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It is proposed to publish four issues in the year 1988, the current issue being the second in the year.

Subscription rates for 1988 are:

Inland	:	(i)	Rs. 100 (for four issues of the 1988 volume inclusive of postage)
		(ii)	Rs. 25 (for a single issue of the 1988 volume inclusive of postage)
Foreign	:	(i)	$32 (for four issues of the 1988 volume inclusive of postage by surface mail)
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VOL. 9 NO. 2 JUNE 1988

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BOOK REVIEWS

Published by S.L. Shetty for the Reserve Bank of India and printed by him at
Modern Arts & Industries, 151, A-Z Industrial Estate, Ganpatrao
Kadam Marg, Lower Parel, Bombay 400 013.
Editor: S.L. Shetty

Recent Financial Deepening and Disintermediation in India: Incidence, Impact and Issues@

Narendra Jadhav*

Introduction

THE Indian economy has witnessed a significant financial transformation in the last few years. New financial institutions are being spawned, new financial instruments are being devised and new financial markets are being developed. Several changes which have brought about a broadening and deepening of the financial system in India may be enumerated as under:

1. Fiscal policy has allowed increasingly liberal tax concessions on investment in, and returns from, specified financial assets. For example, the monetary ceilings to qualify for income-tax exemption have been raised in respect of income from certain assets (e.g., units of the UTI, investment in equity shares of new industrial undertakings). 6 year National saving certificates, particularly Series VI have become very popular because they qualify for tax concessions. Increasing popularity and attractiveness of this VI Series is evident from the 157 per cent increase in its outstandings within a period of three years from Rs. 5,155 crores at end-March 1985 to Rs. 13,224 crores at end-March 1988.

2. The Life Insurance Corporation of India (LIC) has introduced many innovative schemes carrying liberal tax concessions such as, *Jeevan Dhara* and *Jeevan Akshay.*

3. Public sector undertakings have been permitted to accept deposits from the public and a selected few have been allowed to raise funds through issue of bonds carrying 14 per cent (taxable) or 10

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@ An earlier version of this paper was presented at the Silver Jubilee Conference of the Indian Econometric Society held in Bangalore during January 1988.

per cent (non-taxable) interest.[1] The receipts from the PSU bonds aggregated Rs. 1,978.0 crores during 1986-87 and Rs. 1,823.5 crores in 1987-88 as compared to Rs.354.0 crores in 1985-86.

4. In recent years, capital raised by companies in the private sector through issues of shares and debentures have shown a sudden spurt after remaining almost stagnant at around Rs.100 crores a year during the 1960s and up to the late 1970s. During the five years, i.e., 1983-84 through 1987-88, the amount of capital raised by non-government public and private companies averaged as high as Rs. 1,000 crores per year.

5. Several new financial institutions have emereged and new ones are still emerging:

(a) Until recently , the Unit Trust of India was the only mutual fund designated to mobilise savings of a growing number of small financial investors and channelling them into the private corporate sector. Now, similar mutual funds have been established by State Bank of India and Canara Bank. Contractual saving institutions like the LIC and GIC have also come forward to establish a mutual fund. A few other commercial banks have proposed to set up mutual funds through jointly-sponsored subsidiaries.

(b)The banking industry has started participating in the development of the capital market also through their merchant banking subsidiaries or through their merchant banking divisions; several such proposals have already been approved.

(c)The RBI has set up the Discount and Finance House of India (DFHI) jointly with public sector banks and financial institutions to deal in short-term money market instruments with the primary object of imparting liquidity to these instruments.

(d) The Government of India has recently set up the Securities and Exchange Board of India (SEBI) to deal with matters relating to development and regulation of securities market and investor's protection.

6. Several new financial instruments have been introduced and many others are in offing:

(a) In order to develop treasury bills as a monetary instrument with flexible rates and to impart greater flexibility to banks in their funds management, a scheme of auctions of 182-days Treasury Bills has been introduced.

(b) A large number of small savings instruments such as, *Indira Vikas Patra* (IVP), *Kisan Vikas Patra* (KVP), special National Savings

Scheme (NSS) and 9% Relief Bonds have been introduced particularly with a view to mobilising rural savings. After launching the IVP scheme on November 19, 1986, for instance, the collections under the scheme at the end of February 1988 were placed at Rs. 1,724 crores.

(c) Amongst debt instruments, inter bank participation certificates (PCs) have been introduced and there is a move to introduce Commercial Paper (CP).

These changes, which are symptomatic of the increasing degree of sophistication of the Indian financial system and which to an extent have been inspired by the recommendations of the Chakravarty Committee on the working of the Monetary System and of the Vaghul Committee on the Money Market, are bound to have significant repercussions on the conduct of monetary policy in India. At the present stage of financial deepening in India, it is important, therefore, to assess its initial impact on the financial asset preferences of savers in the economy, to analyse the possible structural change in the growth and composition of various monetary assets that it may have caused and to identify potential implications which merit attention. The present study, which makes an attempt in that direction, is hoped to be a useful precursor to a more detailed analysis of the impact of financial deepening on the conduct of monetary policy in India.

The remainder of this study is organised as follows: Section II examines whether the recent financial deepening has led to financial disintermediation in India. This is done by analysing broad changes in composition of financial savings of the household sector. Section III presents a disagregated analysis so as to isolate the nature and extent of portfolio adjustments among monetary assets. For this purpose, trends in the growth and composition of monetary assets are analysed for 32 quarters beginning April 1, 1978? Section IV deals with monetary implications of these portfolio shifts. An analytical framework is developed with a view to identifying some crucial ratios of monetary assets which reflect the evolving asset-substitution tendencies and at the same time,can be related directly to relative changes in the narrow and broad money aggregates. Using suitable econometric techniques, evolution of these ratios is examined in detail and the possibility of structural shifts in the time series of these ratios is explored. Finally, against the backdrop of the inferences emerging from the statistical and econometric analysis, Section V highlights policy issues arising from the process of financial deepen-

ing which are likely to engage the attention of monetary authorities in near future.

II

Recent Changes in the Composition of Financial Savings

Since the late 1970s,although the overall saving rate in India has stabilised (around 22 to 23 per cent of GDP), significant changes have taken place in sectoral composition of domestic saving. In particular, contribution of the household sector has increased as campared with that of other sectors and within the household sector, the proportion of saving in the form of financial assets has risen in contrast to the share of saving in physical assets[3] What is relevant for this study, however, is the possible inter-asset substitution within the pool of financial savings of the household sector.

Financial savings of the household sector comprise currency, bank deposits, small savings, investment in government, corporate and co-operative securities, loans to companies, life insurance fund, provident fund, units of Unit Trust of India etc. Data relating to gross financial savings of the household sector in each of these financial assets for the eight year period, 1978-79 through 1985-86, is presented in Statement I.

For analytical purposes, these assets may be grouped under three headings:

(a) *Monetary Assets* such as, currency and bank deposits in view of their relevance for M_1 and M_3;

(b) *Contractual Savings* such as, life insurance fund, and provident fund in view of the contractual nature of such savings; and

(c) *Other Assets* to include the rest[4]

Data on gross financial savings of the household sector in terms of these sub-groups along with a further distinction between currency and bank deposits among the "monetary assets" are presented in Statement II. Data presented in Statement II depict considerable year-to-year variations in the shares of various sub-groups of assets in gross financial savings of the household sector. However, when four-yearly averages[5]are examined, a clear shift in the asset preferences becomes descernible. The eight year period, 1978-79 to 1985-86 is sub-divided into two periods of equal length, i.e., Period I (1978-79 to 1981-82) and Period II (1982- 83 to 1985-86) and the average shares of various sub-groups are indicated in Table 1.

Table 1: Gross Financial Savings: Average Shares (%)

Asset	£ Period I	$ Period II
(a) Monetary Assets	59.0	54.5
of which		
(i) Currency	11.7	12.0
(ii) Bank Deposits	47.3	42.5
(b) Contractual Savings	23.9	22.7
(c) Other Assets	17.1	22.8
Total	100.0	100.0

Source: Statement II.

Notes: £ Period I covers 4 years, i.e., 1978-79 through 1981-82.
$ Period II covers 4 years, i.e., 1982-83 through 1985-86.

Table 1 reveals the following broad features of changes in asset preferences:

(i) The share of monetary assets has distinctly declined. This decline has emanated entirely from the fall in the share of bank deposits. The share of currency has, in fact, marginally increased.

(ii) The share of contractual savings has registered a small decline.

(iii) The share of other assets has substantially increased. Particularly noteworthy are the gains made by small savings, corporate and cooperative securities and units of the UTI.

Thus, the financial deepening taking place in the economy seems to have resulted in a marked shift from monetary assets in general and from bank deposits in particular, to direct saving such as claims on Government and corporate bodies. In other words, funds which had previously flowed from ultimate providers to ultimate users through financial intermediaries are now, to some extent, diverted away from them and are being provided directly, i.e., some degree of financial disintermediation seems to be taking place in the economy. In order to assess the monetary implications of this phenomenon, it is necessary to identify specific categories within the set of monetary assets from which the said shift is emerging. This is taken up in the next section. In doing so, however, data relating to total monetary aggregates (including those monetary assets held by non-household sectors) have been analysed and not only household financial assets as shown in Table 1 above.

III

Trends in the Growth and Composition of Monetary Assets[6]

Quarterly data on monetary assets, namely currency, demand deposits, and time deposits compiled from the R.B.I. Monthly Bulletins, covering 32 quarters beginning April 1, 1978, are presented in Statement III[7] Since these quarterly data are subject to substantial seasonal variations, simple adjustments for seasonality were made. The method adopted for seasonal adjustments is described in Appendix A. Seasonally adjusted data on monetary assets are presented in Statement IV.

A) Trends in Growth Rates of Monetary Assets

Seasonally adjusted data on monetary assets were used to compute quarterly growth rates of monetary assets. These are indicated in Statement V. The quarterly growth rates were then averaged, grouping the four quarters corresponding to each financial year together. These results, covering the eight year period, 1979-80 through 1986-87, are presented in Table 2 and illustrated in Graph 1[8]

Table 2: Average Quarterly Growth Rates of Monetary Assets (1979-80 to 1986-87)
(Per cent)

Period	C	DD	TD
1979-80	3.443	3.674	4.366
1980-81	3.619	4.499	4.685
1981-82	1.858	1.972	3.989
1982-83	3.548	3.877	4.140
1983-84	4.104	3.119	4.486
1984-85	3.776	5.587	4.212
1985-86	2.650	2.703	4.655
1986-87	3.464	4.174	4.398

Source: Statement IV.

