4	14,085
1993-94	2,008	608.0	2,07,601	107.3	41,814	48.6	16,680
1994-95	2,021	654.5	2,53,333	108.7	55,229	49.0	21,571
1995-96	2,024	708.8	2,94,336	110.2	51,816	52.6	21,264
1996-97	2,023	776.7	3,43,018	122.7	56,741	60.3	24,279
1997-98	2,046	849.2	3,98,959	133.1	63,618	68.4	27,551
1998-99	2,048	916.4	4,57,435	148.4	75,316	81.2	35,373
1999-00	2,048	1,013.0	5,34,589	169.7	91,214	97.0	44,169
2000-01	2,048	1,130.2	6,43,241	196.6	1,24,772	109.1	59,641

Source: Annual Reports of LIC.

per cent in 1981-82 to 55.5 percent in 2000-01. In terms of sum assured, this share increased from 26.6 per cent in 1981-82 to 47.8 per cent in 2000-01. The Committee on Reforms in the Insurance Sector (Malhotra Committee) had recommended that it should be made mandatory for insurance companies to transact a minimum business in rural areas and they should not be allowed to avoid small policies. With improving rural infrastructure, rising incomes and greater awareness among the rural people regarding the importance of life cover, further growth in rural insurance business can be achieved.

Life Insurance Business of Private Companies

The insurance market was opened to the private sector in August 2000 and the initial batch of new registrations was granted on 23rd October, 2000. During 2000-01, there were 6 registered private life insurance companies *viz.*, (i) Birla Sun-Life Insurance Company Ltd. (BSLIC), (ii) HDFC Standard Life Insurance Company Ltd. (HSLIC), (iii) ICICI Prudential Life Insurance Company Ltd. (IPLIC), (iv) Max New York Life Insurance Company Ltd. (MNYLIC), (v) SBI Life Insurance Company Ltd. (SLIC) and (vi) TATA AIG Life Insurance Company Ltd. (TALIC). Out of these, only 4 companies *viz.*, BSLIC, HSLIC, IPLIC and MNYLIC have started doing business by the end of March 2001. The business of these 4 companies during 2000-01 is given below (Table 2).

Table 2 : Life Insurance Business of Private Companies during 2000-01

(Figures in Lakhs)

	BSLIC	HSLIC	IPLIC	MNYLIC
No. of Policies	0.01	0.01	0.06	0.02
Sum Assured (Rs.)	552.50	3,015.06	10,000.00	1,335.31
Annual Premium (Rs.)	31.90	67.19	597.00	15.98

Source : First Annual Report of Insurance Regulatory and Development Authority, 2000-01.

Investments of LIC

The investments of an insurance company are intended to build up reserves and not to book short-term profits. These reserves provide a cushion for long-term contingencies, which can be directed towards investment in socially desirable sectors like infrastructure.

The provisions of Section 27 A of the Insurance Act, 1938 as amended from time to time have prescribed the investment patterns for life insurance. The Malhotra Committee (1994) had recommended that the mandated investment of funds of LIC should be reduced from the then existing level of 75 per cent to 50 per cent. Consequent to the liberalisation of the insurance sector, and as per the notification of IRDA (Investment) Regulations, 2000 dated August 14, 2000, the life insurance companies have to invest a minimum of 50 per cent of their total assets in government and other approved securities. They are also required to invest a minimum of 15 per cent in infrastructure and social sectors, leaving the balance 35 per cent free for investment in the capital market.

The investment pattern of LIC for the period 1980-81 to 2000-01 shows that major share of its investments were in Central and State Government securities followed by loans to State and Central government and their Corporations and Boards (Table 3). The share of investments in Central and State Government securities increased from 55.0 per cent in 1980-81 to 79.8 per cent in 2000-01. On the other hand, the share of investments in the form of loans to State and Central government and their Corporations and Boards declined from 41.7 per cent in 1980-81 to 18.3 per cent in 2000-01.

Table 3 : Investments of Life Insurance Corporation of India

(Rs. Crore)

Year	Loans to State and Central Government and their Corporations and Boards *etc.*	Stock Exchange Securities (Central Govt. State Govt. Securities and Others)	Special Deposits with Central Government	Other Investments (UTI, LIC, MF *etc.*)	Investment out of India
(1)	(2)	(3)	(4)	(5)	(6)
1980-81	2,726	3,591	106	72	40
1981-82	3,072	4,041	241	78	41
1982-83	3,427	4,603	341	87	41
1983-84	3,755	5,239	471	102	46
1984-85	4,072	5,948	621	114	49
1985-86	4,474	6,823	771	137	60
1986-87	4,885	7,930	921	143	78
1987-88	5,442	9,231	1,071	130	89
1988-89	6,218	10,932	1,259	190	103
1989-90	7,260	12,919	1,409	262	109
1990-91	8,895	15,671	1,483	297	126
1991-92	1,102	19,059	1,528	414	181
1992-93	13,092	23,082	1,628	410	195
1993-94	14,603	29,538	1,698	496	227
1994-95	16,114	37,278	1,839	628	323
1995-96	18,086	47,088	1,970	802	332
1996-97	20,487	58,851	2,140	772	415
1997-98	22,882	72,537	2,380	758	410
1998-99	26,110	90,824	2,192	920	400
1999-00	28,925	1,14,032	2,042	906	458
2000-01	32,155	1,40,106	1,862	891	476

Source: Life Insurance Corporation of India.

Section IV

Business and Investment of Non-Life Insurance in India

The general insurance companies mainly specialise in insurance business like fire, marine, aviation, theft, crop, accident, health (medi-claim) etc. General insurance policies, unlike life insurance

policies are short duration contracts. Also, general insurance policies, in comparison to life insurance policies do not mobilise savings, but they collect funds from the premiums paid. The number of offices of GIC has more than trebled from 1272 in 1980-81 to 4177 in 2000-01 (Table 4). However, after 1992-93, this growth was either negligible or negative. As regards the growth in the number of policies and net claims payable of GIC and its subsidiaries, no steady pattern is observed. However, the volume of business in terms of number of policies and net claims payable has improved substantially over the years.

Table 4 : Business of GIC and its subsidiaries

Year	No. of Offices	No. of Policies	Net Claims Payable (Rs. Crore)
(1)	(2)	(3)	(4)
1980	1,272	N.A.	296
1981	1,346	N.A.	360
1982	1,550	N.A.	435
1983	1,684	N.A.	512
1984	2,229	1,18,51,020	689
1985	2,731	1,35,24,793	795
1986	3,089	1,44,09,538	904
1987	3,489	1,63,63,931	1,008
1988-89*	3,727	2,12,53,053	1,676
1989-90	4,025	1,79,74,945	1,503
1990-91	4,180	2,03,32,070	1,898
1991-92	4,304	2,21,55,284	2,303
1992-93	4,352	2,10,82,757	2,839
1993-94	4,236	2,11,88,038	3,050
1994-95	4,202	2,19,82,359	4,289
1995-96	4,213	2,45,90,980	4,427
1996-97	4,220	2,76,00,225	5,105
1997-98	4,208	2,97,58,577	5,625
1998-99	4,166	2,92,18,297	6,461
1999-00	4,174	3,39,70,855	7,586
2000-01$	4,177	3,72,94,002	8,872

*15 Months. $ Provisional. N.A. : Not available.

Note : Data upto 1987 are as at end December and for the remaining years data are as at end March.

Source : General Insurance Corporation of India.

The rural business of GIC and its subsidiaries form only 5.2 per cent of total domestic general insurance premium in 1998-99 (latest available). The non-life business transacted in the rural areas mainly relates to insurance of livestock. Major portion of this business transacted relates to livestock cover under the Integrated Rural Development Programme (IRDP) with bank credit linkages, where insurance is mandatory. Other rural businesses covered include agricultural pumpsets, Janata Gramin Personal Accident, commercial poultry farms and other businesses including pisciculture and sericulture.

Non-Life Insurance Business of Private Companies

During 2000-01, there were 4 registered private non-life insurance companies *viz.*, (i) IFFCO-Tokio General Insurance Company Ltd., (ITGIC), (ii) Reliance General Insurance Company Ltd. (RGIC), (iii) Royal Sundaram Alliance Insurance Company Ltd. (RSAIC), (iv) TATA AIG General Insurance Company Ltd. (TAGIC). The business of these companies during 2000-01 was very low (Table 5).

Table 5 : Non-Life Insurance Business of Private Companies during 2000-01

(Rs. Crore)

	ITGIC	RGIC	RSAIC	TAGIC
Net Claims Payable	0.00	0.00	0.02	0.00
Net Premium	0.25	0.00	0.19	0.00

Source : First Annual Report of Insurance Regulatory and Development Authority, 2000-01.

Investments of General Insurance Companies

The provisions of Section 27 B of the Insurance Act 1938 as amended from time to time has prescribed the investment patterns for non-life insurance. The Malhotra Committee (1994) had recommended that the mandated investment of funds of the general insurance companies should be reduced from the then existing level of 70 per cent to 35 per cent. In April 1995, the Government relaxed the investment policies of GIC and its subsidiaries and they were allowed to invest upto 55 per cent of the annual accretion of their funds in

market oriented schemes as against 30 per cent earlier. Consequent to the liberalisation of the insurance sector, and as per the notification of IRDA (Investment) Regulations, 2000 dated August 14, 2000, the investments of non-life insurance companies cannot be less than 30 per cent in government and other approved securities. They are also required to invest a minimum of 10 per cent in infrastructure and social sectors and a minimum of 5 per cent in the area of housing and fire fighting. Of the balance 55 per cent, 30 per cent will be governed by prudential norms, while 25 per cent can be invested in unapproved securities including investment in equities.

Table 6 : Investments of GIC and its Subsidiaries

(Rs. Crore)

Year	Central Govt. Securities	State Govt. & Public Sector	Soft Loans for Housing & Fire Fighting	Market Investment	Other Investment
(1)	(2)	(3)	(4)	(5)	(6)
1980	189	83	74	299	243
1981	232	106	117	326	303
1982	327	136	200	388	268
1983	387	166	323	491	280
1984	453	204	423	660	147
1985	522	222	548	741	142
1986	599	247	707	869	144
1987	657	302	813	989	154
1988-89*	729	376	1,002	1,149	257
1989-90	794	450	1,181	1,394	315
1990-91	952	549	1,438	1,617	606
1991-92	1,066	648	1,654	2,111	856
1992-93	1,270	796	1,957	2,761	856
1993-94	1,567	875	2,481	3,128	979
1994-95	1,793	1,022	3,048	3,727	986
1995-96	2,214	582	2,941	5,380	1,716
1996-97	2,647	861	2,954	6,226	2,205
1997-98	3,166	1,166	3,113	6,945	2,886
1998-99	3,649	1,497	3,175	8,224	3,194
1999-00	4,391	2,139	3,198	9,691	3,240
2000-01$	5,125	2,550	3,404	10,637	2,293

* 15 months. $ Provisional.

Note : Data upto 1987 are as at end-December and for the remaining years data are as at end-March.

Source : General Insurance Corporation of India.

The investment pattern of GIC and its subsidiaries for the period 1980-81 to 2000-01 shows that the important avenues for its investments were in market investment followed by Central Government securities (Table 6). Market investments of GIC and its subsidiaries increased from 33.7 per cent in 1980-81 to 44.0 per cent in 2000-01. Whereas the investments in Central Government securities decreased marginally from 21.3 per cent in 1980-81 to 21.0 per cent in 2000-01. The investment pattern of GIC is thus different from that of LIC, whose major investments are in Central and State Government securities.

Section V

Insurance Penetration in India as Compared to Global Standards

Insurance density, measured in terms of premium per capita, was much lower in emerging markets in 2000 as compared with the industrialised countries of the world (Table 7). Similarly, insurance premium as percentage of GDP *i.e.,* insurance penetration, was lower in the emerging markets as compared to the industrialised countries in 2000. However, South Africa and South Korea, which figure among the emerging markets are exceptions and are among the forerunners in insurance penetration. Of the total world insurance business in terms of insurance premiums, nine-tenths were contributed by industrialised countries, whereas, the emerging markets accounted for 10 per cent of total world business in insurance. However, the growth rate of premium in 2000 in the emerging markets was higher as compared with the industrialised countries, indicating the growing importance of the insurance sector in the former. India's insurance penetration was only 2.3 per cent, as against the world average of 7.8 per cent in 2000 (Table 8). The low insurance penetration reflects on the vast potential for the development of insurance market in India.