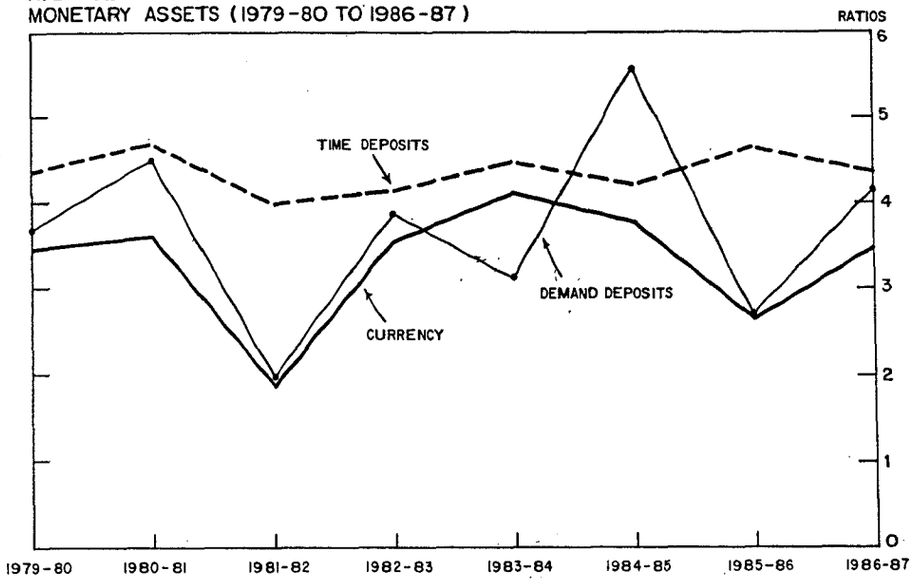
A number of observations may be made from these data:

(i) Over the entire period, movements in the average quarterly growth rates of all monetary assets exhibit an irregular pattern. No persistent acceleration or deceleration is evident in respect of any monetary asset.

(ii) The extent of variability in quarterly growth rates differs from one monetary asset to another. The lowest instability is evident in respect of time deposits, while demand deposits appear

GRAPH - 1

AVERAGE ANNUAL GROWTH RATES OF MONETARY ASSETS (1979-80 TO 1986-87)



to be the most volatile aggregate. This observation is supported by graphical representation as well as measures such as the co-efficient of variation which was found to be as high as 28.3 per cent in respect of demand deposits compared to 20.3 per cent and 5.3 per cent in case of currency and time deposits, respectively.

(iii) An important question here, is whether there is any structural change in the pattern of these quarterly growth rates in recent years.

If the data are divided into two halves, indeed, a peculiar change in the pattern becomes discernible. In the first half of the eight-year period, the average of quarterly growth rates of all monetary assets moved in the same direction (see Table 2). This is, however, not true for the second half. Throughout the second half, the growth rate of demand deposits moved in the opposite direction vis-a-vis the growth rate of time deposit. The same is also true of currency in the last two years, i.e., 1985-86 and 1986-87. In other words, there is some indirect evidence of an enhancement in the degree of asset substitution in recent years.

B) Trends in Compostion of Monetary Assets

Seasonally adjusted data on monetary assets were used to com-

pute quarterly shares of currency, demand deposits and time deposits in broad money (M_3). These are indicated in Statement VI. The quarterly shares were then averaged on financial year basis. These results, covering the eight-year period, 1979-80 through 1986-87, are presented in Table 3.

Table 3: Average Quarterly Shares of Monetary Assets in Broad Money (1979-80 to 1986-87)

(Per cent)

Period	C/M_3	DD/M_3	TD/M_3	D/M_3
1979-80	24.7	16.8	57.9	74.7
1980-81	24.1	16.4	59.0	75.4
1981-82	22.9	16.7	60.1	76.8
1982-83	22.5	16.4	60.8	77.2
1983-84	22.3	15.6	61.9	77.5
1984-85	22.3	15.5	61.7	77.2
1985-86	21.3	15.6	63.1	78.7
1986-87	20.3	15.7	63.8	79.5

Source: Statement IV.

Notes: 1) D = DD + TD.

2) Shares do not add up to 100 on account of the omission of "other deposits with the RBI".

A number of observations are in order here:

(i) The share of total bank deposits (D), i.e., demand and time deposits together, in M_3, has increased almost continuously throughout the period—from 74.7 per cent in 1979-80 to 79.5 per cent in 1986-87. This increase has obviously come at the expense of the share of currency. As a result the currency-deposit ratio (C/D) declined steadily from 33.0 per cent in 1979-80 to 25.5 per cent in 1986-87.

(ii) The shares of two components of total bank deposits have moved in opposite directions. The share of demand deposits in M_3 has marginally declined. It implies that the increase in the share of time deposits has been more pronounced than the rise in the aggregate share of bank deposits in M_3.

(iii) The share of time deposits in M_3 has steadily increased from 57.9 per cent in 1979-80 to 63.8 per cent in 1986-87. Since this increase has come at the expense of currency and to some extent at the expense of demand deposits, the currency - time deposit ratio (C/TD) has declined markedly from 42.6 per cent in 1979-80 to 31.9 per cent in 1986-87 and the demand deposit-

time deposit ratio (DD/TD) has come down from 29.1 per cent to 24.7 per cent during the same period. Concomittantly, the share of time deposits in total bank deposits (TD/D), has increased from 77.5 per cent in 1979-80 to 80.2 per cent in 1986-87.

(iv) A cursory examination of these data fails to detect any structural shift in the time series for various ratios discussed above. Perhaps, use of some econometric techniques is warranted. In this regard, it may be desirable to focus attention on one or two crucial ratios that have a direct bearing on monetary policy. Identification of such ratios is taken up in the next section.

IV

Monetary Implications of Portfolio Shifts

In order to examine monetary implications of the recent changes in the financial system, it is desirable to develop a suitable analytical frame work for identifying one or two crucial ratios which capture the evolving changes in asset- substitution and at the same time, can be linked directly to relative changes in the narrow and broad money stock in the economy.

A. *Analytical Framework*

By definition, the narrow money stock (M_1) in the economy is the sum total of currency with the public (C) and demand deposits with banks (DD)[9]. Thus,

(Eq. 1) $M_1 = C + DD$

Similarly, the broad money stock (M_3) in the economy comprises M_1 and time deposits with banks (TD). Thus,

(Eq. 2) $M_3 = C + DD + TD$

Now, relative variations in the narrow and broad money can be captured by the ratio (M_1/M_3) which may be expressed as:

$$(M_1/M_3) = \frac{C + DD}{(C + DD) + TD} = \frac{1}{1 + \dfrac{TD}{(C + DD)}} \quad \text{or}$$

(Eq. 3)
$$(M_1/M_3) = \frac{1}{1 + \dfrac{1}{\left(\dfrac{C}{TD}\right) + \left(\dfrac{DD}{TD}\right)}}$$

Thus, we get an expression for (M_1/M_3) in terms of two ratios, i.e., (C/TD) and (DD/TD). Accordingly, relative variations in M_1 and M_3 can be analysed in terms of only two crucial ratios, i.e., (C/TD) and (DD/TD).

B. *Trends in C/TD, DD/TD and M_1/M_3 Ratios*

Seasonally adjusted data on monetary assets were used to compute quarterly ratios (expressed in percentage forms) namely, C/TD, DD/TD and M_1/M_3. These are indicated in Statement VII and also depicted in Graph 2. For the purpose of discussion, these quarterly ratios were averaged on financial year basis. These results, covering the eight-year period 1979-80 through 1986-87, are presented in Table 4.

Table 4: Average Quarterly Ratios, C/TD, DD/TD and M_1/M_3 (1979-80 to 1986-87)

(Per cent)

Year	C/TD	DD/TD	M_1/M_3
1979-80	42.6	29.1	42.1
1980-81	40.8	27.8	40.9
1981-82	38.2	27.7	39.9
1982-83	37.1	27.0	39.2
1983-84	36.0	25.2	38.1
1984-85	36.1	25.3	38.3
1985-86	33.8	24.8	37.2
1986-87	31.9	24.7	36.2

Source: Statement VII.

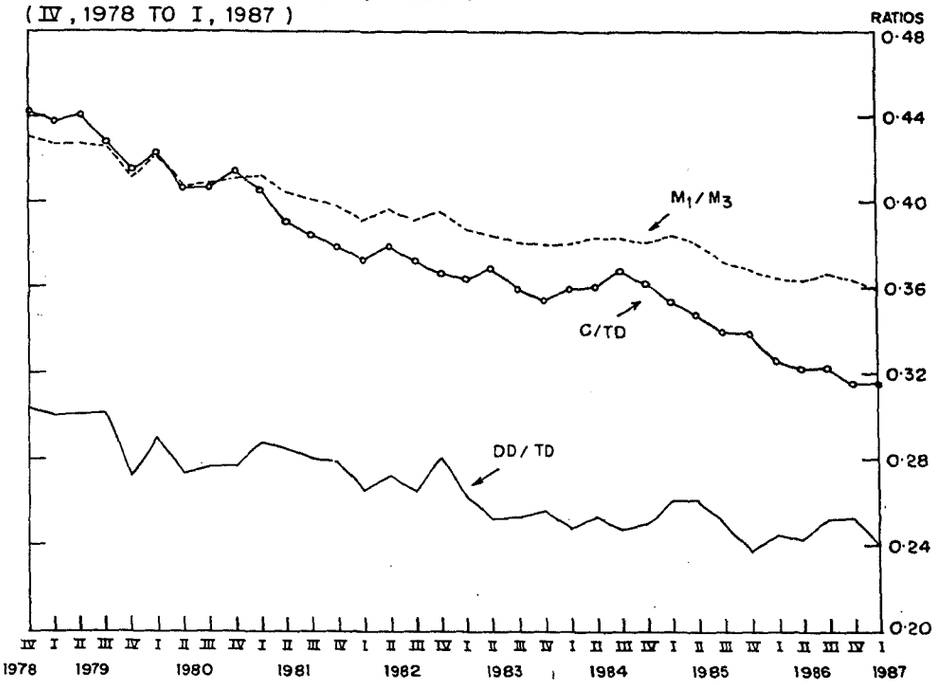
It is evident from Table 4 that (M_1/M_3) ratio has declined almost unabatedly throughout the eight-year period. Further, this decline has been caused by the corresponding decline in *both*, (C/TD) and (DD/TD) ratios.

C. *Econometric Analysis of Trends*

Econometric techniques were used to analyse the trends in (C/TD), (DD/TD) and (M_1/M_3) ratios. For each ratio, four alternative specifications were tried:

a) Linear Trend: $(Yt) = A0 + A1\ (t)$
b) Exponential Trend: $\log\ (Yt) = A2 + A3\ (t)$

GRAPH-2
QUARTERLY RATIOS OF MONETARY ASSETS
(IV, 1978 TO I, 1987)



c) Autoregressive Trend: $(Yt) = A4 + A5\ (Yt-1)$

d) Logarithmic Autoregressive Trend: $\log\ (Yt) = A6 + A7 \log\ (Yt-1)$

Where Y = the variable being examined
t = time (in quarters)

(i) Trends in (M_1/M_3) Ratio

Trend equations for (M_1/M_3) ratio are presented in Table 5.

It may be noted that the slope coefficients are statistically significant in all four specifications. Also $\bar{R}^2$ are very high and SER values are very low in all four specifications. However, when tested for the existence of autocorrelation, some differences in the goodness of fit become discernible![10] At 1 per cent level of significance, equation(6) i.e., autoregressive trend, indicates the problem of negative serial correlation while all others are acceptable. It may be noted that in the autoregressive models (i.e., eq. 6 and 7), Durbin's 'h' statistic has been used instead of the conventional D.W. statistic[11].

(ii) Trends in (C/TD) Ratio

Trend equations for (C/TD) ratio are presented in Table 6.

Table 5: Trend Equations for M_1/M_3
Sample Period: IV, 1978 to I, 1987 (34 quarters)

Eq. No.	Functional Form	Constant	Slope Co-efficient	Statistical Measures
4	Linear	42.47	−0.1990	$\bar{R}^2$ = 0.945, SER = 0.4639 or (1.19%)
		(257.01)	(23.46)	D.W. = 1.29
5	Exponential	1.6290	−0.0022	$\bar{R}^2$ = 0.948, SER = 0.005 or (0.31%)
		(920.82)	(24.29)	D.W. = 1.30
6	Autoregressive	1.4971	0.9564	$\bar{R}^2$ = 0.931, SER = 0.5182 or (1.33%)
		(0.830)	(20.86)	Durbin's 'h' = −2.66
7	Logarithmic Autoregressive	0.0549	0.9641	$\bar{R}^2$ = 0.934, SER = 0.0056 or (0.35%)
		(0.762)	(21.341)	Durbin's 'h' = −2.49

Notes: 1) Figures in parenthesis indicate 't' values.
2) SER, i.e., Standard Error of Regression when expressed in parenthesis indicates % of mean value of respective dependent variable.

Table 6: Trend Equations for C/TD
Sample Period: IV, 1978 to I, 1987 (34 quarters)

Eq. No.	Functional Form	Constant	Slope Co-efficient	Statistical Measures
8	Linear	43.29	−0.3562	$\bar{R}^2$ = 0.948, SER = 0.8044 or (2.16%)
		(151.06)	(24.22)	D.W. = 0.72
9	Exponential	1.6397	−0.0042	$\bar{R}^2$ = 0.952, SER = 0.009 or (0.57%)
		(511.33)	(25.24)	D.W. = 0.73
10	Autoregressive	0.7709	0.9693	$\bar{R}^2$ = 0.964, SER = 0.6740 or (1.81%)
		(0.61)	(29.13)	Durbin's 'h' = 0.93
11	Logarithmic Autoregressive	0.0244	0.9816	$\bar{R}^2$ = 0.965, SER = 0.0076 or (0.48%)
		(0.47)	(29.91)	Durbin's 'h' = 0.81

Notes: 1) Figures in parenthesis indicate 't' values.
2) SER, i.e., Standard Error of Regression when expressed in parenthesis indicates percentage of mean value of respective dependent variable.

In this case, only the autoregressive equations (i.e., eq.10 and 11) have done well. The other two equations i.e., linear and exponential

trend equations, are subject to the problem of positive serial correlation.

(iii) Trends in (DD/TD) Ratio

Trend equations for (DD/TD) ratio are presented in Table 7.

Table 7: Trend Equations for DD/TD
Sample Period: IV, 1978 to I, 1987 (34 quarters)

Eq. No.	Functional Form	Constant	Trend Co-efficient	Statistical Measures
12	Linear	29.42	-0.1693	$\bar{R}^2$ = 0.79, SER = 0.8415 or (3.17%)
		(98.15)	(11.00)	D.W. = 1.58
13	Exponential	1.4697	-0.0028	$\bar{R}^2$ = 0.79, SER = 0.0136 or (0.96%)
		(304.34)	(11.10)	D.W. = 1.59
14	Autoregressive	4.6025	0.8205	$\bar{R}^2$ = 0.70, SER = 0.9989 or (3.76%)
		(1.83)	(8.77)	Durbin's 'h' = -2.14
15	Logarithmic Autoregressive	0.2448	0.8262	$\bar{R}^2$ = 0.70, SER = 0.0162 or (1.14%)
		(1.82)	(8.75)	Durbin's 'h' = 1.96

Notes: 1) Figures in parenthesis indicate 't' values.
2) SER, i.e., Standard Error of Regression when expressed in parenthesis indicates percentage of mean value of respective dependent variable.

In this case, linear and exponential trend models seem to provide better results. The exponential model is particularly noteworthy in respect of its low SER. Among the autoregressive models, the logarithmic autoregressive model has performed better.

D. *Possibility of a Structural Break in the Evolution of Monetary Assets*

Having examined the trends in the time series for (M_1/M_3), (C/TD) and (DD/TD) ratios, it may be worthwhile, now, to investigate the possibility of structural shift in the evolution of these time series. A commonly used econometric technique for this purpose is the Chow's Test which comprises the following steps:

Suppose the time series under consideration has N observations:

Step I : Divide the data into two parts at the point of suspected structural shift. Suppose that period I and II have N_1 and N_2 observations respectively. Clearly, $N = N_1 + N_2$.

Step II : Run the specified regression thrice, once with all N observations and then individually for N_1 and N_2 observations.

Step III : Let S_1, S_2, S_3 be the respective residual sums of squares from these three regressions.

Define $S_4 = S_2 + S_3$ and

$S_5 = S_1 - S_4$

Step IV : Apply the Chow's F test as follows:

$$F = \frac{S_5/k}{S_4/N_1 + N_2 - 2k} \quad \text{with d.f.} = (k, N_1 + N_2 - 2k)$$

where k = No. of coefficients estimated including the intercept.

If the computed F exceeds the critical F, reject the hypothesis that there is no structural shift at the point under consideration.

An attempt was made to assess the possibility of strutctural shift in (M_1/M_3), (C/TD) and (DD/TD) series in the middle of the sample period, i.e., IV, 1982. Separate regressions for the Period I (i.e., upto IV, 1982) and period II (i.e., from IV, 1982 to I 1987) using the exponential trend yielded the following results.

Table 8: Segregated Exponential Trend Equations

Eq. No.	Dependent Variable and Period		Constant	Slope Coefficient	Statistical Measures
16	(M_1/M_3)	I	1.6324 (667.06)	−0.0026 (10.32)	$\bar{R}^2$ = 0.875, SER = 0.0047 D.W. = 2.42
17	(M_1/M_3)	II	1.5915 (626.98)	−0.0019 (7.85)	$\bar{R}^2$ = 0.79, SER = 0.0040 D.W. = 0.575
18	(C/TD)	I	1.6474 (504.13)	−0.0053 (15.64)	$\bar{R}^2$ = 0.942, SER = 0.0062 D.W. = 1.88
19	(C/TD)	II	1.5777 (323.71)	−0.0045 (9.36)	$\bar{R}^2$ = 0.844, SER = 0.0096 D.W. = 0.574
20	(DD/TD)	I	1.4704 (208.35)	−0.0025 (3.48)	$\bar{R}^2$ = 0.425, SER = 0.0135 D.W. = 1.98
21	(DD/TD)	II	1.4101 (236.36)	−0.0013 (2.22)	$\bar{R}^2$ = 0.20, SER = 0.0118 D.W. = 1.60

Note: 1) Figures in brackets indicate the respective 't' values.

It is evident from Table 8 that results of all equations seem to be fairly satisfactory[12] except eq. (17) and eq. (19) which indicate serious autocorrelation problems. As is well known, in such cases, the standard error of regression (SER) is under-estimated.[13] Since the residual sum of squares (RSS) is positively, related to the standard error of regression (SER),[14] it follows that the RSS will also be an underestimate and therefore, the Chow's test would be misleading unless suitable corrections are made to eliminate the problem of autocorrelation in equations (17) and (19).

In order to solve the autocorrelation problem, firstly, the coefficients of autocorrelation (ϱ) were estimated applying the Theil-Nagar formula to the equations (17) and (19). Theil and Nagar have suggested the following formula:[15]

$$\text{(Eq. 22)}\quad \hat{\varrho} = \frac{N^2\left(1 - \frac{D.W.}{2} + k^2\right)}{N^2 - k^2}$$

where N = Total number of observations

D.W. = Durbin-Waston Statistic

k = Number of coefficients including the intercept.

The estimates of the coefficient of autocorrelation turned out to be 0.7365 and 0.737, respectively.

Having estimated the coefficients of autocorrelations (ϱ), the generalised difference equation form i.e.,

$$\text{(Eq. 23)}\quad (Y_t - \varrho\, Y_{t-1}) = \beta_0 (1 - \varrho) + \beta_1 (X_t - \varrho\, X_{t-1}) + \varepsilon_t$$

was used for re-estimation. These results are presented in Table 9:

Table 9: Correction for Autocorrelation

Eq. No.	Dependent Variable and Period		Constant	Slope Co-efficient	Statistical Measures
24	(M_1/M_3),	II	1.5896	-0.0017	$\bar{R}^2$ = 0.12, SER = 0.0046
			(127.57)	(1.76)	D.W. = 1.54
25	(C/TD),	II	1.5977	-0.0058	$\bar{R}^2$ = 0.389, SER = 0.0087
			(68.11)	(3.25)	D.W. = 2.08

Note: 1) Figures in brackets indicate the respective 't' values.

(a) *Application of Chow's Test to (C/TD) & (DD/TD) ratios.*

It is evident from Table 9 that the autocorrelation problem is solved in both the equations. However, eq. (24) is still not satisfactory in view of the statistically insignificant slope coefficient. Accordingly, the Chow's Test is applied only in respect of (C/TD) and (DD/TD) ratios, while the possibility of a structural break in (M_1/M_3) ratio is assessed using a different technique.

Table 10: Results of Chow's 'F' Test

Dependent Variable	Estimated value of Chow's 'f' statistic	Tabulated value of Chow's 'f' (2.28) statistic at 5 % level of significance
C/TD	7.28	3.34
DD/TD	3.41	3.34

It can be seen from Table 10 that the estimated values of Chow's 'F' statistic in case of (C/TD) and (DD/TD) ratios are more than their respective tabulated values. It follows that the hypothesis that there is no structural shift at the mid-point of the sample period is rejected. In other words, the structural shift around IV, 1982 is confirmed for (C/TD) and (DD/TD) ratios.

(b) *Regression Technique based on Dummy Variable Applied to (M_1/M_3) Ratio.*

As mentioned above, the Chow's Test does not seem to be appropriate for assessing the possibility of a drift in the (M_1/M_3) ratio. As an alternative, the regression technique based on dummy variables may be used. According to this technique, instead of one regression line, two lines are fitted with a kink at their intersection.[16]

Consider a model of the form:

(Eq. 26) $\log (M_1/M_3) = a_1 + a_2 D + b_1 T + b_2 (D \times T) + E$

Where T = time in quarters

D is a dummy variable such that

= 1 at the time of structural shift and onwards

= O, before the time of structural shift.