Table 7 : Continent-wise Market Share of World Insurance Business and Growth in Premium in 2000

Continent	Share of World Market (%)	Real Premium Growth (%)	Premium as % of GDP	Premium per capita (USD)
(1)	(2)	(3)	(4)	(5)
America	**39.0**	**4.9**	**7.6**	**1,165**
North America	37.3	4.8	8.6	2,988
Latin America	1.7	6.6	2.1	80
Europe	**31.9**	**11.9**	**8.2**	**945**
Western Europe	31.2	11.8	8.7	1,607
Central/East Europe	0.7	15.8	2.5	52
Asia	**26.5**	**2.8**	**7.7**	**180**
Japan	20.6	0.6	10.9	3,973
S&E Asia	5.4	11.7	4.2	42
Middle East	0.4	5.3	1.6	36
Africa	**1.0**	**7.5**	**4.1**	**32**
Oceania	**1.6**	**1.7**	**8.9**	**1,316**
World	**100.0**	**6.6**	**7.8**	**405**
Industrialised Countries*	***90.7***	***6.2***	***9.1***	***2,384***
Emerging Markets#	***9.3***	***10.3***	***3.2***	***44***

* North America, Western Europe, Japan and Oceania.

\# Latin America and Caribbean, Central and Eastern Europe, South and East Asia, Middle East and Africa.

Source: Swiss Re, Sigma No. 6/2001.

Opening up of the insurance sector has been a key component of economic reforms put in place in South and East Asian economies in the 1980s and 1990s. The major insurance markets in South and East Asia are generally open indicating the impact of the reform measures. Since liberalisation of the Korean and Taiwanese insurance markets in 1987, these markets grew at a much faster pace than before, suggesting that liberalisation of the insurance sector facilitated growth of insurance in these countries.

Table 8 : International Comparison of Insurance Penetration in 2000 : Premiums as share of Gross Domestic Product (%)

Continent	Select Countries	Total Business	Life	Non-Life
North America	United States	8.8	4.5	4.3
	Canada	6.6	3.3	3.3
Latin America	Panama	5.0	1.6	3.5
	Chile	4.1	2.9	1.2
	Colombia	2.3	0.6	1.6
	Brazil	2.1	0.4	1.8
	Argentina	2.5	0.9	1.6
	Venezuela	1.9	0.1	1.8
	Uruguay	1.9	0.3	1.6
	Mexico	1.7	0.9	0.9
Europe	Switzerland	12.4	7.7	4.7
	United Kingdom	15.8	12.7	3.1
	France	9.4	6.6	2.8
	Germany	6.5	3.0	3.6
	Italy	5.8	2.4	2.5
	Sweden	4.5	2.0	2.5
	Russia	1.6	3.4	2.4
Asia	South Korea	13.1	9.9	3.2
	Japan	10.9	8.7	2.2
	Taiwan	7.4	5.1	2.3
	Singapore	4.2	3.2	1.0
	Malaysia	3.7	2.1	1.6
	India	2.3	1.8	0.6
	Thailand	2.5	1.5	1.0
	Philippines	1.4	0.8	0.6
	China	1.8	1.1	0.7
Africa	South Africa	16.9	14.0	2.8
	Zimbabwe	4.0	2.0	2.1
	Kenya	2.6	0.7	1.9
	Morocco	2.8	0.8	2.0
	Tunisia	1.7	0.1	1.6
Oceania	Australia	9.4	6.0	3.4
	New Zealand	6.0	1.6	4.3

Note : The components may not add up to the total due to rounding off.
Source: Swiss Re, Sigma No. 6/2001.

In India, the share of life insurance premium as a percentage of GDP, *i.e.,* insurance penetration, has increased steadily from 0.6 per cent in 1980-81 to 1.6 per cent in 2000-01 (Table 9). However, this is much lower as compared to that of the industrialised countries. The life fund[3] as percentage of GDP increased from 4.6 per cent in 1980-81 to 8.9 per cent in 2000-01 reflecting an impressive performance of LIC in terms of generating premium and investment income in excess of its expenditures and claims. The life insurance density, *i.e.,* life insurance premiums per capita has steadily increased from Rs. 13.1 in 1980-81 to Rs. 334.8 in 2000-01. However, this is much lower in comparison with world standards. This again reveals the vast scope for life insurance penetration in India. The life fund per capita which was Rs. 97.4 in 1980-81 has increased more than eighteen fold to Rs. 1819.5 in 2000-01 reflecting the attractiveness of life insurance business.

Table 9 : Penetration of Life Insurance Business in India

Year	Premium Income (Rs. Crore)	Per cent to GDP	Life Fund (Rs. Crore)	Per cent to GDP	Premium per capita (in Rs.)	Life Fund Per capita (in Rs.)
(1)	(2)	(2.1)	(3)	(3.1)	(4)	(5)
1980-81	888	0.6	6,614	4.6	13	97
1981-82	1,007	0.6	7,563	4.5	15	109
1982-83	1,109	0.6	8,632	4.6	16	122
1983-84	1,229	0.6	9,800	4.5	17	136
1984-85	1,405	0.6	11,191	4.6	19	151
1985-86	1,609	0.6	12,666	4.6	21	168
1986-87	1,885	0.6	14,502	4.7	24	188
1987-88	2,337	0.7	16,632	4.7	30	211
1988-89	2,938	0.7	19,569	4.6	37	243
1989-90	3,812	0.8	23,472	4.8	46	286
1990-91	4,777	0.8	28,401	5.0	57	339
1991-92	5,946	0.9	34,691	5.3	69	405
1992-93	7,146	1.0	40,998	5.5	82	470
1993-94	8,758	1.0	49,666	5.8	98	557
1994-95	10,385	1.0	59,979	5.9	114	659
1995-96	12,094	1.0	72,780	6.1	130	784
1996-97	14,500	1.1	87,760	6.4	153	928
1997-98	17,066	1.1	1,05,833	7.0	177	1,098
1998-99	20,234	1.2	1,27,389	7.3	206	1,296
1999-00	24,540	1.3	1,53,442	8.0	245	1,533
2000-01	34,118	1.6	1,85,407	8.9	335	1,820

Source: Annual Reports of Life Insurance Corporation of India.

In India, the share of gross and net insurance premiums for non-life insurance as a percentage of GDP, *i.e.*, non-life insurance penetration, have increased from 0.4 per cent and 0.3 per cent, respectively in 1980-81 to 0.5 per cent and 0.5 per cent in 2000-01 (Table 10). However, this compares quite unfavourably with that of the industrialised countries and other emerging markets in general. The non-life gross and net premiums per capita (non-life insurance density) have both steadily increased from Rs. 7.4 in 1980-81 to Rs. 105.7 in 2000-01 and from Rs. 7.1 to Rs. 100.8, respectively during the same period. However, this is much lower in comparison with world standards. This reveals the vast scope for non-life insurance penetration in India.

Table 10 : Penetration of General Insurance Business in India

Year	Gross Premium (Rs. Crore)	as % of GDP	Net Premium (Rs. Crore)	as % of GDP	Gross Premium Per capita (in Rs.)	Net Premium Per capita (in Rs.)
(1)	(2)	(2.1)	(3)	(3.1)	(4)	(5)
1980	503	0.4	481	0.3	7	7
1981	624	0.4	600	0.4	9	9
1982	761	0.4	725	0.4	11	10
1983	895	0.4	881	0.4	12	12
1984	1,035	0.4	1,031	0.4	14	14
1985	1,204	0.4	1,191	0.4	16	16
1986	1,423	0.5	1,366	0.4	18	18
1987	1,652	0.5	1,580	0.5	21	20
1988-89*	2,349	0.6	2,255	0.5	29	28
1989-90	2,279	0.5	2,186	0.5	28	27
1990-91	2,912	0.5	2,743	0.5	35	33
1991-92	3,503	0.5	3,450	0.5	41	40
1992-93	4,070	0.5	3,868	0.5	47	44
1993-94	4,766	0.6	4,427	0.5	53	50
1994-95	5,271	0.5	4,879	0.5	58	54
1995-96	6,377	0.5	5,956	0.5	69	64
1996-97	7,348	0.5	6,733	0.5	78	71
1997-98	8,086	0.5	7,357	0.5	84	76
1998-99	9,158	0.5	8,403	0.5	93	85
1999-00	9,982	0.5	9,364	0.5	100	94
2000-01	10,772	0.5	10,272	0.5	106	101

Note : Data upto 1987 are as at end December and for the remaining years data are as at end March. * 15 months

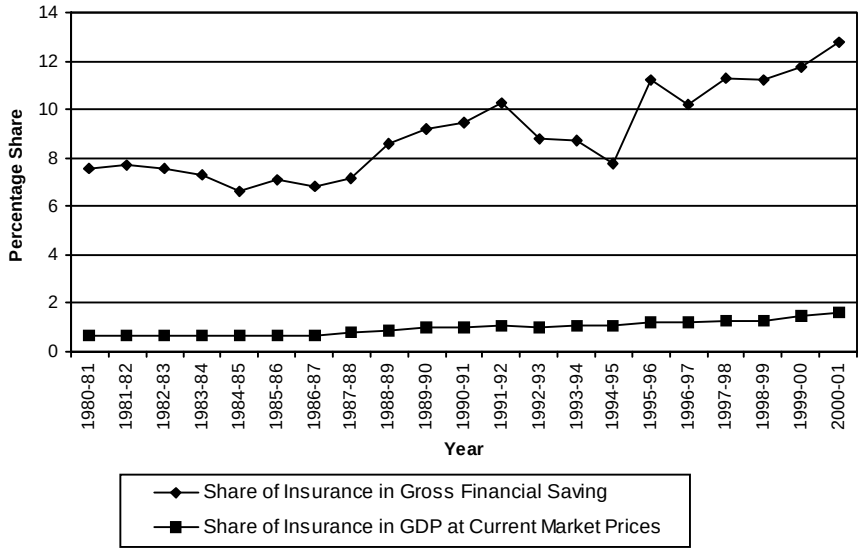
Source: General Insurance Corporation of India.

Section VI

Role of Insurance in Financial Saving and GDP

Insurance is an important financial saving instrument of the households. The saving component of life insurance competes with the savings of the households in other financial instruments such as bank deposits, mutual funds and equities. The total life insurance in India comprises three components *viz.*, life insurance, postal and state insurance. The life insurance business is almost in the hands of the LIC. Its share ranged between 85 per cent and 95 per cent of the total insurance fund during 1980-81 through 2000-01. The share of insurance, which constitutes a significant part of gross financial savings of the household sector, has gone up from 7.6 per cent in 1980-81 to 12.8 per cent in 2000-01 (Chart 1 and Table 11). During the period 1991-92 to 2000-01, this share has remained above 10 per cent, barring the three years from 1992-93 to 1994-95. The average share of insurance in gross financial savings which was 7.6 per cent in the 1980s increased to 10.3 per cent in the 1990s. The share of insurance in GDP has shown a consistently rising trend and more than doubled from 0.7 per cent

Chart 1 : Share of Insurance in Gross Financial Saving of the Household Sector & in GDP



in 1980-81 to 1.6 per cent in 2000-01. The average share of insurance as a percentage of GDP increased from 0.8 per cent in the 1980s to 1.2 per cent in the 1990s.

Table 11 : Financial Assets of the Household Sector : Insurance Funds

(Rs. Crore)

Year	Total Insurance Funds	Life	Postal	State	Gross Financial Saving	Share of Insurance in Gross Financial saving (%)	Share of In-surance in GDP (%)
(1)	(2)	(2.1)	(2.2)	(2.3)	(3)	(4)	(5)
1980-81	915	821	24	70	12,118	7.6	0.7
1981-82	1,048	944	28	76	13,618	7.7	0.7
1982-83	1,235	1,092	33	110	16,270	7.6	0.7
1983-84	1,376	1,221	33	122	18,738	7.3	0.7
1984-85	1,557	1,338	37	182	23,610	6.6	0.7
1985-86	1,802	1,522	49	231	25,541	7.1	0.7
1986-87	2,159	1,855	66	238	31,849	6.8	0.7
1987-88	2,589	2,196	74	319	36,106	7.2	0.8
1988-89	3,423	3,005	88	330	39,958	8.6	0.9
1989-90	4,415	3,984	109	322	48,233	9.2	1.0
1990-91	5,599	5,030	133	436	58,967	9.5	1.0
1991-92	7,003	6,388	165	450	68,136	10.3	1.1
1992-93	7,114	6,440	182	492	80,450	8.8	1.0
1993-94	9,548	8,784	222	542	1,09,597	8.7	1.1
1994-95	11,370	10,439	258	673	1,45,503	7.8	1.1
1995-96	13,894	12,934	324	636	1,24,339	11.2	1.2
1996-97	16,121	15,102	400	619	1,58,518	10.2	1.2
1997-98	19,410	18,194	458	758	1,71,740	11.3	1.3
1998-99	23,428	21,936	536	956	2,09,723	11.2	1.3
1999-00	28,644	26,894	667	1,083	2,43,287	11.8	1.5
2000-01P	34,064	32,218	592	1,254	2,65,134	12.8	1.6

P : Provisional Estimates.