For quarter before the shift, D = O

$$E\left(\frac{M_1}{M_3} / D = 0, T\right) = a_1 + b_1 T$$

$$E\left(\frac{M_1}{M_3} / D = 1, T\right) = (a_1 + a_2) + (b_1 + b_2) T$$

In other words, the time has a slope b_1 before the shift, but the slope changes to $(b_1 + b_2)$ afterwards - and the intercept changes as well. Notice that when $b_2 = O$, the equation reduces to a single straight line segment. It follows, therefore, that when the equation of the form specified above is fitted, a test of significance for a_2 and b_2 (the usual 't' test) provides a simple test for structural shift.

In order to detect the time period when the structural shift in (M_1/M_3) ratio has occurred, a set of 18 equations varying form I, 1981 to II, 1985 (the possible quarters where structural shift can be suspected) were run for (M_1/M_3) ratio in an exponential form. The existence of structural shift was found in III, 1984, result of which is reproduced below:

(Eq. 27) $\log (M_1/M_3) = -0.8416 + 0.0598\ D - 0.0058\ T - 0.0014\ TD$
$(206.420)\ (2.224)\ (19.628)\ (1.451)$
$\bar{R}^2 = 0.967$, SER = 0.0094, D.W. = 2.1039
(Figures in the brackets indicate respective 't' values).

The equation provides a satisfactory fit. As is evident, the differential intercept coefficient (a_2) turns out to be statistically significant at 5% level of significance, implying thereby a shift in the intercept.

Having established that there are structural shifts in the time series for (C/TD), (DD/TD) and (M_1/M_3) ratios, some comments on the nature of the shift involved are in order. Relevant trend coefficients in this regard are summarised in Table 11.

Table 11: Trend Coefficients

Variable	Functional form	Period	Trend Coefficients
(C/TD)	Exponential	Upto IV, 1982	-0.0053
	Exponential	I, 1983 to I, 1987	-0.0058
(DD/TD)	Exponential	Upto IV, 1982	-0.0025
	Exponential	I, 1983 to I, 1987	-0.0013
(M_1/M_3)	Exponential	Upto III, 1984	-0.0058
	Exponential	IV, 1984 to I, 1987	-0.0072

It is clear from Table 11 that throughout the sample period, the downward trends have continued in all three ratios. However, the (C/TD) line became relatively steeper in the later half and the (DD/TD) line became relatively flatter. However, the net result was a steeper fall in (M_1/M_3) line, but only later, around III, 1984.

No doubt, any sharp structural shift should have been optically

visible in the graphical representation of the monetary ratios, as in the earlier Graph 2. A surface view of the graph shows downwards movements of all the three curves representing (DD/TD), (C/TD) and (M_1/M_3) ratios. While this is true, there are nevertheless qualitative differences in the behaviour of the three ratios. While (DD/TD) curve depicts a downward movement rather indistinctly, (C/TD) curve makes a sharp break at around III, 1984 which also gets manifested *albeit* less sharply in the (M_1/M_3) curve. This latter feature is what is confirmed by the statistical results shown above.

Indeed, because of the differing behaviour of the individual components comprising M_1 and M_3, the graph of (M_1/M_3) does not exhibit the structural shift quite clearly. If M_1 has a structural shift at time 't' and so has M_3, but with varying degrees, the visual impact of the kink in the graph of (M_1/M_3) gets diluted. This indicates the need for further research in this area, particularly in the transmission of ripple effects from financial disintermediation, as discussed in Section III earlier, on to the monetary variables analysed in the subsequent sections.

V

Implications of Change

The statistical and econometric analyses presented in the preceding sections have demonstrated that the process of financial deepening taking place in the Indian economy has led to financial disintermediation to some extent and has also caused some porfolio shifts among monetary assets leading to structural shifts in the evolution of ratios which have bearing on the conduct of monetary policy. These developments have raised several policy issues which will have to be addressed in the near future.

1. With the financial disintermediation, funds are being obtained directly from the market thus diluting the traditional financial intermediation process. If the goals set before the policy of financial intermediation are still valid, as they indeed are, it is important to know about the end-use of these funds directly mobilised. Another area of enquiry relates to the nature and size of funds coming back into the banking system at second remove. In this regard, effective returns (i.e., nominal returns adjusted for fiscal incentives) on alternate financial assets will have to be examined in detail.
2. Academic literature, particularly seminal studies by Gurley and

Shaw (1955, 1960) and others contend that prolification of interest-bearing money substutes tends to increase the interest elasticity of money demand and thereby, makes monetary policy less effective. Relevance of this hypothesis in the Indian context will have to be examined.

3. When a financial system is undergoing rapid changes and adjustment in response to policy initiatives, there are invariably other changes taking place, simultaneously, which reflect the perceived need to the existing policy framework. In the relevant literature, such changes are often called "financial innovations". Development of money market mutual funds in the USA in response to Regulation Q is a well-known example of financial innovations.

Just as financial institutions change in response to regulations, the regulatory authorities must change their regulations in response to financial innovations. Edward Kane (1981) has called this process the "regulatory dialectic" and has compared the financial institutions and regulatory authorities as two riders on a seesaw that adopt continually to each other.

Appendix A: Seasonal Adjustment of Data

Quarterly data on monetary aggregates were adjusted for seasonality using the method described below.

A time series (Y_t) is represented as the product of four components:

(A.1) $Y_t = T \times S \times C \times I$

Where T = Long term secular trend
S = Seasonal component
C = Cyclical component
I = Irregular component

The objective is to eliminate the seasonal component (S).

Step 1: Compute 4-quarter moving average ($\bar{Y}_t$)
which give estimates of (TxC).

Step 2: Compute ($Y_t/\bar{Y}_t$)
which gives estimates of (SxI).

Step 3: Average the values of (SxI) corresponding to the same quarters which smooths out the irregular fluctuations. The four averages so obtained are then normalised so as to add up to 4.0. This gives seasonal indices for the 4 quarters.

Step 4: Divide each value in the given time series by the corresponding seasonal index which yields seasonally adjusted figures.

Statement I: Gross Financial Savings of Households—by Assets

(Rs. crores at Current Prices)

Assets	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
1. Currency	1430.5	1332.2	1508.9	946.2	2012.1	2742.6	2957.9	2205.3
	(15.06)	(12.98)	(11.88)	(6.68)	(12.78)	(14.17)	(12.43)	(8.60)
2. Bank Deposits	4625.8	4658.8	6430.7	6294.9	6665.4	8500.7	10045.8	10660.6
	(48.69)	(45.41)	(50.63)	(44.4)	(42.33)	(43.91)	(42.23)	(41.64)
3. Loans to Companies	232.0	476.6	385.4	772.2	800.4	1070.1	1300.7	1296.6
	(2.44)	(4.65)	(3.03)	(5.45)	(5.08)	(5.53)	(5.47)	(5.06)
4. Life Insurance Fund	683.0	772.9	943.4	1030.6	1228.3	1379.7	1602.5	1777.8
	(7.19)	(7.53)	(7.43)	(7.27)	(7.80)	(7.13)	(6.74)	(6.94)
5. Provident Fund	1605.3	1748.5	2009.2	2347.8	2913.8	2996.8	3430.5	3556.1
	(16.89)	(17.04)	(15.82)	(16.57)	(18.50)	(15.48)	(14.42)	(13.89)
6. Claims on Government	542.7	737.5	793.5	1754.3	1246.4	1866.9	3013.4	4105.2
	(5.71)	(7.19)	(6.25)	(12.38)	(7.92)	(9.64)	(12.67)	(16.03)
7. Corp. & Co-op. Securities	201.0	248.2	140.7	363.4	275.4	564.0	673.4	759.7
	(2.12)	(2.42)	(1.11)	(2.56)	(1.75)	(2.91)	(2.83)	(2.97)
8. Securities of Term Lending and other Financial Institutions	2.4	4.4	184.5	65.2	208.3	169.1	148.8	349.1
	(0.03)	(0.04)	(1.45)	(0.46)	(1.32)	(0.87)	(0.63)	(1.36)
9. Units of UTI	78.9	40.6	32.8	94.5	125.5	185.1	567.0	667.0
	(0.83)	(0.40)	(0.26)	(0.67)	(0.80)	(0.96)	(2.38)	(2.61)
10. Others@	98.6	240.0	271.2	503.9	270.5	−117.3	48.2	227.4
	(1.04)	(2.34)	(2.14)	(3.56)	(1.72)	(−0.6)	(0.20)	(0.89)
11. Total	9500.2	10259.7	12700.4	14173.0	15746.1	19357.7	23788.2	25604.8
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

@ Including Compulsory Deposits. Figures in parentheses are percentage to total.

Source: Reports on Currency & Finance, Vol. II, 1982-83, Vol. II, 1983-84 & Vol. II, 1985-86.

Statement II: Gross Financial Savings of Households—by Assets Groups

(Rs. crores at Current Prices)

	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
1. Monetary Assets	6056.3	5991.0	7939.6	7241.1	8677.5	11243.3	13003.7	12865.9
	(63.75)	(58.39)	(62.51)	(51.08)	(55.11)	(58.08)	(54.66)	(50.24)
Of which (a) Currency	1430.5	1332.2	1508.9	946.2	2012.1	2742.6	2957.9	2205.3
	(15.06)	(12.98)	(11.88)	(6.68)	(12.78)	(14.17)	(12.43)	(8.60)
(b) Bank Deposits	4625.8	4658.8	6430.7	6294.9	6665.4	8500.7	10045.8	10660.6
	(48.69)	(45.41)	(50.63)	(44.40)	(42.33)	(43.91)	(42.23)	(41.64)
2. Contractual Savings	2288.3	2521.4	2952.6	3378.4	4142.1	4376.5	5033.0	5333.9
	(24.08)	(24.58)	(23.25)	(23.84)	(26.31)	(22.61)	(21.16)	(20.84)
3. Other Assets	1471.8	1747.3	1808.2	3553.5	2926.5	3737.9	5751.5	7405.0
	(12.17)	(17.03)	(14.24)	(25.08)	(18.58)	(19.31)	(24.18)	(28.92)
4. Total	9816.4	10259.7	12700.4	14173.0	15746.1	19357.7	23788.2	25604.8
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Figures in parentheses are percentage to total.

Source: Statement I.