Note : As the data on insurance funds and its break-up as per 1993-94 series are not available, the data used in this table upto 1992-93 are based on 1980-81 series. For the remaining years, data are based on 1993-94 series.

Source : Central Statistical Organisation.

The share of insurance in real GDP *i.e.*, insurance as a percentage of real GDP during the period 1981-82 to 2000-01 was below 1 per cent (Chart 1 and Table 12). The insurance sector has been only a marginal contributor to the country's GDP. This is despite the country's vast population and immense potential for growth of insurance. One of the reasons attributable to this could be the lack of effective competition due to the monopoly position enjoyed by the public sector. Opening up of the insurance sector may augur well for the growth in income from this sector.

Table 12 : Gross Domestic Product from Insurance (at factor cost at 1993-94 prices)

(Rs. Crore)

Year	GDP	Insurance	Insurance Growth	Insurance as % of GDP		
				Life	Non-life	Total
1	2	3	4	5	6	7
1981-82	4,25,073	2,284	11.7	0.2	0.4	0.5
1982-83	4,38,079	2,510	9.9	0.2	0.4	0.6
1983-84	4,71,742	2,820	12.4	0.2	0.4	0.6
1984-85	4,92,077	2,680	-5.0	0.2	0.3	0.5
1985-86	5,13,990	3,074	14.7	0.2	0.4	0.6
1986-87	5,36,257	3,383	10.1	0.2	0.4	0.6
1987-88	5,56,778	3,199	-5.4	0.2	0.3	0.6
1988-89	6,15,098	3,275	2.4	0.2	0.3	0.5
1989-90	6,56,331	5,211	59.1	0.3	0.5	0.8
1990-91	6,92,871	4,034	-22.6	0.3	0.3	0.6
1991-92	7,01,863	5,477	35.8	0.3	0.5	0.8
1992-93	7,37,792	4,738	-13.5	0.3	0.3	0.6
1993-94	7,81,345	5,409	14.2	0.3	0.4	0.7
1994-95	8,38,031	3,736	-30.9	0.3	0.1	0.5
1995-96	8,99,563	4,973	33.1	0.3	0.2	0.6
1996-97	9,70,083	4,920	-1.1	0.3	0.2	0.5
1997-98	10,16,399	7,424	50.9	0.4	0.4	0.7
1998-99	10,82,472	7,979	7.5	0.4	0.4	0.7
1999-00	11,48,500	7,492	-6.1	0.4	0.2	0.7
2000-01	11,93,922	7,771	3.7	0.5	0.2	0.7

Note : The components may not add up to the total due to rounding off.
Source : Central Statistical Organisation.

Section V1I

Insurance Regulation in India

Insurance regulation in India started with the passage of the Life Insurance Companies Act, 1912 and the Provident Fund Act, 1912. The first comprehensive legislation was introduced with the Insurance Act, 1938 which provided strict State control over insurance business in the country under the supervision of the Controller of Insurance. Subsequently, the Insurance Act, 1950 was enacted to check malpractices in the insurance business and also to exercise more control over the operations of the insurance companies. With the nationalisation of the life insurance industry in 1956 and the general insurance industry in 1972, the role of the Controller of Insurance diminished over a period of time. On account of the monopoly status of the public sector units *viz.*, LIC and GIC in the area of insurance, prior to liberalisation of this sector, regulation was perceived to be of less interest due to the inbuilt procedures in place.

The phased globalisation of the Indian economy that started in the early 1990s began to have its impact on the monopolistic structure of the Indian insurance industry. Further, the liberalisation of insurance markets was among the objectives of the Uruguay round negotiations conducted under the auspices of General Agreement on Trade and Tariff (GATT). These negotiations included trade in services and insurance in the context of financial services (UNCTAD Report, January 1993). In 1993, the Government appointed a Committee headed by Shri R.N. Malhotra to examine the reforms required in the insurance sector. The Committee in its report submitted in 1994 recommended *inter alia* the opening up of the insurance sector to players other than State-Owned ones. These recommendations were accepted by the Government and the Insurance Regulatory and Development Authority (IRDA) Act, 1999, consequent amendments to the Insurance Act, 1938, Life Insurance Corporation Act, 1956 and the General Insurance Business Act, 1972 were passed in the year 2000, paving the way for opening up of the insurance sector.

The important functions of the IRDA as per the IRDA Act 1999, include the following:

i) Licensing and regulating the insurance sector by acting as an independent and regulatory body.

ii) Specifying requisite qualifications, code of conduct and practical training for insurance intermediaries and agents.

iii) Protecting the interests of the policyholders in matters concerning assigning of policy, settlement of insurance claim *etc.*

iv) Regulating investment of funds by insurance companies.

v) Calling for information from, undertaking inspection of, conducting enquiries and investigations including audit of the insurers and other organisations connected with the insurance business.

vi) Regulating maintenance of margin of solvency of the insurer.

vii) Adjudication of disputes between insurers and intermediaries or insurance intermediaries.

viii) Supervising the functioning of the Tariff Advisory Committee.

ix) Promoting efficiency in the conduct of insurance business.

Efforts are underway to bring about internationalisation of regulations in the insurance sector on the lines of the banking sector so as to take care of development and health of the insurance sector. This concern had resulted into the establishment of International Association of Insurance Supervisors (IAIS), head quartered at Basle in Switzerland. More than 100 regulators of insurance industries worldwide are members of this Association and India is also one amongst them. The underlying objective of this organisation is to bring about a degree of standardisation in regulatory procedures adopted by different countries. The Advisory

Group on Insurance Regulation (Chairman: Shri R. Ramakrishnan) appointed by the Standing Committee on International Financial Standards and Codes (Chairman: Dr. Y.V. Reddy), stated that Indian insurance regulations are, by and large, in consonance with international standards.

Section VIII

Concluding Observations

The insurance sector in India was hitherto the monopoly of the State. Though the performance of the public sector insurance companies - LIC and GIC was quite satisfactory, the Indian insurance business, both life and non-life, left much to be desired as compared to international standards. There is low penetration and general lack of efficiency. The per capita premiums are very low when compared to the standards of both industrialised countries and other emerging markets. With the entry of private players into the insurance business, it is expected that competition would increase and overall functioning of the insurance sector would improve. The liberalisation process initiated in the insurance sector is expected to bring about better integration of the financial markets and promote financial development of the country.

Insurance, apart from acting as an important financial instrument for risk cover, is also a major instrument for mobilisation of long-term savings. The savings part of insurance, if channelised efficiently into long-term investments, could play a greater role in funding infrastructure projects with long gestation periods. With increasing urbanisation and longer life expectancy, the demand for insurance is expected to increase substantially in the years to come. In the liberalised scenario, the Indian insurance regulator *i.e.,* IRDA will have to play a crucial role towards meeting the special needs and challenges of the Indian insurance market. The regulator, besides ensuring long-term solvency of insurers, should also promote competition among them. The development of the Indian insurance market into a healthy and vibrant one is expected to further aid in the economic and financial development of the country by acting as a mobiliser of savings and as a factor of

production, besides playing the usual role of providing social security.

Notes

1. 154 Indian insurers, 16 non-Indian insurers and 75 provident societies.

2. Reinsurance operates on the same principle as that of insurance. It covers the risks of insurers by spreading the risk with as many insurers as possible.

3. Life fund of an insurance company is the excess of premiums and investment income over claims and expenses on its revenue and capital accounts. This fund is generally used for distribution to policy holders and also for adding to the reserves of the company.

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Delay and Cost Escalation in Central Public Sector Projects

R.K. Jain*

Delay and cost escalation in the implementation of public sector projects have been an area of concern. Such delays not only put additional burden on public finances, but also deprive the country of their beneficial effects in terms of their direct and indirect contribution to output and employment. In view of these far reaching consequences, an analysis of the typical implementation period, time and cost overruns and factors responsible for delay in large public sector projects in various sectors is desirable. It is also desirable to find out ways to improve project planning and implementation of these projects in order to minimise delays and cost escalation. In this context, the present study makes an attempt to analyse some of these aspects and makes some suggestions to reduce time and cost overruns in Central public sector projects.

Introduction

In the Indian context, the Central sector projects form the core of the infrastructure initiatives undertaken by the central government. The delay in implementation of these projects not only affects the project's contribution to the economic growth, but also leads to reduction in the employment potential to be generated on completion. The timely completion of large investment projects, particularly in the infrastructure sector, is also important for improving the production performance of many other sectors. It is, therefore, necessary to minimise the time and cost overruns of these projects. In this context, an analysis of the typical implementation period, time and cost overruns and factors responsible for delay in large public sector projects in various sectors has been undertaken in this study. It is also desirable to find out ways to improve project planning and implementation of these projects.

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The study has been organised in five sections. Section I makes an attempt to estimate cost escalation in public sector projects in different areas. Section II throws some light on typical implementation period in various sectors. Section III dwells on the causes behind the delay in implementation of these projects, while Section IV suggests measures for improvement in project planning and implementation. Section V outlines the concluding observations.

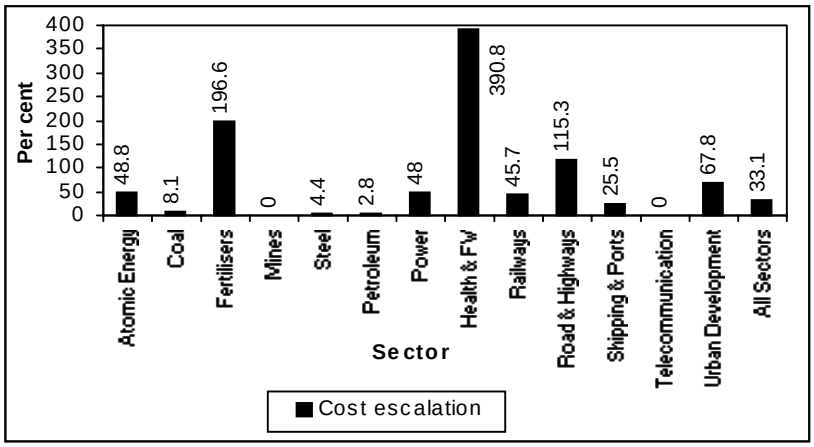
Section I
Magnitude of Cost Escalation in Public Sector Projects

The study is based on 192nd Flash Report on Central Sector Projects (costing Rs. 100 crore and above) for the month of October 2001, released by the Ministry of Statistics and Programme Implementation (MOSPI), Government of India. The Project Monitoring Division (PMD) is a Division in the MOSPI that compiles and publishes this Report, which provides ready information on the implementation of ongoing projects and helps in monitoring their progress. The analysis conforms to the classification and terminology used in this Report. Supplementary information regarding causes for delay and strategy for improvement in project implementation has been obtained from the Ninth Five Year Plan documents.

At end-October 2001, there were 191 projects in the Central sector, each costing Rs. 100 crore and above on the monitoring system of PMD. Of these 191 projects, 36 were mega projects costing Rs.1,000 crore and above and the remaining 155 projects were major projects costing between Rs. 100 crore and Rs. 1,000 crore. Most of the projects were approved during 1990-2001, except 4 projects during 1970s and 16 projects during 1980s.

The original cost of 191 projects was estimated at Rs. 1,20,791 crore. 'Now anticipated cost' of these projects at Rs. 1,60,800 crore has gone up by 33.1 per cent over the original cost estimates. Sector-wise, power projects indicated maximum cost escalation (Rs. 16,725 crore), followed by railway projects (Rs. 10,783 crore). In contrast, there was no cost escalation in case of mines and telecommunications projects. Though health and family

Chart 1 : Sector-wise Cost Escalation in All CPS Projects



welfare projects showed the highest escalation in cost (390.8 per cent), followed by fertilisers projects (196.6 per cent) in percentage terms, their share in total cost escalation was not much significant. Petroleum and steel projects showed nominal cost escalation at 2.8 per cent and 4.4 per cent, respectively (Chart 1 and Table 1).