Statement III: Volume of Monetary Assets—Unadjusted, Quarterly*
(I, 1978 to I, 1987)

(Rs. Crores)

Period		C	DD	TD	M_1	M_3
1978						
	I	8631	5687	18518	14388	32906
	II	9228	5817	19705	15152	34857
	III	9006	5658	20710	14807	35517
	IV	9454	6830	22057	16474	38531
1979						
	I	10212	6843	22632	17258	39890
	II	10994	7324	24058	18463	42521
	III	10352	7257	25222	17892	43114
	IV	10796	7442	26845	18543	45388
1980						
	I	11687	7855	26848	19953	46801
	II	12052	7922	28617	20214	48831
	III	11645	7893	29840	19718	49558
	IV	12597	8852	31413	21667	53080
1981						
	I	13464	9336	32241	23117	55358
	II	13943	9939	34471	24004	58475
	III	13229	9608	35804	22998	58802
	IV	13779	10633	37468	24559	62067
1982						
	I	14492	10087	37697	24729	62426
	II	15549	10913	39519	26610	66129
	III	14845	10506	41418	25469	66887
	IV	15628	12587	44038	28459	72498
1983						
	I	16659	11690	44333	28535	72868
	II	17948	11996	46939	30109	77048
	III	17021	11934	49327	29137	78464
	IV	18070	13761	52691	31988	84679
1984						
	I	19553	13195	52833	33066	85899
	II	21013	14432	56210	35851	92061
	III	20551	13746	58058	34524	92582
	IV	21742	15841	62030	37885	99915
1985						
	I	22664	16382	62308	39642	101957
	II	23927	17590	66482	42002	108484
	III	22542	16573	69211	39339	108550
	IV	23937	17639	73054	41868	114022
1986						
	I	25160	18180	74739	43591	118330
	II	26677	19722	79861	46671	126532
	III	25323	19755	81779	45346	127125
	IV	26742	22526	87659	49558	137217
1987						
	I+	28828	21375	88762	50492	139254

* Last Friday of the quarter.
\+ As on March 13, 1987.
Source: Compiled from Reserve Bank of India Bulletins.

Statement IV: Volume of Monetary Assets—Seasonally Adjusted, Quarterly*
(IV, 1978 to I, 1987) (Rs crores)

Period		C	DD	TD	M_1	M_3
1978						
	IV	9608	6599	21731	16376	38112
1979						
	I	10061	6898	23000	17138	40131
	II	10581	7202	24010	17943	42017
	III	10772	7591	25247	18676	43860
	IV	10972	7190	26448	18432	44894
1980						
	I	11514	7918	27285	19814	47084
	II	11600	7790	28560	19644	48252
	III	12118	8256	29870	20582	50415
	IV	12802	8553	30949	21538	52502
1981						
	I	13265	9411	32765	22956	55692
	II	13420	9773	34402	23328	57782
	III	13766	10050	35840	23996	59819
	IV	14003	10273	36914	24412	61392
1982						
	I	14278	10168	38310	24557	62803
	II	14965	10731	39440	25860	65345
	III	15447	10990	41459	26586	68044
	IV	15882	12161	43387	28289	71709
1983						
	I	16413	11784	45054	28337	73308
	II	17274	11795	46845	29260	76134
	III	17712	12483	49376	30414	79821
	IV	18364	13296	51912	31797	83775
1984						
	I	19264	13301	53692	32836	86418
	II	20224	14191	56098	34841	90969
	III	21385	14379	58116	36038	94183
	IV	22096	15305	61113	37659	98828
1985						
	I	22329	16514	63321	39366	102572
	II	23029	17296	66349	40818	107198
	III	23457	17336	69280	41064	110428
	IV	24326	17043	71974	41618	112781
1986						
	I	24788	18327	75954	43288	119044
	II	25676	19392	79702	45356	125032
	III	26351	20664	81861	47334	129324
	IV	27177	21764	86364	49262	135724
1987						
	I+	28402	21547	90205	50141	140095

* Last Friday of the quarter. + As on March 13, 1987.

Statement V: Quarterly Growth Rates of Monetary Assets Based on Seasonally Adjusted Data (I, 1979 to I, 1987)

(Percentage)

Period		C	DD	TD	M_1	M_3
1979						
	I	4.715	4.531	5.840	4.653	5.298
	II	5.168	4.407	4.391	4.697	4.700
	III	1.805	5.401	5.152	4.085	4.386
	IV	1.857	-5.238	4.757	-1.306	2.358
1980						
	I	4.940	10.125	3.165	7.498	4.878
	II	0.747	-1.617	4.673	0.858	2.481
	III	4.466	5.982	4.587	4.775	4.483
	IV	5.644	3.597	3.612	4.645	4.140
1981						
	I	3.617	10.032	5.868	6.584	6.076
	II	1.168	3.847	4.996	1.620	3.753
	III	2.578	2.845	4.180	2.864	3.525
	IV	1.722	2.219	2.997	1.734	2.630
1982						
	I	1.964	-1.022	3.782	0.594	2.298
	II	4.812	5.537	2.950	5.306	4.048
	III	3.221	2.414	5.119	2.807	4.130
	IV	2.816	10.655	4.650	6.406	5.386
1983						
	I	3.343	-3.100	3.842	0.170	2.230
	II	5.246	0.093	3.975	3.257	3.855
	III	2.588	5.833	5.403	3.944	4.843
	IV	3.681	6.513	5.136	4.547	4.954
1984						
	I	4.901	0.038	3.429	3.268	3.155
	II	4.983	6.691	4.481	6.106	5.266
	III	5.741	1.325	3.597	3.436	3.533
	IV	3.325	6.433	5.157	4.498	4.932
1985						
	I	1.054	7.899	3.613	4.533	3.788
	II	3.135	4.735	4.782	3.688	4.510
	III	1.859	0.231	4.418	0.603	3.013
	IV	3.705	-1.690	3.889	1.349	2.131
1986						
	I	1.899	7.534	5.530	4.013	5.553
	II	3.583	5.811	4.935	4.777	5.030
	III	2.629	6.559	2.709	4.361	3.433
	IV	3.135	5.323	5.501	4.073	4.949
1987						
	I	4.507	-0.997	4.447	1.784	3.221

Source: Statement IV.

Statement VI: Quarterly Shares of Monetary Assets in M_3 Based on Seasonally Adjusted Data (IV, 1978 to I, 1987)

Period		C/M_3	DD/M_3	TD/M_3
1978				
	IV	0.252	0.173	0.570
1979				
	I	0.251	0.172	0.573
	II	0.252	0.171	0.571
	III	0.246	0.173	0.576
	IV	0.244	0.160	0.589
1980				
	I	0.245	0.168	0.579
	II	0.240	0.161	0.592
	III	0.240	0.164	0.592
	IV	0.244	0.163	0.589
1981				
	I	0.238	0.169	0.588
	II	0.232	0.169	0.595
	III	0.230	0.168	0.599
	IV	0.228	0.167	0.601
1982				
	I	0.227	0.162	0.610
	II	0.229	0.164	0.604
	III	0.227	0.162	0.609
	IV	0.221	0.170	0.605
1983				
	I	0.224	0.161	0.615
	II	0.227	0.154	0.615
	III	0.222	0.156	0.619
	IV	0.219	0.160	0.620
1984				
	I	0.223	0.154	0.621
	II	0.223	0.156	0.617
	III	0.227	0.152	0.617
	IV	0.224	0.152	0.618
1985				
	I	0.218	0.161	0.617
	II	0.215	0.161	0.619
	III	0.212	0.157	0.627
	IV	0.216	0.151	0.638
1986				
	I	0.208	0.154	0.638
	II	0.205	0.155	0.637
	III	0.204	0.160	0.633
	IV	0.200	0.160	0.636
1987				
	I	0.203	0.154	0.644

Source: Compiled from Statement IV.

Statement VII: Quarterly Ratios of Monetary Assets Based on Seasonally Adjusted Data (IV, 1978 to I, 1987)

Period		C/TD	DD/TD	M_1/M_3
1978				
	IV	0.442	0.304	0.430
1979				
	I	0.437	0.300	0.427
	II	0.441	0.300	0.427
	III	0.427	0.301	0.426
	IV	0.415	0.272	0.411
1980				
	I	0.422	0.290	0.421
	II	0.406	0.273	0.407
	III	0.406	0.276	0.408
	IV	0.414	0.276	0.410
1981				
	I	0.405	0.287	0.412
	II	0.390	0.284	0.404
	III	0.384	0.280	0.401
	IV	0.379	0.278	0.398
1982				
	I	0.373	0.265	0.391
	II	0.379	0.272	0.396
	III	0.373	0.265	0.391
	IV	0.366	0.280	0.395
1983				
	I	0.364	0.262	0.387
	II	0.369	0.252	0.384
	III	0.359	0.253	0.381
	IV	0.354	0.256	0.380
1984				
	I	0.359	0.248	0.380
	II	0.361	0.253	0.383
	III	0.368	0.247	0.383
	IV	0.362	0.250	0.381
1985				
	I	0.353	0.261	0.384
	II	0.347	0.261	0.381
	III	0.339	0.250	0.372
	IV	0.338	0.237	0.369
1986				
	I	0.326	0.245	0.364
	II	0.322	0.243	0.363
	III	0.322	0.252	0.366
	IV	0.315	0.252	0.363
1987				
	I	0.315	0.239	0.358

Source: Compiled from Statement IV.

Notes

1. The rate of interest on these bonds was reduced by one percentage point with effect from April 1, 1987 to 9 per cent in the case of Tax-free bonds and to 13 per cent for other bonds.
2. The choice of the starting point for analysis has been dictated by the fact, the new M_1 Series data are available from April 1, 1978.
3. For a discussion of recent trends in savings, see RBI (1985-87).
4. Post Office depoits included in 'other assets' are also monetary assets in view of their relevance for M_2 and M_4. However, M_1 and M_3 are the commonly used monetary aggregates for which they are not relevant.
5. A conscious choice of four-yearly averages was made because in the year 1982-83, upward revisions were effected in interest rates. On a number of financial assets, maximum bank deposit rate was raised from 10 per cent to 11 per cent; maximum post office time & recurring deposit rate from 10.5 per cent to 11.5 per cent; and the ceiling rate of interest on non-convertible debentures from 13.5 to 15.0 per cent (with a number of other promotional measures for debenture capital).
6. This and subsequent sections are based on monetary statistics and not on household saving data. Hence, as stated in the text, these monetary assets include those held by non-households.
7. Strictly speaking, monetry assets also include "other deposits" with the RBI. In view of their relatively insignificant shares (i.e., 0.6% of M_1 and 0.2% of M_3 in 1985-86), they are ignored in this study.
8. It may be noted that quarterly data for the year 1978-79 are lost in the process of seasonal adjustment.
9. "Other deposits" with the RBI are also included in M_1. However, as indicated before (footnote No. 7), they are ignored in this study.
10. At 5% level of significance, the hypothesis of no autocorrelation can be accepted (with N = 33) if the D.W. statistic falls in the interval (1.51 to 2.49) or if the Durbin's 'h' statistic falls in the interval (−1.96 to 1.96). On the other hand, for 1% level of significance, the same intervals are (1.29 to 2.71) and (−2.58 to 2.58) respectively.
11. The conventional D.W. statistic is not meaningful for testing the existence of autocorrelation when one or more lagged dependent variables are present. In such cases, Durbin's 'h' statistic defined as

$$h = \left(1 - \frac{D.W.}{2}\right)\sqrt{\frac{N}{1 - N[\text{var}\ (\hat{\alpha}_2)]}}$$

where $\text{Var}(\hat{\alpha}_2)$ = Square of the standard error of the coefficient of the lagged dependent variable.

12. In the context of testing for structural breaks, a low $\bar{R}^2$ for the trends equations, as in Eqns. 20 and 21, is not a major constraint.
13. See, for example, Pindyck and Rubinfeld (1981, P.153).
14. In fact, RSS = $(SER)^2 \times (N - k)$ where k = No. of coefficients estimated including the intercept.
15. See Theil and Nagar (1961).
16. These techniques can be generalised to several lines as also to non-linear data. These generalised functions are called 'Spline Functions'. For details, see Poirier (1976).

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Concept of Work in National Income and Population Census

A.K. Nag*

THE estimates of domestic product and estimates of the work force of an economy are expected to have close correspondence to each other insofar as the former seeks to measure the effect (or output) of a set of activities for which the latter is a part of the cause (or input). In India, the Central Statistical Organisation (CSO) provides the estimates of the domestic product while the Registrar General's (RG) office gives the most comprehensive estimates of work force. However, the definition of 'work' employed by the CSO in its measurement of domestic product differs in some important respects from the one adopted by the RG's office in its decennial censuses. This has important implications as the observed long-term trend in the overall and broad sectoral labour productivity (i.e., output per worker) based on these two sets of data may be of limited value if the definition of work underlying them are not the same.

The term 'work' is used in economic literature in a restricted sense and therefore is not equivalent to the physico-mechanical usage of the term. Any expenditure of human labour is not recognised as 'work' in economic literature unless the corresponding activity is included in the sphere of 'economy'.[1]

What constitutes the 'economy' within the space of human activities is determined more by convention, institutional arrangements prevailing within the society and the way of living, rather than by any objective criterion. In a developed market economy, it is said that the market is the ultimate filter through which an economic activity is separated from other activities. An activity may have utility, but it will have no economic value unless it is priced and marketed.

However, even in a most advanced economy, activities resulting in non-marketed output/services are also evaluated for the purpose of estimation of gross domestic product. For example, though there

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exists no market for services provided by organs of the State, such services are valued for the estimation of gross domestic product. But services provided by the members of households for home consumption are not evaluated as these services are not considered to be 'economic'. The distinction between economic activities and non-economic activities becomes even more fuzzy in a country like India where a substantial portion of productive activities is carried out within the households with the minimal use of wage labour and more often than not, in conjunction with other non-economic activities. A large part of the outputs produced by such own-account producers are not sold in the market but are used either for home consumption or as an intermediate input. But the exclusion of such non-marketed output from the domain of the gross domestic product is not advocated mainly for two reasons. Firstly, their exclusion will grossly underestimate the total availability of goods and services to its populace, and secondly, a substantial amount of labour is employed in these activities. Therefore, in most of the developing countries, national income estimates cover 'production for own use' of the main agricultural commodities and also to some extent, non-marketed output of certain secondary and tertiary activities.[2]

Treatment of non-marketed output and the concept of work employed by the Central Statistical Organisation

The CSO defines the non-marketed economic activity in the following words: "(The) non-marketed economic activity is that part of the economic activity ... which takes place without the intervention of money. For example, some of the goods and services produced are not eventually sold in the market though they are similar in all essential respects to the goods and services which are marketed".[3]

The above definition has obviously been badly phrased. Firstly, money is a medium of exchange and not exchange itself. Equating exchange with monetary transaction is obviously fallacious. That apart, the CSO's definition does not clearly say which activities outside the marketed sector need to be considered as part of the economy. If all the activities, outputs of which are similar to the marketed outputs, are to be included in the corpus of economic activities, it is obvious that such definition is not employed by the CSO in its estimation of gross domestic product. For example, many of the services produced and consumed within a household are also produced commercially and sold in the market. But such services are not taken

into account in the estimation of GDP. The principal characteristic of an activity that needs to be reckoned with is the extent to which the output of these activities are amenable to measurement and, of course, their relative importance. In fact, many of the services produced and consumed within a household are of vital social importance and measurement of them have been tried by many authors.[4]

Following the recommendations of the United Nations' *A System of National Accounts* [UN (1969)], the CSO includes all production of primary products in gross output, whether product is for own-account consumption or for barter or for sale. In the case of agricultural sector, the entire output whether marketed or consumed at home or paid as wages is included in the domestic product. Similarly, in the case of livestock products like milk and milk products, meat and meat products, etc., outputs are estimated on the basis of estimates of number of productive animals and production per animal. Thus, the entire output whether marketed or consumed at home is included in the domestic product.

The CSO does not give estimates of the share of non-marketed output in total domestic product. Mazumdar and Chaturvedi[5] have estimated the share of monetised and non-monetised gross domestic expenditure in total private final consumption expenditure for the years 1964-65 and 1973-74. According to their calculation the share of non- monetised expenditure worked out to 47.3 per cent and 38.9 per cent in the respective years for rural areas and 8.1 per cent and 9.2 per cent for urban areas. It may be observed that there had been a marked decline in the share of non-monetised transaction in rural areas during the period and the share of non-monetised transaction in urban areas was quite low. Madalgi, following a different and indirect approach, arrived at a diametrically opposite conclusion about the share of non-monetised transaction in the total economy.[6] According to his estimates, percentage of national income monetised remained more or less at a constant level around an average of 83 to 84 per cent during the period 1961-62 to 1974-75. Be that as it may, we only need to stress that any trend or fluctuation in the share of non-monetised transaction may render the usual interpretation of observed labour participation rate invalid, since the substantial portion of labour engaged in non-monetised sector is not included in the census working force.

To be consistent with the CSO's definition of economic activity, any human effort resulting in products included in the domestic

product should be considered as work. Since no objective criterion for inclusion or exclusion of one output or the other in the domestic product exists, the CSO's definition of work can be of a heuristic nature only. Serious estimational problem may arise if such a definition of work is adopted for measuring the size of the working force or of the labour force. Some of these problems are discussed below in relation to the working force estimates given by the National Sample Survey Organisation (NSSO) in its employment and unemployment surveys since the NSSO adopts a definition of work very much similar to the one implicit in CSO's treatment of economic activities.

Concept of Work in NSSO

In its labour force surveys NSSO has classified all persons according to their activity situations. According to NSSO, "one of the following three major activity situation or a combination of them will obtain to a person:

i) Working or being engaged in gainful work for pay, profit or family gain (working),

ii) being not engaged in gainful work but either of making tangible efforts to seek gainful work or of expressing one's own availability for gainful work if the work is available (i.e., seeking work),

iii) being not available for gainful work because of various reasons (outside labour force)".

The gainful activity has been defined as "the activity pursued for pay, profit or family gain or in other words, the activity which *adds value to the national product*".[7] Thus, it is clear, irrespective of its status in the commodity market, an activity is considered by NSSO as an economic activity if its value is included in estimation of domestic product. However, while clarifying this aspect of its definition of gainful activity, NSSO adds: "Normally it is an activity which results in production of goods and services *for exchange*. However, the activities in agriculture in which the part or whole of the agricultural production is used for own consumption and does not go for sale are considered gainful". It has been further clarified that the phrase "activities in agriculture" used in the definition of gainful activities is meant to include all activities in industry division 'O' (i.e., primary industries other than cultivation).[8] Presumably this takes care of the entire primary sector. The production of non-marketed outputs is, however, not confined to the primary sector alone. From the estimates

given in Mazumdar and Chaturvedi (op. cit), it may be observed that 28.8 per cent of total expenditure on construction in farm business in rural areas was non-cash expenditure during the year 1971-72. The corresponding figure in respect of non-farm business was 11.2 per cent.[9] In respect of labour intensive *kutcha* construction, the share of unpaid family labour is expected to be large. It is not however clear whether such activities have been considered as gainful by NSSO. In fact even in the primary sector there are activities not considered as gainful by NSSO even if the output of these activities are included in the domestic product. For example, the activity of adding further value to a part of milk by its conversion to ghee, butter and *lassi* by producers for the purpose of home consumption is not considered gainful activity by NSSO.[10] The error arising out of such omission may, however, be quite marginal.

More importantly a sizeable section of the rural females may be recorded in any survey as non-workers although they may partly be engaged in activities which are considered economic in national income compilation irrespective of their status in the exchange economy. A study of the activity structure of rural females who are usually engaged in domestic duties brings home this point quite vividly. According to the result of the 32nd NSS Round, about 17 per cent of rural families were estimated to be engaged in domestic duties as well as in some specified activities like free collection of goods, maintenance of kitchen gardens, orchards, work in household poultry, dairy, etc. The percentage of rural females engaged in free collection of goods to total females of age 5 years and above and engaged in domestic duties was above 37 per cent. Analysing the survey results the NSSO concluded that "a large proportion of rural females engaged in domestic duties, whether they are rich or poor, married or unmarried, children or adult or associated with some ancillary activities, *though not recognised directly* as gainful".[11] That many of these ancillary activities are not considered gainful by the NSSO is also evident from the following clarification given regarding activity category '93' (i.e., attended domestic duties and was also engaged in free collection of goods, sewing, tailoring, weaving, etc., for household uses): "it is well known that normally a part of the total working time of the women usually engaged in household duties is spent on certain activities to meet the household needs. These activities are considered gainful if the goods or services produced as a result of such work are *essentially for sale*". However, for national income purposes many

of these activities are considered as gainful even if the outputs are meant for domestic consumption. For example, in the case of household poultry or dairy, the estimation procedure in national income copilation is such that even if outputs are used for domestic consumption they will be included in the national product. Similar is the case in respect of firewood and other minor forest products. The magnitude of error in estimation of sectoral output per worker due to non-inclusion of labour expended on such activities may not be negligible. For example, in the case of firewood the new national income series has revised upwards the output of firewood by Rs. 1,946 crores due to adoption of new norms for calculating unrecorded production. It is most likely that the major part of this unrecorded production would be carried out by unpaid women labour in addition to their household duties. It is also doubtful whether rural females carrying out any work in connection with the maintenance of the household milch animal will ever report themselves as engaged in secondary work, even if the output is sold in the market. The point that requires emphasis is that in a production system where productive activities cannot be distinguished in time and space from the non-productive activities, it may be impossible to bring strict correspondence between the estimated working force and the estimated national product. A better correspondence may, however, be obtained if separate estimates of marketed output and non-marketed output are provided in national income statistics.