Table 1 : Sector-wise Cost Escalation in Central Public Sector Projects

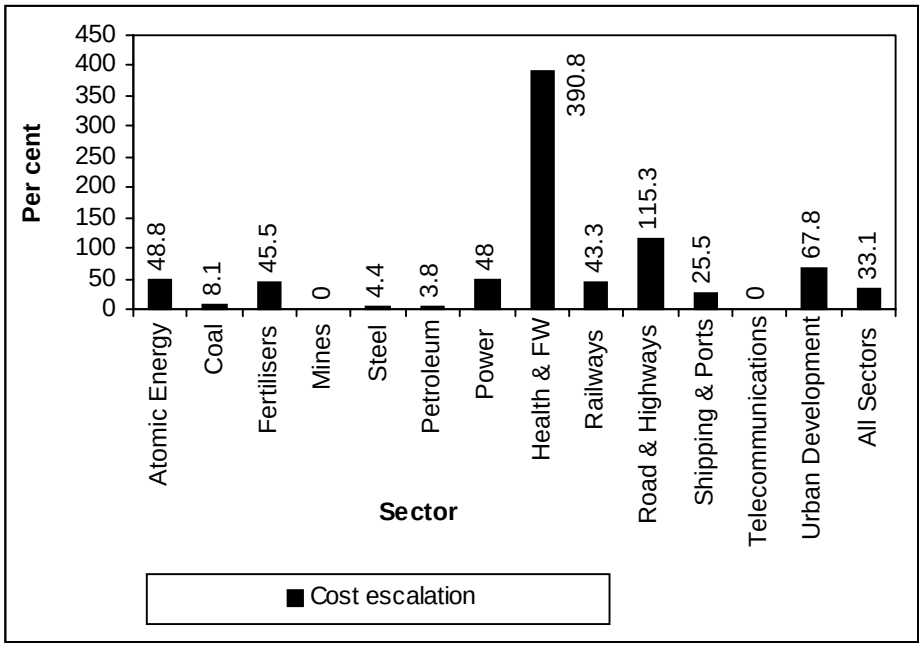
Sector	No. of projects on monitor	Original cost (Rs. crore)	Cost now anticipated (Rs. crore)	Cost escalation (Rs. crore)	Cost escalation (per cent)
Atomic Energy	3	7,785	11,582	3,797	48.8
Coal	12	7,972	8,615	643	8.1
Fertilisers	2	438	1,299	861	196.6
Mines	2	3,727	3,727	0	0.0
Steel	1	431	450	19	4.4
Petroleum	31	32,521	33,436	915	2.8
Power	29	34,819	51,544	16,725	48.0
Health & Family Welfare	2	141	692	551	390.8
Railways	89	23,594	34,377	10,783	45.7
Road Transport & Highways	10	1,483	3,193	1,710	115.3
Shipping & Ports	8	2,789	3,499	710	25.5
Telecommunications	1	231	231	0	0.0
Urban Development	1	4,860	8,155	3,295	67.8
All Sectors	191	1,20,791	1,60,800	40,009	33.1

Of the 191 projects on monitor, 'now anticipated date of commissioning' was available for only 124 projects. 'Now anticipated cost' of these projects at Rs. 1,29,580 crore has gone up by 33.1 per cent over the original cost estimates of Rs. 97,379 crore. Sector-wise, power projects showed highest cost escalation (Rs. 16,725 crore), followed by atomic energy projects (Rs. 3,797 crore). In contrast, there was no cost escalation in case of mines and telecommunications projects. In percentage terms, though health and family welfare projects indicated the highest cost escalation of 390.8 per cent, their share in total cost escalation was not much significant. Petroleum and steel projects showed moderate cost escalation of 3.8 per cent and 4.4 per cent, respectively (Table 2 and Chart 2).

Table 2 : Sector-wise Cost Escalation in Central Public Sector Projects with Now Anticipated Date of Commissioning (DOC)

Sector	No. of projects	Original cost (Rs. crore)	Cost now anticipated (Rs. crore)	Cost escalation (Rs. crore)	Cost escalation (per cent)
Atomic Energy	3	7,785	11,582	3,797	48.8
Coal	12	7,972	8,615	643	8.1
Fertilisers	1	350	509	159	45.5
Mines	2	3,727	3,727	0	0.0
Steel	1	431	450	19	4.4
Petroleum	28	24,301	25,215	914	3.8
Power	29	34,819	51,544	16,725	48.0
Health & Family Welfare	2	141	692	551	390.8
Railways	26	8,490	12,168	3,678	43.3
Road Transport & Highways	10	1,483	3,193	1,710	115.3
Shipping & Ports	8	2,789	3,499	710	25.5
Telecommuni-cations	1	231	231	0	0.0
Urban Development	1	4,860	8,155	3,295	67.8
All Sectors	124	97,379	1,29,580	32,201	33.1

Chart 2 : Sector-wise Cost escalation in Projects with 'Now Anticipated Date of Commissioning'



Out of these 124 projects, 62 projects were 'ahead or on schedule' and the remaining 62 projects were delayed ones. Cost escalation in 62 projects 'ahead or on schedule' has been estimated at Rs. 7,617 crore or 12.2 per cent over the original cost estimates of Rs. 62,428 crore. Sector-wise, there was cost reduction in case of coal projects (9.8 per cent) and shipping and ports (3.5 per cent), while there was no cost escalation in case of mines and telecommunications projects. On the other hand, urban development projects recorded the highest cost escalation of 67.8 per cent, followed by atomic energy projects (48.8 per cent). Urban development (one project) and atomic energy (three projects) together accounted for the major portion of cost escalation in 'ahead or on schedule' projects (Chart 3 and Table 3).

Chart 3 : Sector-wise Cost Escalation in Projects - Ahead or on Schedule

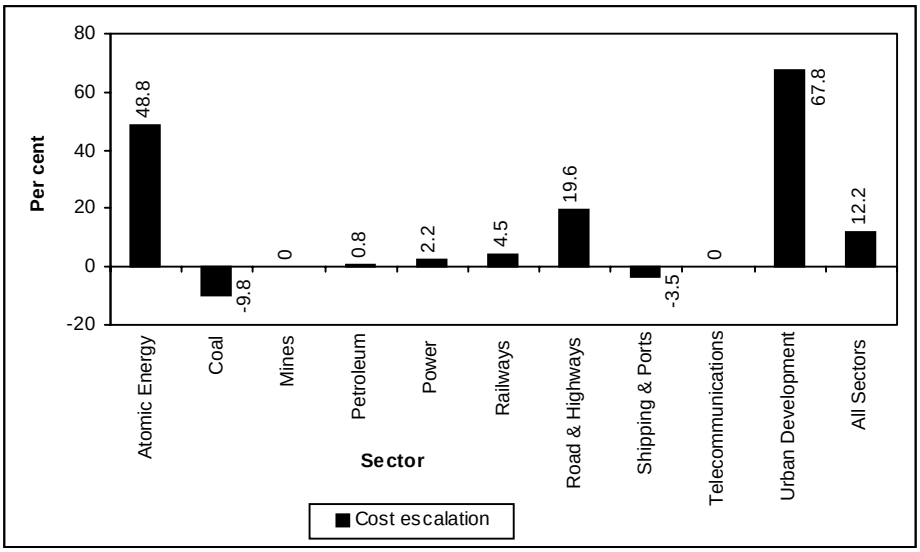


Table 3 : Sector-wise Cost Escalation in Central Public Sector Projects - 'Ahead or on Schedule'

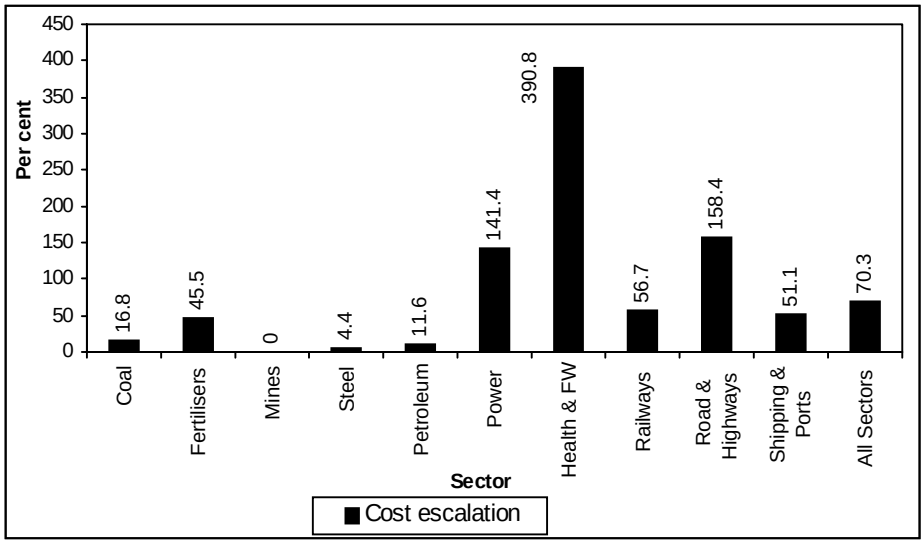
Sector	No. of projects	Original cost (Rs. crore)	Cost now anticipated (Rs. crore)	Cost escalation (Rs. crore)	Cost escalation (per cent)
Atomic Energy	3	7,785	11,582	3,797	48.8
Coal	4	2,615	2,359	(-) 256	(-) 9.8
Mines	1	2,062	2,062	0	0.0
Petroleum	23	17,580	17,712	132	0.8
Power	17	23,350	23,858	508	2.2
Railways	6	2,175	2,272	97	4.5
Road Transport & Highways	2	460	550	90	19.6
Shipping & Ports	4	1,310	1,264	(-) 46	(-) 3.5
Telecommuni-cations	1	231	231	0	0.0
Urban Development	1	4,860	8,155	3,295	67.8
All Sectors	62	62,428	70,045	7,617	12.2

The cost escalation in 62 delayed projects has been estimated at Rs. 24,584 crore or 70.3 per cent over the original cost estimates of Rs. 34,951 crore. The maximum cost escalation was noticed in power projects (Rs. 16,217 crore), followed by railway projects (Rs. 3,581 crore). On the other hand, there was no cost escalation in case of mines projects and moderate cost escalation of 4.4 per cent in case of steel projects. In percentage terms, though the highest cost escalation was in health and family welfare projects (390.8 per cent), their share in total cost escalation was not significant. Road transport and highways projects (158.4 per cent) and power projects (141.4 per cent) were the other sectors showing higher level of cost escalation (Table 4 and Chart 4).

Table 4 : Sector-wise Cost Escalation in Delayed Public Sector Projects

Sector	No. of delayed projects	Original cost (Rs. crore)	Cost now anticipated (Rs. crore)	Cost escalation (Rs. crore)	Cost escalation (per cent)
Coal	8	5,357	6,256	899	16.8
Fertilisers	1	350	509	159	45.5
Mines	1	1,665	1,665	0	0.0
Steel	1	431	450	19	4.4
Petroleum	5	6,721	7,503	782	11.6
Power	12	11,469	27,686	16,217	141.4
Health & Family Welfare	2	141	692	551	390.8
Railways	20	6,315	9,896	3,581	56.7
Road Transport & Highways	8	1,023	2,643	1,620	158.4
Shipping & Ports	4	1,479	2,235	756	51.1
All Sectors	62	34,951	59,535	24,584	70.3

Chart 4 : Sector-wise Cost escalation in Delayed Projects



Latest Position

As per the latest 202nd Flash Report on Central Sector Projects (Costing Rs. 100 crore & above), the number of projects on the monitoring system of the Ministry of Statistics and Programme Implementation (MOSPI) has gone up to 275 projects by the end of August 2002 from 191 projects at the end of October 2001. During the period October 2001 to August 2002, some of the on-going projects have been completed, but many new projects have been started. As a result, there has been net addition of 84 projects on the monitoring system of the MOSPI. Accordingly, the original cost estimates of these projects have gone up from Rs. 1,20,791 crore at October-end 2001 to Rs. 1,60,186 crore at August-end 2002. Similarly, now anticipated cost estimates have also gone up from Rs. 1,60,800 crore at October-end 2001 to Rs. 1,99,539 crore at August-end 2002. Thus in absolute terms, the total cost escalation of these projects is estimated to be marginally lower at Rs. 39,353 crore at August-end 2002 as compared with Rs. 40,009 crore at October-end 2001. However, in percentage terms, the cost escalation of these projects is estimated

to be significantly lower at 24.6 per cent at August-end 2002 than 33.1 per cent at October-end 2001. This is due mainly to the expansion of the base (of original cost estimates from Rs. 1,20,791 crore in October 2001 to Rs. 1,60,186 crore in August 2002) on account of net addition of 84 new projects on the monitoring system of MOSPI during the period October 2001 to August 2002.

Section II

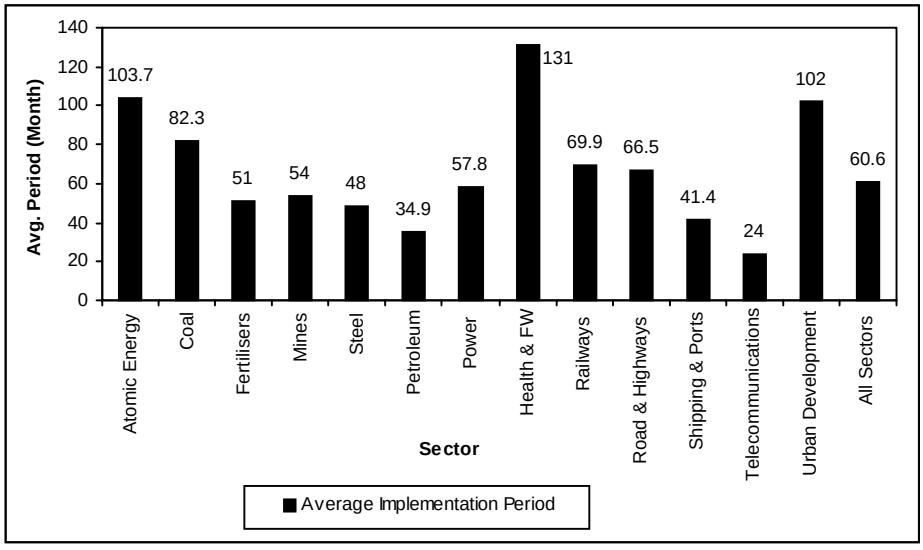
Typical Implementation Period in Various Sectors

At end-October 2001, there were 191 projects in the Central sector each costing Rs. 100 crore and above on the monitoring system of PMD. Of these, the 'original date of commissioning' (DOC) was available for 147 projects. The range of implementation period from the 'date of approval' to the 'original date of commissioning' varied from sector to sector and from project to project in the same sector and as such cannot be generalised. For example, in the atomic energy sector, the range of implementation period of 24-186 months indicates that the shortest project required 24 months for completion, while the longest project required 186 months for completion. Railway projects had the widest implementation range of 11-239 months, followed by atomic energy projects (24-186 months). The average implementation period was longest in case of health and family welfare projects (131 months), followed by atomic energy projects (103.7 months). The average implementation period was the shortest in case of telecommunications projects (24 months), followed by petroleum projects (34.9 months). The range of implementation period and the average implementation period for all these projects was 11-239 months and 60.6 months, respectively (Table 5 and Chart 5).

Table 5 : Sector-wise Typical Implementation Period in Public Sector Projects as per the Original Date of Commissioning (DOC)

Sector	No. of projects with original DOC	Range of implementation period (months)	Average implementation period (months)
Atomic Energy	3	24-186	103.7
Coal	12	36-135	82.3
Fertilisers	2	43-59	51.0
Mines	2	51-57	54.0
Steel	1	48	48.0
Petroleum	29	18-60	34.9
Power	29	24-96	57.8
Health & Family Welfare	2	108-154	131.0
Railways	47	11-239	69.9
Road Transport & Highways	10	49-99	66.5
Shipping & Ports	8	28-60	41.4
Telecommunications	1	24	24.0
Urban Development	1	102	102.0
All Sectors	147	11-239	60.6

Chart 5 : Sector-wise Typical implementation period as per Origional DOC

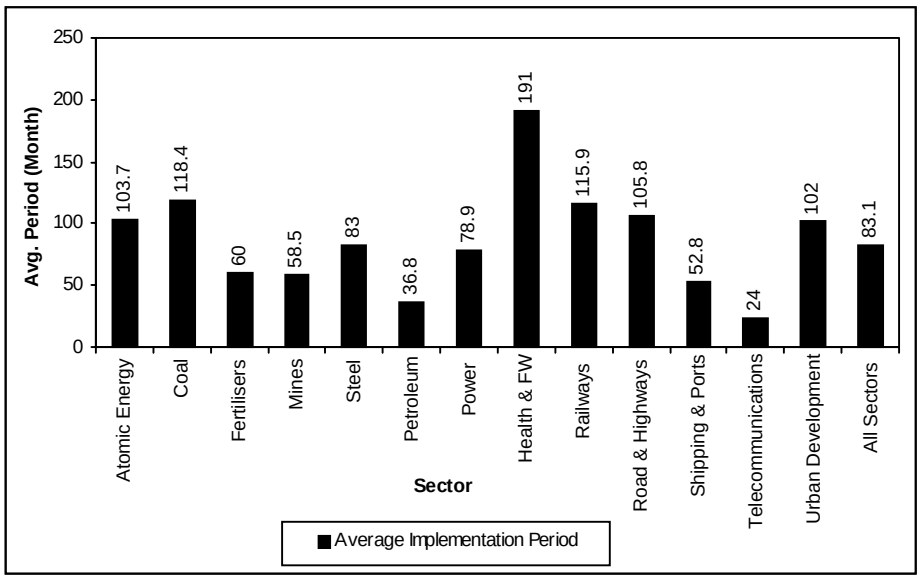


Of the 147 projects, the 'date of commissioning now anticipated' was available for only 124 projects. The range of implementation period and the average implementation period for these 124 projects, from the date of approval to the 'date of commissioning now anticipated', has gone up to 10-264 months and 83.1 months, respectively. Sector-wise, the average implementation period was the longest in case of health and family welfare projects (191 months), followed by coal projects (118.4 months) and railway projects (115.9 months) and the shortest in case of telecommunication projects (24 months), followed by petroleum projects (36.8 months). In case of power projects the average implementation period was 78.9 months (Table 6 and Chart 6).

Table 6 : Sector-wise Typical Implementation Period in Public Sector Projects as per the Date of Commissioning (DOC) Now Anticipated

Sector	No. of projects with 'DOC now anticipated'	Range of implementation period in projects (months)	Average implementation period (months)
Atomic Energy	3	24-186	103.7
Coal	12	61-195	118.4
Fertilisers	1	60	60.0
Mines	2	51-66	58.5
Steel	1	83	83.0
Petroleum	28	10-73	36.8
Power	29	24-253	78.9
Health & Family Welfare	2	156-226	191.0
Railways	26	52-264	115.9
Road Transport & Highways	10	79-203	105.8
Shipping & Ports	8	28-102	52.8
Telecommunications	1	24	24.0
Urban Development	1	102	102.0
All Sectors	124	10-264	83.1

Chart 6 : Sector-wise Average Implementation Period As Per DOC Now Anticipated

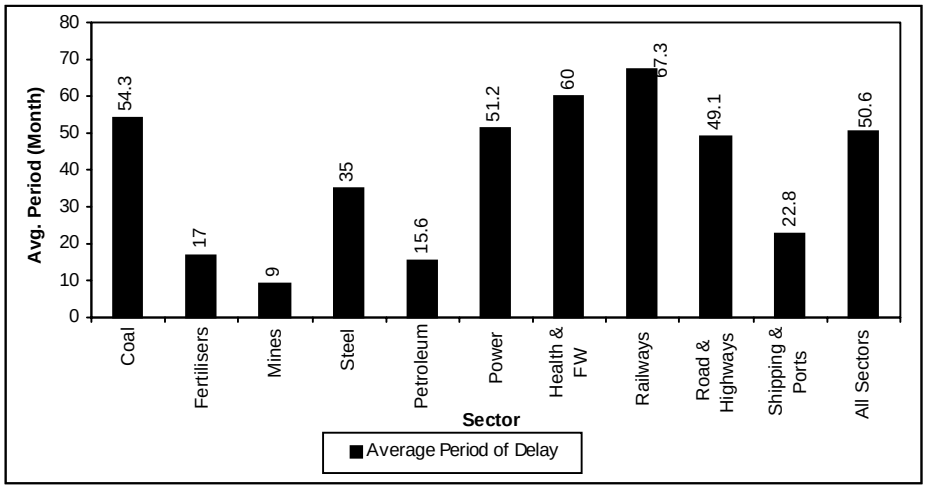


Delay in the implementation of projects on the basis of 'date of commissioning now anticipated' less the 'original date of commissioning' varied from project to project within the same sector as also from sector to sector. The range of delay varied from 9 months in case of mines projects to 0-132 months in case of road transport and highways. The average delay in the implementation of 62 delayed projects was estimated at 50.6 months. The maximum average delay was anticipated in the implementation of railways projects (67.3 months), followed by health and family welfare projects (60 months), while the minimum average delay was anticipated in case of mines projects (9 months), followed by petroleum projects (15.6 months). The average delay in case of power projects and road transport and highways was 51.2 months and 49.1 months, respectively (Table 7 and Chart 7).

Table 7 : Sector-wise Range of Delay (months) in Public Sector Projects as per the Original Date of Commissioning (DOC) and DOC Now Anticipated

Sector	No. of delayed projects	Range of delay in implementation of projects (months)	Average delay in implementation of projects (months)
Coal	8	0-96	54.3
Fertilisers	1	17	17.0
Mines	1	9	9.0
Steel	1	35	35.0
Petroleum	5	(-5)-52	15.6
Power	12	(-1)-77	51.2
Health & Family Welfare	2	48-72	60.0
Railways	20	(-3)-117	67.3
Road Transport & Highways	8	0-132	49.1
Shipping & Ports	4	0-42	22.8
All Sectors	62	(-5)-132	50.6

Chart 7 : Sector-wise Average Period of Delay in Projects

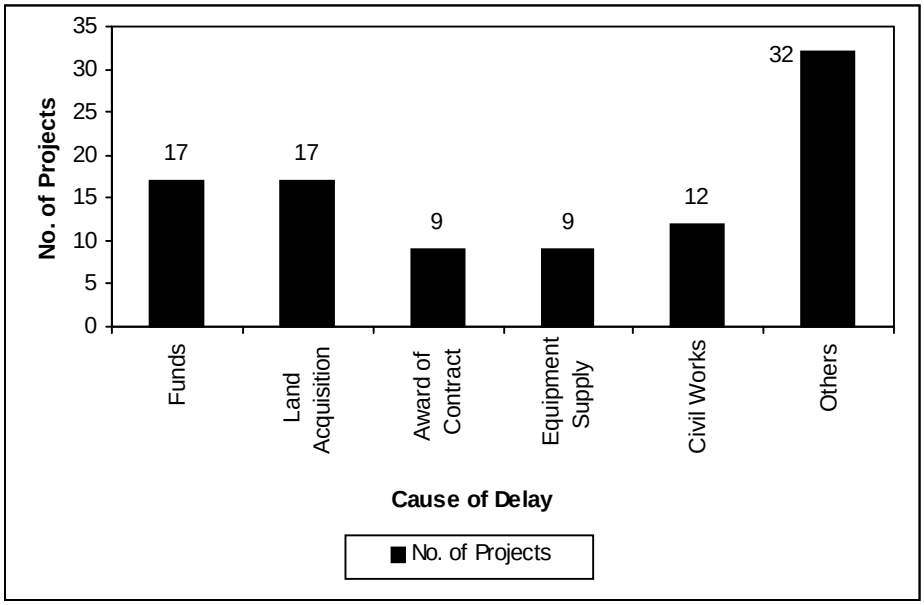


Section III

Causes behind Delay in Implementation

As mentioned earlier, there were 62 delayed Central public sector projects as at end-October 2001 out of 191 projects on the monitoring system of the Project Monitoring Division. Of these 62 delayed projects, information on causes for delay is available for 44 projects. The delay in the completion of these projects was mainly due to delay in release of funds, land acquisition, award of contract, equipment supply and carrying out civil works. Out of these 44 projects, 32 projects were delayed due to multiple reasons *i.e.*, more than one factor causing delay in the same project. Moreover, 17 projects were affected due to problems relating to funds, 17 projects due to land acquisition, 12 projects due to civil works, 9 projects due to equipment supply, 9 projects due to award of contract and 32 projects due to other reasons than these (Chart 8).