Concept of Work in Censuses

The concept of work adopted in various censuses has been described in the following way. "The fundamental concept of economic activity of population adopted in recent censuses is almost same. Any work for which the person engaged therein is remunerated directly or indirectly in cash or in kind is to be considered as an economically productive work."[12] Although the definition is broad enough to be compatible with the one adopted by the CSO for national income accounting, in actual practice it may be seen that the census concept of work does not involve any 'evaluation for the purpose of inclusion in the national product' as an yardstick for demarcating the work from non-work. Thus the instructions manual of 1981 census says: "An adult woman who is engaged in household duties but doing no other productive work to augment the family resources should not be considered as 'working'. If, however, in addition to

her household work, she engages herself on work such as rice pounding *for sale or wages* or any domestic services *for wages for others* or minding cattle *for wages or selling firewood etc.*, should be treated as working. A man or woman who is doing household duties may be producing or making something only for domestic consumption of the household and not for sale. Such a person is not a 'worker.'"[13] The census, however, does not adopt the criterion of sale for activities broadly grouped under cultivation. But any activity other than cultivation but belonging to the broad industry division 'O' i.e., primary industries resulting in non-marketed output, will not be considered as gainful by census even if the value of such product is included in national income. Furthermore, the census definition of cultivation is quite restricted. According to the census instruction manual, a person can be classified as a cultivator or as an agricultural labourer only on the basis of crops grown. There are a number of crops which are not considered as cultivation in the census. They are plantation crops, edible nuts other than groundnuts, fruits, coconuts, vegetables, roots and tubers, flowers and arecanuts.[14] Since many of these crops are not necessarily meant for sale in the market only, the labour that will be expended on the non-marketed portion of the output of such crops will not be captured by the cencus. Therefore, no direct correspondence can exist between the size of working force given in the census and the output as measured by the CSO.

Worker and Non-Worker:

Despite the fact that concept of work itself has not undergone any major revision during the last four censuses, the criterion for inclusion of any person in the working force has changed substantially from one census to another.

In the 1951 census the working force comprised of two broad segments - self-supporting persons and earnings dependents. A self-supporting person was defined as one who earned enough to atleast support himself while an earning dependent was one who earned a small income in cash or kind (including unpaid income) not enough to support himself. The rest of the population were non-workers, i.e., non-earning dependents. A detailed classification of economic activity was provided only for self- supporting persons. The classification was based on the usual status of the self-supporting persons. The emphasis on income rather than work in the 1951 census led to an under estima-

tion of the working force, particularly in rural areas as many of the unpaid family workers were excluded from the working force although theoretically as per definition of earning dependents they should have been reported under this category.

In the 1961 census there was an usual status definition for a part of the working force and 'current status' for rest of the working force. In fact it was a mixture of 'gainful occupation' and 'labour force' approach. The labour force concept which was introduced in the Western countries around the 1930s to measure the current rate of unemployment always relates to a short reference period, whereas in the 'usual status' concept it is assumed that there is a normal attachment of the population of working age to some gainful occupation. Taking into account of the subsistence and predominantly agrarian nature of our economy, it was felt that the use of short reference period for collecting information on industry, occupation, etc., would not be appropriate for a large section of the working force. Therefore, in the case of agriculture, livestock dairying, household industry, etc., a person who works for atleast one hour a day for the major part of the working season was deemed as a worker. While in the case of trade, professions, services, business or commerce, only those engaged in work in the preceding 15 days were regarded as a worker.

1971 census adopted the concept of main activity, i.e., activity (not necessarily work) in which a person "engaged himself mostly". The entire population was first divided into two segments, viz., worker and non-worker on the basis of their man activity. A person whose main activity was non-work was also asked of his/her secondary activity (which can be work) but the order of the questions made a material difference in the results obtained. The effect of the 1971 census economic question was that many persons who had work of an intermittent nature reported non-work as their main activity and their secondary work was not appropriately recorded. In the 1961 census, many of these persons would have been recorded as worker. The reference period for the current status question was also reduced from a fortnight in the 1961 census to one week in the 1971 census. Since a person having atleast one day's work during the reference period was regarded as a worker (main or marginal), the reduction in the duration of reference period obviously entailed a reduction in the probability of a casual worker being recorded as a worker. The

reduction is likely to be more in the case of rural female workers as the incidence of marginal workers are more among them. The effect of reference period on participation rate may also be seen from the NSS 32 Round results which show that the current day status participation rate is lower than the current weekly status participation rate in respect of rural female in almost all states.[15]

The 1981 census economic questions started with a sorting question that was expected to net all workers except the chronically unemployed in the working force. Thus the 1981 census adopted a wider approach to the working force concept compared to even the 1961 census. Even one hour's work in the whole year would be enough to record one as a marginal worker in the 1981 census. In the 1961 census, however, the criterion for seasonal work was one hour's work a day during the major part of the working season. The reference period was one year for all types of workers in the 1981 census.

The above brief discussion of the economic questions included in the last four censuses points out that there had been differences in phrasing of the economic question, the order in which the question have been asked and the reference period, apart from the one in the basic concept of worker. However, it may be seen that the concept employed in the 1981 census is able to capture a larger portion of labour engaged in economic activities than that in the previous censuses and in this sense, it is a closer approximation to the national income concept.

In view of the definitional changes, it has become extremely difficult to compare work participation rates obtained from various census and throw light on the employment and unemployment situation in the country. A number of researchers have made efforts to make the working force data of different censuses comparable.[16] Very often the census participation rate has been compared with the participation rate obtained from NSSO surveys. In the absence of any reliability criterion, such exercises may be questioned on two grounds.

Firstly, the concept of work, as we have seen, is not the same as between the NSSO and the censuses. Secondly, the criterion of inclusion of a person in the working force is also not the same as between the two sources of data. For example, a person will be regarded as secondary worker by the NSSO only if the person pursues the secondary work with some regularity. In the 1981 census, however,

no such regularity in secondary work was required for a person to be included as a marginal worker.

Prior to the 1981 census, a detailed study was made wherein questions with different concepts were canvassed in some selected areas and the effect of the difference in concepts on the results was examined.[17] It was found that when the 1971 census concepts were used in the case of males, the participation rates from the pilot study fluctuated around the observed 1971 rates. In the case of females, the participation rates increased in all but one of the selected districts. Thus, even the same concepts may result in divergent participation rates between the two census and therefore to accept one participation rate from a particular census as a standard need not be valid.

In a comparative study of NSSO and census working force data, efforts were made to reconcile female work participation rate in rural areas obtained from the 32 Round NSS with the comparable 1981 census rate.[18] Despite making adjustments for conceptual differences, the NSSO estimates of rural women work participation rate was found to be higher by 6 percentage points compared to the census rate.[19]

Furthermore, the definition of work in census is mainly related to the marketed portion of domestic output except in respect of cultivation for which the criterion of market is not applied, and we have seen that the census definition of cultivation is a restricted one. In view of the above, it is an arduous task arriving at any firm conclusion from the census working force data about the temporal trend in the extent to which the population is engaged in economic activities.

Use of census work force data for National Income estimation:

The census work force data is also used for the preparation of benchmark estimates of domestic product in certain sectors. The list of these sectors is provided in Annexure I. It may be seen that around a quarter of gross domestic product depends on the estimates of working force from the population census. The problems with the estimates of domestic product of these sub- sectors is that any measurement error in the working force figures may seriously affect the reliability of the benchmark estimates themselves.

In respect of some of the unorganised sectors like unregistered manufacturing, personal services, household and retail trade, etc., the estimates of domestic product for the benchmark year are arrived at using the data of working force obtained from the census and value

added per worker data from the NSSO surveys. After having obtained the estimate of gross value added from the benchmark year the same is moved forward in some sectors with suitable quantum/volume indicators. For the rest of the above listed sectors, the working force estimates in the subsequent years are projected on the basis of the growth rate observed between the last two decennial censuses.

When those projected figures based on the growth rates observed between 1961-1971 are compared with the actual 1981 census figures, it is found that the projected figures differ substantially with the actual figures in various sectors, as may be seen below:

(Figures in thousands)

Sectors	Projected working force	Census working force (1981)
Business services	621	272
Legal services	162	238
Research and scientific services	67	110
Religious and other community services	485	632
Domestic services	810	1027
Laundry and related services	984	814
Hair dressing, etc.	828	706
Personal services not elsewhere classified	2462	408
Other services not elsewhere classified	751	2259
Total	7170	6,466

Source: Jagdish Kumar and L. P. Rai (1987).

Since census working force figures are released with a substantial time lag, the projected figures have to be used for compilation of domestic product originating from these sub- sectors. As a result the domestic product in these sector are either under-estimated or over-estimated depending upon the direction of bias in the working force estimates. Discussing the projected figures in relation to the census figures in respect of various types of services mentioned above, Kumar and Rai concluded that the "value added estimates in respect of each of the above services .... are affected resulting in either over-estimation or under-estimation depending upon whether projected working force figures is higher or lower than the census figures. However, at the aggregate level we have found that these estimates tend to cancel out and estimates of value added for the year 1980-81 seem to be only marginally under estimated".[20] No substantative evidence, however, has been provided by them in support of their above conclusion. In

fact, a comparison of the new national income series (with the base year 1980-81) which makes use of the working force data from the 1981 census, with the old 1970-71 series which used the 1971 census data, reveals substantial differences between the two series in their estimates of gross value added in these sub-sectors. The differences arise mainly due to new estimates of the number of workers engaged in these services.

In a similar exercise, for the state of Kerala, income originating in some of the above mentioned sub-sectors have been estimated based on the growth rates of working force observed between 1961 and 1971 census as well as between 1971 and 1981 census.[21] It is found that the estimated incomes according to two growth rates differ substantially. For the four sectors, namely, water supply, other services, medical and health (private sector) and business services, the estimated income based on 1961-71 growth rate is found to be almost 20 per cent higher than the one based on 1971-1981 growth rate.

Furthermore, for the purpose of arriving at bench mark estimates of domestic product in these sub-sectors, the size of the total number of workers (i.e., both main workers and subsidiary workers) are required to be estimated for each of these sub-sectors. It has been observed by many others and also accepted by the census authorities that the size of the subsidiary workers were substantially under estimated during the 1971 census. As a result, the extent of over-or under-estimation may be more than what has been conjectured by Kumar and Rai. The obvious conclusion is that the estimation of domestic product on the basis of working force data of censuses leaves much to be desired.

Conclusion:

The above discussion about the concept of 'work' and 'worker' in both census and CSO/NSSO points out that the correspondence between the working force data from census and income data from CSO is quite weak. The worker participation rate obtained from census figures, therefore, may have to be interpreted with caution, as the institutional restructuring of the production organisation may bring an unknown extent of changes in the participation rate.

The concept of work adopted by NSSO is nearer to the concept of work implicit in CSO's definition of economic activities. Since identification of activities as economic activities in conformity with the CSO's definition at the field level requires asking of probing

questions and expertise in investigation, it will be better if the estimation of size and sectoral distribution of the working force for the purpose of national income estimation is done with the help of regular labour force survey than by a nationwide census operation. The problem of non-availability of state level estimate of size and detailed sectoral distribution of working force may be overcome by enlarging the sample size and by suitable modification in sampling design, if required. The census working force data will, however, continue to be useful for other analytical studies but their use for national income compilation should be avoided. The definition of worker adopted in the 1981 census should be adopted for future censuses also.

Implementation of these suggestions will go a longway to increase the reliability of our national income estimates for the unorganised sector and bring about much needed correspondence between working force and national income data.

ANNEXURE—I

Gross domestic product at factor cost by industry of origin for the sectors for which population census figures are used for estimation of domestic product.