Chart 8 : Causes for Delay in Project Completion



Sector-wise, problems relating to funds affected the largest number of projects in railways (12), followed by road transport and highways (3). Land acquisition delayed maximum number of projects again in railways (10), followed by coal (2), power (2) and shipping and ports (2). Problems relating to award of contract were responsible for delay in the completion of 3 projects each in railways, road transport and highways. Equipment supply accounted for delay in completion of 4 projects in coal and 2 projects in railways. Civil works affected the largest number of projects in railways (4), followed by road transport and highways (3). In all, 32 projects were affected by problems other than funds, land acquisition, award of contract, equipment supply and civil works. Out of these, 11 projects belonged to railways, 7 projects to road transport and highways and 5 projects to power (Table 8).

Table 8 : Causes for Delay in the Project Completion*

(No. of projects)

Sector	Release of Funds	Land Acquisi-tion	Award of Contract	Equip-ment Supply	Civil Works	Others	Total
Coal	1	2	1	4	1	3	7
Fertilisers	1	0	0	1	1	1	1
Steel	0	0	0	0	0	1	1
Petroleum	0	0	0	0	0	1	1
Power	0	2	0	0	2	5	6
Health and Family Welfare	0	0	1	0	1	0	1
Railways	12	10	3	2	4	11	17
Road Transpor and Highways	3	1	3	1	3	7	7
Shipping and Ports	0	2	1	1	0	3	3
All Sectors	17	17	9	9	12	32	44

* : The delay in many projects was due to multiple reasons. Hence, item-wise sub-totals will not add up to the total number of projects delayed.

In addition to the factors cited above, Ninth Five Year Plan (1997-2002) documents based on past experience also attributed

delay in the completion of development projects to the following factors:

(i) Poor project formulation due to inadequate field investigation, lack of adequate data, inadequate analysis of environmental and rehabilitation implications, changes in prices and exchange rate regimes.

(ii) Delays in clearance from various regulatory agencies in land acquisition and procurement of materials. Such delays were primarily due to poor co-ordination and project planning, as these problems are not explicitly considered or taken into account at the planning stage.

(iii) Changes in design and scope of projects midway through execution.

(iv) Inability of the project management to take prompt decisions on various aspects of these projects even when the objective circumstances warrant such decisions.

(v) Management problems such as personnel, labour and contractor disputes, mis-match of equipment, *etc.*

(vi) Inadequate and untimely release of funds.

(vii) Unforeseen factors such as adverse geo-mining conditions and natural calamities.

Delay in the implementation of projects at various points such as land acquisition, award of contract, civil works and equipment supply is project-specific and differs from project to project and sector to sector. Project-wise information on duration of delay at each point, *i.e.*, how much delay took place due to a particular reason is available for only 12 projects, where the delay was caused by a single factor. Of these, 3 projects in railways got delayed due to paucity of funds (average delay being 63 months), one project in power due to land acquisition related problems (77 months) and two projects in coal, one due to delay in award of contract (78 months) and another due to delay in equipment supply

Table 9 : Average Delay in Implementation of Projects with Single Factor as Cause of Delay

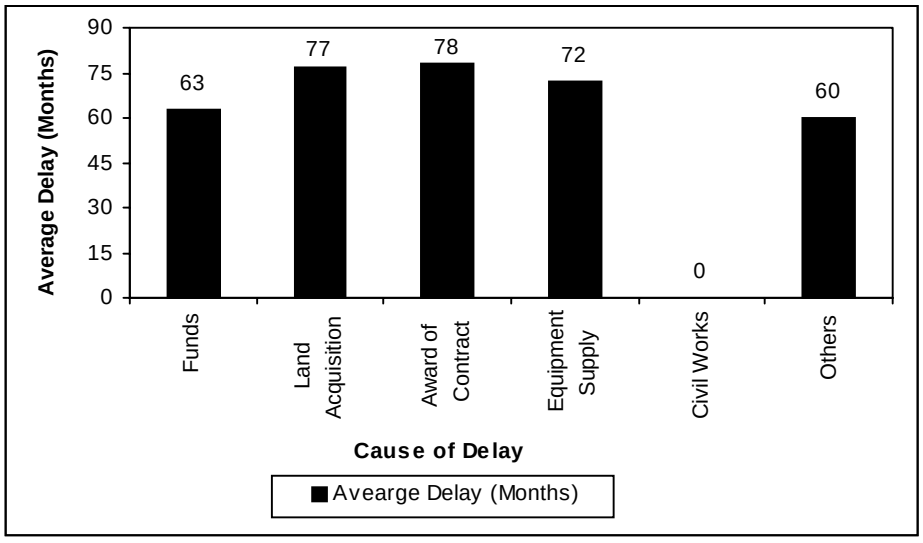
(Months)

Sector	Release of Funds	Land Acquisi-tion	Award of Contract	Equip-ment Supply	Civil Works	Others
Coal	0	0	78 (1)	72 (1)	0	0
Steel	0	0	0	0	0	35 (1)
Petroleum	0	0	0	0	0	52 (1)
Power	0	77 (1)	0	0	0	79 (3)
Railways	63 (3)	0	0	0	0	0
Road Transport and Highways	0	0	0	0	0	36 (1)
Average Delay	63 (3)	77 (1)	78 (1)	72 (1)	0	60 (6)

Note: Figure in brackets indicates number of projects.

(72 months). Of the remaining 6 projects, 3 projects in railways (average delay being 79 months), one each in steel (35 months), petroleum (52 months), and road transport and highways (36 months) were delayed due to other reasons (not specified) (Table 9 and Chart 9).

Chart 9 : Average Delay in Implementation of Projects (with single factor as cause of delay)



Project-wise information on duration of delay at each point is not available for those projects in which there were multiple reasons for delay. However, review of some projects with substantial time and cost overruns to identify activity-wise delays, type of cost overruns and the reasons thereof have been discussed in the Ninth Five Year Plan documents. In a coal washery project with a time overrun of 10 years, the activity-wise time overruns and the reasons thereof were: 4 years and 6 months in land acquisition owing to litigation and law and order problem; 1 year and 6 months in land filling work (not envisaged at the planning stage) due to poor planning; and 4 years due to non-fulfillment of contractual obligations. About 94 per cent of the cost overrun of the project was accounted for by these delays.

Section IV
Suggestions for Improvement in Project Implementation

Suggestions for improvement in time and cost overruns in public sector projects, discussed in various fora are as following :

(i) There is a need for better prioritisation of Plan projects. On-going projects, in preference to new projects, should have the first charge on the Department's budgetary allocations so as to optimise on early completion of incomplete projects. The Ministry of Finance and the Planning Commission have already initiated suitable actions in this regard. Some of the measures being proposed include shelving of projects which have not made substantial progress in terms of physical and financial targets and according priority to projects which are at an advanced stage of completion.

(ii) Improving the quality of projects 'at entry' point is essential for reducing time and cost overrun of projects. This calls for scientific approach to project planning. A number of steps are required for improving project planning. First, the organisations responsible for project design must be made sensitive to the factors that generally contribute to time and cost overruns through dissemination of the findings of ex-post evaluation of projects so

that adequate attention is paid at the planning stage itself to prevent their recurrence. Second, there is a need for capacity building of these organisations through training and interactions with technical institutes. Third, inter-agency co-ordination must begin with the project preparation itself, so as to minimise the procedural delays later.

(iii) The detailed procedures for submission, examination and approval of projects need to be reviewed and clearly defined limits should be set in terms of project cost and processing time for approval by various agencies. Though the Government has taken a decision in this regard, it is necessary to review the capacity of the agencies in terms of both staff and technical competence so as to ensure that clearance is given only after detailed scrutiny of the proposals.

(iv) There is a need for an appropriate manpower management policy for effective project implementation. Short tenure of key project staff, inadequate provision of technical and administrative personnel for projects and lack of training of project staff affect project implementation. Selection of key project staff must precede project implementation and their continuity should be ensured during implementation. Training of project staff at all stages of the project cycle is also needed.

(v) Adoption of a simplified procedure for acquisition of land is required to avoid time and cost overrun of projects. If the resettlement cost assessment is realistic, much of the delays associated with land acquisition can be eliminated. Appropriate guidelines for cost-benefit analysis of the project must be formulated for realistic assessment of the financial and economic rates of return and the issues relating to subsidy and pricing of project output/service must be brought upfront. The Planning Commission should review the existing guidelines and effect necessary changes, if required.

(vi) Project authorities should be more autonomous and less dependent on Ministries for procedural approval of various types.

This would require some binding arrangements with the financial institutions for loan-financing of projects. This switch-over will eventually give rise to a new dimension for repayment. This, in turn, will include the policy makers to focus attention on policy reforms and cost recovery, and consequently, make the project entities more cost-conscious. It may also help in moving towards privatisation of some project entities.

(vii) The issues of cost recovery, loan repayment and cost consciousness are also relevant in the context of sustainability of project output, which has been affected due to lack of maintenance of capital equipment and infrastructure. The issue of sustainability should be addressed clearly at the planning stage itself and within a broad policy framework and authority needs to be delegated to the agencies responsible for project operation and maintenance for setting economic prices and fees. The agencies responsible for project appraisal must ensure that the issue of sustainability of output has been adequately addressed in the project proposals.

(viii) The trends in macro-economic variables and the policy evolution, including socio-political changes have to be considered in preparing projects, estimating costs and working out financial and economic returns. Changes in interest rates, exchange rates, fiscal deficit and inflation rate influence the project outcome in different ways. Explicit consideration of these aspects is required in working out the project viability.

(ix) Monitoring and evaluation are important components of investment management. Ministry of Statistics and Programme Implementation provides the information on delays. However, currently, adequate follow-up action is usually not taken on monitored information, partly because of the inability of the project management to take prompt action and partly due to non-adherence to the accountability criteria. With the delegation of authority to the project management to resolve all implementation related problems within the authority of the Ministry/Department and strict adherence to accountability, the monitoring system is likely to be effective. All large projects must be post-evaluated and the cost of

such studies should form a part of the project cost. The findings of such studies need to be discussed in seminars and given publicity to generate awareness among project managers, planners and policy makers about the problems in design and implementation and to draw lessons thereof.

(x) Deficiency in contract management has been a major cause for time and cost overrun. Lack of transparency in contract document, lack of professionalism in the project management and inadequate delegation of authority cause most of the disputes and delays. The weaknesses in the legal system also stand in the way of speedy disposal of disputes. Apart from building the capacity and skill of the project management, there is a need for suitable amendments to laws so as to ensure speedy disposal of cases.

It may be mentioned that in recent years there has been progress in reducing delays. As an apex institution for monitoring, the Ministry of Statistics and Programme Implementation (MOSPI) has initiated several measures to improve the system and procedure relating to project formulation, implementation and monitoring. The Project Monitoring Division (PMD) of the MOSPI has strengthened the institution of Memorandum of Understanding (MoU) system, 3-tier regular monitoring, adoption of network-based monitoring, extensive training of project managers, prioritisation of projects matching with available resources and several project-based interventions. A host of other measures such as Land Acquisition Act, development of Standard Rehabilitation Package, On-line Computerised Monitoring System and formation of Standing Committee in various Ministries for fixation of responsibilities for time and cost overruns are under progress. This should lead to a decline in time and cost overruns in projects.

Section V

Concluding Observations

Time and cost overruns in Central public sector projects have been quite substantial. Delay in the implementation of projects at

various points such as land acquisition, award of contract, civil works, equipment supply, *etc.*, is project-specific and sector-specific and varies from project to project and sector to sector as discussed above. The findings of diagnostic evaluation studies/ reviews undertaken by the Planning Commission also lend support to the observations about the factors causing time and cost overruns. However, what is important to note is that factors like land acquisition/ rehabilitation, obtaining clearances, non-fulfillment of contractual obligations by both public sector units and private contractors, inadequate and untimely release of funds and inadequacies in tender documents contribute more often to the greater part of the time and cost overruns of public sector projects. These problems arise due to inadequacies in approval procedures and implementation.

Project planning has, therefore, to be more scientific and approval procedures more realistic to ensure that avoidable time and cost overruns are much less frequent. The approval procedure should be linked with early completion of incomplete projects and sustainability of project output. Because of unrealistic approval procedure, many of the projects are delayed. At the other extreme, less stringent approval procedures encourage a tendency to get too many projects cleared without the requisite financial resources in sight. There is, thus, a need for striking a balance between these extremes. It is important to ensure that rigour in appraisal and planning does not itself become a cause of delay because of repetitive and multi-level examination of technical and economic data. Strict time-tables need to be laid down for completion of the approval processes and preliminary work. Similarly, strict financial procedures should be formulated for eliminating projects, which do not have financial backing. Time-bound clearances at different stages and effective inter-agency co-ordination would cut down time and cost overruns considerably. There is also need for keeping track of the progress in implementation and taking necessary corrective actions, as the progress may be affected by unforeseen factors. Thus, monitoring and evaluation system must be strengthened and the implementing agencies must be made accountable for non-adherence to the plan of work. The Ministry

of Statistics and Programme Implementation is reported to have already started implementation of some of these suggestions, and this process if carried forward, should help in minimising delays and cost escalation in the implementation of Central public sector projects.

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Book Reviews

Industrialisation and Globalisation: Theory and Evidence from Developing Countries *John Weiss, Routledge,* London and New York, 2002, pages 222.

Industrialisation has often been identified as the cornerstone in the tradition of 'modern economic growth' *a la* Kuznets and Clark. However, the development experience of a large number of developing countries including India runs counter to this conventional wisdom. The preponderance of services ahead of industry remains a major contrast to the development experience of the developed world, giving rise to the phenomenon of *industry-less growth*. When the obituary on industry is slowly gaining currency, while services sector is increasingly becoming important even among the academia and the policy makers, the present pursuit by John Weiss comes as a refresher and re-invents the role of industrialisation. The central message of Weiss is indeed powerful: the future of the developing world lies in industrialisation in this age of integration and globalisation. The issue is all the more appealing when the Indian industry is currently reeling under the WTO bogey and is desperately seeking a way out of the on-going slowdown.

In a pithily presented opening survey, John Weiss takes stock of the industrialisation process in the developing world since 1960 and comes up with the central inquiry why the manufacturing performance has varied widely across the spectrum of countries. What follows in the rest is an attempt to link the different aspects of policy towards manufacturing and performance. In an intellectually challenging discourse, Weiss goes on to juxtapose the cross-country experiences to the predominant theories of industrial growth and asks, "Are there different paths to industrialisation?" Finally, he classifies different countries on the basis of policies pursued. The discussion runs in terms of dichotomies in policies such as 'open' versus 'closed' trade policies; 'dependent' versus

'independent' policies particularly in relation to foreign countries; and 'capitalist' versus 'socialist' policies on industrial ownership. Interestingly, India is indicated as one of the fully closed economies during 1960-92 in terms of Sachs-Warner openness index. However, post-1985, India is placed as one of the tariff-reforming economies with the average import tariff down to 38.3 per cent in the late 1990s from 99.4 per cent in the mid-1980s. What transpires is that relatively closed, often highly distorted economies have not, in general, done well in growth terms. FDI has emerged as an important engine for growth particularly for those countries where the mix of policy and the education base is supportive. The most important observation has been only the limited scope for choosing different paths to industrialisation. At present, it is squarely unrealistic to practice autarky and achieve industrialisation, given the need for both foreign finance and technology. While public ownership in a socialist path to industrialisation cannot be ruled out, the State in developing countries lacks the capacity to provide the material base necessary for a socialist transformation of the societies. At the end, the developing countries seem to be left with no choice but to join the process of integration and globalisation for sustained economic growth. It is in this context, the opening up of the Indian economy in the 1990s seems to be in the right direction.

Next, Weiss moves on to elaborate the dominant neoclassical orthodoxy in terms of the role of market forces and pricing mechanism in the process of industrialisation. Specifically, State intervention stifles the functioning of markets and contributes to an inefficient form of industrialisation. Besides, the trade policy of import substitution has stunted the growth of exports, ignored specialisation on the basis of comparative advantage and resulted in misallocation of resources. The neoclassical paradigm, however, does not rule out the case that import substitution may bring in efficiency provided it arises from market-based decisions. The neoclassical paradigm, which became popular during 1970s and 1980s, has come to be linked with the broader stabilisation and adjustment programmes undertaken in many developing countries including India. In the wake of such liberalisation measures, the

impact of trade liberalisation on the manufacturing performance has been examined in terms of employment, exports and total factor productivity. While the overall effect on employment differs across countries, surprisingly there is little evidence of more adverse effect on employment in smaller firms. Such counter-intuitive finding also contradicts the Indian experience in the 1990s when the small firms' share in total employment has indicated a decline. Weiss, however, does not proceed beyond this stylised fact. On the front of export, while higher export and higher productivity were found to move in tandem with trade liberalisation, the evidence is not sufficient on the direction of causality. While a positive relation is obtained between trade liberalisation and total factor productivity (TFP), Weiss is clueless on extracting the right factor out of the omnibus TFP. On the whole, the impact of trade policy reform does not sound as dramatic as the neoclassical reasoning might suggest.

In continuing his search for a plausible approach to industrialisation, Weiss turns to examine the applicability of the structuralist approach in terms of the role of the state and of the manufacturing sector coupled with the possibilities offered by participation in world trade and investment. In contrast to the neoclassical orthodoxy, the structuralist approach believes that due to low price elasticity of demand and supply, the price mechanism cannot be relied upon for allocating resources in developing countries. Instead, the State is assigned the task of resource allocation as also effecting a shift from primary exports to new industries. State should also protect them until they are mature enough to compete in the international market. Weiss has pieced together ample empirical evidences, most recently from the NIEs (*i.e.*, Newly Industrialised Economies) to show that the State does have a positive role to play in industrialisation or development. The East Asian crisis of 1997-98 has, however, demonstrated that the State may overstretch itself. A pragmatic Weiss believes that it will be ideal to have a policy mix that uses the market, wherever appropriate, but is not wholly subservient to it. As regards the special place of manufacturing in development, it is felt that whether the country produces potato chips or computer chips they

matter for long-term growth prospects. The cumulative gains from manufacturing are argued to be higher in an open competitive trading environment through exports. The best policy is to explore the possibilities to encourage new activities and diversify exports instead of delinking from world trade and investment. Finally, the developing economies have much to gain from participation in the world economy. However, Weiss rightly refrains from prescribing any specific form of intervention to encourage new activities and a diversified export.

In order to identify the essential constituents of the pragmatic approach to industrialisation, Weiss cross-checks the role of small-scale industry in the developing world. Small-scale industry is shown to be appropriate in terms of low capital-labour ratios, and low shares of imports in total cost. Besides, it targets the low income segment with simple products and acts as a household survival strategy. However, Weiss warns, the recent, rapid employment growth in small-scale industry of the developing world is not due to its economic dynamism but an outcome of job retrenchment in the public sector at large. Weiss also attempts to test the relationship between size and economic efficiency and finds that wherever technological indivisibility is important, small-scale industry is at a disadvantage. On the other hand, small-scale industry may have competitive advantage in terms of better knowledge of particular local and niche markets. In the opinion of Weiss, only few small firms graduate to the ranks of the medium scale. Such a phenomenon is not surprising in the Indian context of small-scale industry reservation. However, the limited graduation, Weiss reads, is due to the market distortions against the small-scale industry. It is in this context, adequate provision of credit, foreign exchange for import of inputs, and flexible specialisation to respond to the changing market conditions on the part of small-scale industry, deserves a serious attention. In the Indian context too, credit flow to the small-scale sector has dried up with the financial liberalisation in the 1990s.

Technology and technical change having the central role in industrialisation. Weiss gathers evidence on the same in respect of

the NIEs and developing economies. Research and Development (R&D) expenditure and technology exports are used to gauge a country's technological development. R&D activities in the developing countries are very limited as compared to the NIEs and most of such R&D expenditure is made on applied, production-oriented type of activities. Interestingly, R&D expenditure in India is quoted to be 1 per cent of GDP in 1992, which is considered high by international standards. While role of the State in ensuring the availability of infrastructure and minimum critical mass of technological capabilities is acknowledged, Weiss feels that high R&D expenditure in an environment of economic inefficiency and distortions may not work towards technological dynamism as illustrated by the experience of ex-Soviet bloc economies. Most technology exports originating from the developing countries like India, Brazil and Argentina are of adaptation of known technologies to the local market and are, therefore, suitable for factor conditions and markets in other low income economies. The process of globalisation and increasing transnational activity are expected to facilitate adaptation of imported technologies by the latecomers. However, State intervention of some form is essential and welcome in both the orthodoxies - neoclassical or structuralist as it is widely believed that markets will under-provide the supply of technology.

On the whole, the book is a substantial contribution to the literature on industrialisation in the developing world. Setting aside the extremes of industrial policy (*laissez faire* and central plan), Weiss has thrown his weight for the time-tested golden mean: 'market friendly' and/or 'interventionist' industrial policy for the developing world. The 'market friendly' policy is directed at offsetting the externalities through taxes and subsidies while the 'interventionist' policy mainly operates through the directed and subsidised lending, differential import tariffs and licensing. The 'interventionist' policy appears to have worked in the East Asian countries during the initial phase of industrialisation. The long-term success, however, requires a more flexible and market friendly approach as has been the case in Japan, Korea and Taiwan. A reliable test to judge the industrial policy performance is to examine comparative efficiency of the domestic firms in relation to

import competition. The comparative advantage if based on low wage rate may evaporate with success. In contrast, the comparative advantage based on brand name and technological capability is long lasting but requires sustained investment. Moreover, competitiveness has to be a dynamic process not only in terms of mastering production but also other points in the value chain like support facilities and marketing channels. As it is difficult to achieve success at all stages of the value chain, late movers will have to rely substantially on sub-contracting links with the MNCs.

Weiss's advocacy of a flexible specialisation within the small-scale industry, however, does not sound practical. Besides, the role of small-scale industry in fuelling the domestic demand for large manufacturers seems to be overstated. However, Weiss's central message stands: if the developing countries can improve their competitiveness even with the help of short-run State intervention in industrialisation, they have a better future to look forward. Such a possibility does not seem to be far off when the Doha Development Agenda under the aegis of the WTO is focused upon improving the market access for the developing world. However, as Weiss rightly reminds us, the crux lies in improving the competitiveness. Quite often, inefficiencies in key infrastructure sectors like telecommunications, transport, and financial services add more to these countries' export costs than foreign trade barriers. Further trade policy reforms and improved investment environment in the developing world could be necessary complements to better market access.

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Global Regulation of Foreign Direct Investment, by Sherif H. Seid, Ashgate Publishing Limited, Hampshire, England, Year of Publication: 2002

Foreign Direct Investment (FDI) plays a significant role in the development process of most economies through the transfer of technology and technological spill-over, increased productive efficiency, production of exportable goods and services which generate foreign exchange, infrastructure development, increase in saving and investment, and faster growth of output and employment. Tremendous rise in national regulatory changes in favour of FDI in the last decade, globalisation and successive trade negotiations within the GATT/WTO led to a significant rise in the global FDI flow in the 1990s. This book examines the issues surrounding the theories and regulation of FDI, weaknesses of current national and international rules on FDI, strategy of key international players and finally it proposes that in the light of diversified national and international preferences and unsatisfactory current regulatory framework, there is a need for a new international regulatory regimes based on the premises of "regulated openness".

Two schools of thought on the theory of FDI are discussed in the book - neo-classical theory and dependency theory. While neo-classical gave importance to the beneficial effects of FDI, at the same time recognised the associated costs on balance of payment (BOP), but this cost of FDI does not imply that FDI is bad for the country as Dependency Theorist claim. A regime of unrestricted FDI flow may not be invariably beneficial for the host country but in the era of reduced official assistance, FDI has become the major source of funding development projects. In order to realise the full potential of FDI, government's interventionist role and adopting selective policy measures might be necessary. The challenge lies in identifying the best methods of selective intervention in the economy and deciding their limit. This book analyses these issues in detail and suggests a new framework of "*Regulated Openness*" where systematic wisdom for choosing the best methods might prosper.

This book has been divided into three parts. The first part discusses the theoretical aspects of FDI, which has major impact on the regulation on investment nationally and internationally. The current national and international regulatory framework on FDI is discussed in this part. Notably, it is pointed out that though the successful conclusion of successive trade negotiations within the GATT/WTO framework reduced trade barriers and stimulated global FDI flows, the current regulatory framework for FDI is unsatisfactory. The diversity of national and international legal regimes governing FDI introduces excessive distortions as between countries and sectors. There appears to exist an opportunity for further negotiation and the emergence of global investment rules as the host countries are increasingly realising that FDI can contribute positively to their development.

The second part of the book, comprising of four chapters, examines the strategies and positions of the key global players (OECD countries, developing countries, public interest groups and inter-government organisations) on a global investment regime. Among the OECD countries there are three major players, the United States, the European Commission, and Japan. The overall strategy of the OECD and its members has been greater liberalisation of investment rules and higher standard of treatment for foreign investors and security for their foreign investment around the world. It was expected that the Multilateral Agreement on Investment (MAI) would remove the barriers to the market access and stimulate the multilateral trading system, however, each of the three main players preferred playing their own priorities. They wanted other markets to be opened for their own investors but tried to keep their own market as close as possible in the name of national security and cultural security. The agenda of MAI, liberalisation and protection of investor's right ignored the concerns of non-OECD countries as well as other issues of regulation of FDI.

On the other hand, the developing countries were very keen for foreign capital but they were not very sure about their strategy. Their views were unclear on rationale and nature of regulatory regime. Moreover, they were not in favour of extension of MAI to

non-OECD countries as they found it to be a threat to their economic and political sovereignty and the fact that the standardised investment rules would leave very little room for countries to manoeuvre their investment policies according to their developmental objectives. There is a concern that when the major interest of MNC's and host States are in conflicts, MNC's may use muscle as well as the influence of their home countries to interfere in the domestic affairs of the weaker host countries. There is also a genuine fear that many developing countries would not be in the position to defend their case in international adjustment successfully and pay the required legal and other bills. Moreover, it is felt that all types of FDI flowing in all sectors of an economy may not necessarily constitute a necessary condition for achieving rapid growth and sustainable development. It is, therefore, argued that FDI could only be beneficial to the host economies if host countries can regulate it according to their development objectives. Among the developing countries the venue and forum also had been the major point of discussion that whether they should negotiate in the framework of WTO or UNCTAD.

At the micro level, there are at least four players *viz.* Consumer Group, Labour Group, Environmental Group, and Business Group. Despite their vested interest, the majority coalitions of all four groups agree on the benefits of FDI for the host country and the need for a global investment regime. These groups not only help in forming the regulation but to disseminate the information also. Although, all the four agents favour for the international investment regime according to their own interest, while the interest of first three are social and collective in nature, the business representative are in favour of international regime to get greater market access and better predictability of the rules so that they may have more and free choice of locations for investments and operational autonomy. Consumer groups supports the regulatory power of governments, competition policy and consumer protection. They believe that the national democratic process can adopt the policy measure, which is more conducive to the consumer and the country's welfare. Labour unions believe that international investment regime is required as the growing policy

competition between governments to attract more FDI may suppress the standard of labour welfare. Environmentalist also believes in the similar line and argues that some countries may get tempted to reduce environmental standard in the situation of intense competition to attract FDI. They advocate a comprehensive international investment framework, which can ensure investment supports and sustainable development.

The international organisations *viz.* the UN, the World Bank, the WTO, and regional economic blocs play a major role in framing the international regulatory regime. There has, however, not been enough success in developing a comprehensive investment regime acceptable at the global level, although some success at regional level has been achieved. The mistrust between developed and developing countries and between foreign investors and host countries resulted in failure of several attempts in the past including the recent WTO ministerial Conference at Seattle. Developing countries find themselves at loss to influence the events. In this situation some kind of coalition may help them to make the forum in their favour.

The third part of the book tries to explore and evaluates the possible strategies like more liberalisation or more regulation or the combination of these two. The author proposes a new regime of investment namely "regulated openness" at both the global and national level. Regulated openness aims at bringing development with justice. Development with justice requires both procedural justice and credible commitment to continuous improvement of investment policy, investment security, sustainable development, core labour standards, consumer protection, business ethics and good governance. Regulated openness implies a pragmatic balance between regulation and liberalisation in the major issues of investment regulation and a platform where all major stakeholder will have an input and role in the preparation and implementation of FDI rules and meaningful participation of powerless constituencies and credible dispute resolutions. The rule should be compilation of those core principles on which agreement could be reached and international regime could be formed. Each country

should be empowered to use and introduce their own rules according to their priorities and situations. This kind of principle will be able to facilitate the individual country's own affairs and the recognition of the need for economic pluralism in international economic agreement.

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The Economics of Public Spending - Debt, Deficits and Economic Performance by *Hassan Bourgrine, Edward Publishing Ltd.*, UK and USA, 2000, Pages 177, Price £49.95

The post second world war period is often seen as the golden era of capitalism when most of the economies experienced sustained high economic growth while pursuing demand management strategy in the Keynesian framework. The initial euphoria, however, was replaced by strong recessionary pressure that swept through the world economy in the 1970s leaving its lasting impact on macroeconomic policy prescriptions. Fiscal profligacy became the standard explanation for the ills that afflicted the global economy and tight monetary and fiscal policies became the inherent part of strategy to stabilise the economy and revitalising growth through downsizing the public sector and privatisation. The balanced budgets, downsizing of the public sector and privatisation became the widely accepted way to prosperity.

Hassan Bourgrine and colleagues, through eight challenging essays in his book, endeavour to explain that the strategy supported by these principles is based on the misleading conception of the public finances, and the budget deficits, in fact, improve the private sector performance.

The author begins with the argument that the nature of the role and causes of the budget deficits depend on the type of the theory one relies on. The neoclassical theory states that government should follow the principle followed by the individual and should not spend beyond means. The Keynesian theory dwelled upon the capital budgeting supporting the view that government can and should borrow to spend on assets creation for the investments purposes. The macroeconomic models assume that investment in the economy depends on the savings of the private as well as the public sector. The higher budget deficits increase the demand of the funds and rate of interest. The high rate of interest leads to fall in the level of investment and growth rate of the economy.

In order to understand the book, it is necessary to revisit some fundamental propositions of Keynes and Kalecki. Keynes, as is well known, argues that to increase the output, the level of effective demand is the crucial factor. Kalecki has shown that in capitalism the tendency to raise the level of profits through increase in the cost-margins may actually result in decline in level of profits, income and employment. The book also takes the propositions of the circuit theory which states that the financing of the investment and the initiation of the production process is made through borrowings from the banks. The money taken from the banks is distributed to factors of production as payments to their services and the factors of production spend this income on consumption of goods and services to generate income to the firms. To the extent the factors of production save their income, the firms will not be able to get sufficient income to repay all the loans. A part of the debt will be rolled over and fresh borrowings will be made to maintain the cycle of production. It is shown in the book that deficit in the government sector compensates the portion of the income saved by the households which reduces the income of the firms. Thus, the budget deficits increase performance of the private sector. The balanced budget on the other hand, rule out the government role to respond to the cyclical downturns. The author argues that the slowdown during 1990s was the result of low inflation and high nominal rate of interest caused by tight monetary and fiscal policies which led to a decline in the private investment and consequent fall in the effective demand. In this event it becomes necessary for the government to run deficit. The higher debt - GDP ratio due to the deficit should not be considered as destabilising factor as the policy was designed to counter the slowdown. The stability of the debt-GDP ratio would depend on the differential between the rate of interest and growth rate of real GDP.

Philip O'Hara presented the analysis of the institutional aspects of the production process to show that the economic growth depends on a suitable set of institutions which form a social structure of accumulation (SSA). The SSA approach assumes that there are some institutions conducive for growth which help the

economic cycle to take an upward swing and degeneration of these institutions causes the downswing in the economic cycle. Any suitable SSA needs following conditions to be fulfilled - the institutions should contribute to economic stability, they should contribute to class and intra-class resolution of conflict, and they should enhance the profitability. In the post war II era, the Keynesian Welfare State (KWS) was the basis of SSA in the US and it provided a suitable set of institutions as State tried to balance the interests of workers and business, and sought to stabilise the trade cycle. The workers interests were ensured through unemployment insurance and safety net. But it failed to contribute to productivity and also the cost of welfare programmes rose steeply. Consequently, the KWS was replaced by Reagan during 1970s and 1980s. The neo-liberal State emerged with increased privatisation, flexible labour markets and free trade. The four basic tenets of the neo-liberal approach were balanced budget, privatisation, inflation-first strategy, and globalisation. It is shown in the book that neo-liberalism cannot constitute a viable social structure of accumulation because, along with other contradictions, it places constraints on the effective demand through austere fiscal and monetary policies.

The book addresses the issue of resuscitation of demand management policies by tracing the progress of capitalism since the second world war and concludes that the golden age of capitalism was achieved during 1950s and 1960s because of a compromise maintained between the capitalists and labour interests. The slowdown set in the 1970s, after a good economic performance during the 1950s and 1960s, has its roots in the break down of the institutions which enabled the compromise between competing interest groups in the capitalist economy. This is wrongly perceived as the failure of the demand management policies. In the monetary production system the money supply, inflation and the interest rate have different implications for the business and the financiers. The financial wealth owners loose due to high inflation rate and low interest rate and the producers gain on account of rising prices and falling interest rate. The remedy to the problem is the middle path of maintaining the demand pressure through fiscal policy and

adequate money supply to keep the real interest rate low but not negative. Thus, the compromise attained during the 1950s and 1960s, broken by the rentiers in what is called the revenge of rentiers, should be restored.

One redeeming feature of the book is its critical assessment of the Asian debacle. The Asian crisis is examined in different perspective to conclude that it was a real crisis and not a financial one as argued by many analysts. The major cause of the crisis was the lack of effective demand and not the Ponzi finance as explained by several corners. The fiscal deflation by the rich as well as emerging countries resulted in the long-run shortage of the aggregate demand. It is shown in the book that the fiscal austerity will cause poverty and demise of democracy. The alternative is to develop a welfare State based on general theory of dynamic monetary accumulation, where public deficit enhances the profitability and the production.

One of the major problem perceived to be associated with budget deficits is inflation. The book, however, denies that budget deficit is the major cause of inflation. The authors dwell on empirical studies to deny the positive relationship between public deficit and inflation. The budget deficit can be inflationary if debt becomes unsustainable in Domar sense or in terms of Barro's rate of growth of government bonds exceeding the output growth. It is found from the data from G-7 countries that there is no relationship between deficit and inflation. The results, instead, provide strong support for those who call for greater provision of government finance at low real rate of interest as means of moving the world economy along a sustained growth path. Even in the long-run, the deficit is shown to have positive effects on profits so far the growth rate of economy is sufficiently higher relative to the real rate of interest.

The impact of the public investment on the growth is examined with the help of the modified version of Domar model. It is shown that expansion in the public investment will bring the economy on a higher growth path. A comparison is made between

the economy with and without public sector to show that the economy with public sector will grow at faster growth. The crucial element here is the difference between the private propensity to consume and the share of public total revenue devoted to current spending.

Finally the book elucidates that the fiscal policy is more effective than the monetary policy in attaining the full employment state. The deficit financing and the direct state intervention should be used to attain the goal of full employment. It is shown that the national debt does not pose any hindrance in the achievement of full employment but maintaining the same becomes a political matter as the full employment state is incompatible with capitalist system, because it strengthens the working class and in the struggle of capitalist and workers former get weakened.

The book provides convincing arguments for the policy makers in favour of active fiscal policy to revive and stabilise the economic activity. The fundamental propositions of Keynes and Kalecki is restated in the context of the new economic developments. An illuminating critique of public sector downsizing and privatisation is relevant in the context of the debate on disinvestment in India. The book attempts to redefine the role of budget deficit in modern economies particularly in meeting social welfare objectives.

The book, however, is not without limitations. Most of the arguments in the book are based on the circuit theory which assumes some beginning point of the production process. In practice, however, the production process is continuous and it cannot be judged at what point the budget deficit will contribute to private sector profits. Secondly, the deficit is assumed to be financed through creation of new money by the central bank. In the present world, however, the Government is borrowing from the market to finance its expenditures. This causes large outgo on account of interest payments inevitably leading to reduction of social spending and the resultant effect on distribution of income. Thus, the book pays scant attention to the debt financing versus

money financing debate in the conduct of fiscal policy. Again, it is argued in the book that capital flows will ultimately bring equilibrium and stability in the system. But the experience of South-East Asian countries with capital flows is completely ignored in the book. The impact of money supply on the prices and external balance needs to be examined more carefully and thoroughly before agreeing to the fiscal expansion. Another aspect which does not receive the due space in the book is the efficiency or cost of production. The book does not discuss how the public sector can ensure the use of resources more efficiently than the private sector. Finally, the stability of Debt/GDP ratio is dealt with in a passing manner only. The GDP growth rate higher than interest rate does not necessarily implies or ensures the sustainability of debt. Neither does the book prescribe the policy measures to deal with unsustainable levels of public finances. In retrospect, even as the book deviates from run-off-the mill economics, it is thought-provoking and challanging to the reader.

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