(Figures in Rs. crores)

Sector	Old series		New series
	1970-71	1984-85	1985-86
1. Unregistered Manufacturing	1817	9695	15795
2. Water Supply	29	185	223
3. Transport by other means (a)	773	6572	6760
4. Trade, Hotels and Restaurant (b)	4042	27194	27376
5. Business Services	87	896	349
6. Research & Scientific Services	17	68	465
7. Religious & other Community Services	53	181	275
8. Legal Services	51	198	593
9. Recreation and entertainment	48	123	616
10. Personal Services	269	2125	1353
11. Services n.e.c	150	167	1171
12. Subsistence fishing (c)	11	69	N.A.
13. Total	7347	47473	54976
14. (13) as % of total GDP at current prices	20.0%	24.9%	23.6%

Notes: (a) Public Sector GDP originating in this industry has been deducted from total gross value added reported in this industry.

(b) As in (a).

(c) Value of output of this sector has been taken as equal to gross value added.

N.A. Not available.

Notes

1. For a discussion on the concept of 'economy', see Godelier (1972), pp 251-257.
2. In a survey of the treatment of subsistence activities in national accounts of 48 developing countries, it was observed that the share of non-monetary value added in total GDP ranges from over 40% from the poorer countries of Africa to 5% or less for the more advanced countries of Latin America and Southern Europe [See Blades (1975 A)]. In another survey of 70 developing countries it has been shown that "in nearly 40 per cent of the reporting countries non-monetary activities account for 20 per cent or more of total GDP and for 10 per cent or more in above two-thirds of the countries" [See Blades (1975 B)].
3. See CSO (1983).
4. See, for a discussion, Weinrobe (1974) and Mukherjee (1985).
5. See Mazumdar and Chaturvedi (1981).
6. See Madalgi (1976).
7. NSSO (January 1980).
8. Ibid.
9. Mazumdar and Chaturvedi (op. cit).
10. Jacob (April 1986)
11. NSSO (January - April 1981)
12. Quoted from the note presented by the RG's office at the First Data User's Conference for the 1981 Census, published in Registrar General (1983).
13. Ibid p 43.
14. Ibid p 48.
15. NSSO (Jan - April 1981).
16. For example, see Krishnamurthy (1984), Sinha (1982), Jacob (1986).
17. Quoted in Registrar General (1983).
18. See Jacob (1986).
19. Ibid p 13.
20. See Kumar & Rai (1987).
21. See Nair (1987).

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Performance of Infrastructure Industries and their Prospects in the Seventh Five Year Plan

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Introduction

INFRASTRUCTURE industries, apart from being major industries by themselves, are also core industries producing the vital inputs required by other industries. The production trends of these industries thus influence the trend in overall industrial production in the economy and achievement of production targets in the industrial sector very much depends on the achievement of the targets for the infrastructure industries. The group of infrastructure industries comprises coal, cement, crude petroleum, petroleum products, saleable steel and electricity. It is in the context of the key role of infrastructural industries in industrial development, that an attempt has been made in this paper (i) to study the statistical relationship of the Index of Infrastructure Industries (INFR) with the general Index of Industrial Production (IIP), (ii) to review the production trends in the infrastructure industries in the first two years of the Seventh Plan and (iii) to estimate growth rates required to be achieved in the remaining three years of the Seventh Plan to realise the overall production targets.

The study is organised into four sections. Section I deals with the statistical relationship between production of infrastructure industries and total industrial production. Section II provides a synoptic review of the performance of these industries during the past two decades. Section III discusses the production prospects in the Seventh Five Year Plan and Section IV presents conclusions.

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* P.C. Sarker is a Research Officer in the Division of Statistical Analysis, Department of Statistical Analysis and Computer Services. The author is indebted to Shri S.P Gothoskar and Shri R. Nagaraja Rao for their valuable suggestions on an earlier draft of this paper. He is also thankful to Shri K.G.K. Subba Rao and Smt. R.R. Arif, for their guidance. Thanks are due to Smt. L.A. Koparkar and Smt. Philo Joseph for the assistance rendered. This paper was presented at the Econometric Conference held at Bangalore in January 1988.

I

Impact on Total Industrial Production

For analysing the impact of infrastructure industries on the rest of industrial economy, the obvious method would be to construct the relevant input-output table, which brings out the direct as well as the indirect effect of these industries. This has not been attempted here; the scope of the article is rather confined to finding out the most appropriate statistical relationship between the level of output of infrastructure industries and the output of all industries, mainly for two reasons. First, there is a substantial computational advantage in using the statistical relationship straightaway and secondly, such a statistical relationship may be easily used for predicting likely levels of IIP, in a situation where production data for infrastructure industries are available with much less time lag than similar data for overall industrial production.

In order to determine the quantitative impact of the production of infrastructure industries on the total industrial production, five linear regression equations were fitted to the data on their production indices for the period April 1981 to December 1986. The indices for infrastructure industries considered for this purpose were also compiled on the basis of the weighting diagram adopted for the revised series of index of industrial production with the new base 1980-81 = 100 (Table 1).

Besides the equation (Eqn. 1) envisaging contemporaneous relationship between IIP and INFR, equations have been formulated

Table 1: Weighting Diagram of Infrastructure Industries

Industry	Weights		Increase in weights in revised series (in percentage)
	1970=100	1980-81=100	
1. Coal	5.8430	6.6082	13.10
2. Saleable Steel	3.8774	5.2092	34.35
3. Crude Petroleum	1.5460	2.4073	55.71
4. Petroleum Products	1.6200	1.5192	-6.22
5. Cement	1.1700	1.5983	36.61
6. Electricity	9.2300	11.4290	23.82
Infrastructure Industries	23.2864	28.7712	23.55

to test lagged effects of INFR as well as effects of a mixed nature (i.e., a combination of lagged effects from infrastructures other than 'electricity' and instantaneous effect from 'electricity') (Table 2). Further, the relationship has been tested based on actual index numbers as well as detrended series. While Equation 1 deals with instantaneous relationships, Equation 2 regresses IIP on INFR with a month's lag.

Considering 'electricity' as a case of instantaneous impact, separate index of 'non-electricity' group has also been compiled. While, Equation 3 tries to capture the impact of 'electricity' on total inudstrial production, in Equations 4 and 5, IIP is regressed on Index of Electricity (IEL) and Index of Non- Electrical (INEL) group of infrastructures, with INEL operating instantaneously (Eqn. 4) and with a lag (Eqn. 5).

Briefly the results show that the lag effect of the production of infrastructural industries on overall industrial output (Eqn. 2) is weaker than the instantaneous effect (Eqn.1). As for the formulations envisaging separate effects on industrial output from 'electricity' and 'non-electricity' components of infrastructures, all the three equations (Eqn. 3 to 5) reveal no satisfactory results, with the presence of auto-correlated disturbances.

Table 2: Regression Equations for Study Relationships Between IIP and INFR

Eqn. No.					$\bar{R}^2$	DW	SEE
(1)	IIP	= 11.249	+ 0.830 (INFR)		0.966	1.708	3.09
	't'	= 4.291	44.322				
	Elasticity	= 0.0891	0.911				
(2)	IIP	= 59.977	+ 0.488 ($INFR_{-1}$)		0.533	1.620	11.546
	't'	= 7.882	8.859				
	Elasticity	= 0.475	0.525				
(3)	IIP	= 15.425	+ 0.834 (IEL)		0.860	0.847	7.200
	't'	= 2.797	20.795				
	Elasticity	= 0.120	0.880				
(4)	IIP	= 5.976	+ 0.461 (INEL)	+ 0.393 (IEL)	0.966	1.423	3.570
	't'	= 2.126	14.581	10.880			
	Elasticity	= 0.046	0.538	0.415			
(5)	IIP	= 0.282	0.166 ($INEL_{-1}$)	+ 0.697(IEL)	0.876	1.397	6.781
	't'	= 1.671	3.127	12.085			
	Elasticity	= 0.072	0.192	0.736			

IIP = Index of Industrial Production, INFR = Index of Infrastructure Production, IEL = Index of Electricity Generation, INEL = Index of Industrial Production other than Electricity.

In order to compare the trend and seasonality patterns of INFR with those of IIP, linear trend equations were fitted to both IIP and INFR data for the period April 1981 to December 1986. The results are contained in Table 3. The purpose of Equations 6 and 7 is to compare the trend patterns in IIP and INFR. The intercept for INFR is slightly higher and the growth part (i.e., contributory part or regression coefficient) for INFR is also higher. It shows that in the revised series (base: 1980- 81 = 100),the starting point of the INFR series was at a higher level and its growth during the period (April 1981 to December 1986) was also at a higher rate than the growth rate in the general index.

Table 3: Regression Equations for Trend Fitting for the IIP & INFR Series

Eqn. No.			$\bar{R}^2$	DW	SEE
(6)	IIP	= 100.045 + 0.749^t	0.788	1.394	7.769
	't'	= 52.905 15.949			
	Elasticity	= 0.792 0.208			
(7)	INFR	= 108.065 + 0.873^t	0.761	1.589	9.777
	't'	= 45.409 14.764			
	Elasticity	= 0.780 0.220			
(8)	ΔIIP	= 0.0005 + 0.7368 (Δ INFR)	0.858	1.595	2.909
	't'	= 0.001 20.266			

Δ IIP and Δ INFR represent detrended series of the respective indices.

Detrending of the series has been done by subtracting the expected/estimated values of indices from the corresponding actual values. The estimated values are obtained from Equations 6 and 7. It is assumed that the time series are of additive model, i.e., Y= T + S + C + I. Again for the short period, the trend effect and cyclical effect may be considered together, both representing trend effect. The detrended series are:

$$\Delta \text{ IIP} = \text{IIP} - (\hat{\text{IIP}})$$

and Δ INFR = INFR - $(\hat{\text{INFR}})$

These two series Δ IIP and Δ INFR represent the seasonal components of IIP and INFR series mainly. In Equation 8, a simple linear model has been fitted to these two detrended series, which shows a satisfactory fit.

Again, seasonal factors are obtained by Burman's method and are given in Table 4.

Table 4: Seasonal Factors of Index of Industrial Production and Index of Infrastructure Industries' Production

Months	IIP	INFR
January	106.00	107.15
February	101.65	100.38
March	112.74	116.16
April	94.68	93.34
May	95.60	95.31
June	96.28	92.45
July	95.97	96.28
August	96.41	96.30
September	96.74	96.71
October	96.35	98.82
November	98.76	99.46
December	108.80	107.65

These results show that the seasonal components of two series move in the same direction (Two graphs showing their trends and seasonal factors are given at the end of this paper).

In reviewing the results presented above, an aspect which requires an explanation relates to a drastic reduction in $\bar{R}^2$ from Equation 1 (contemporaneous) to Equation 2 (with just a month's lag). We have explored the possible explanation for this behaviour and found that 'electricity', which accounts for about 40 per cent of the total weight of the infrastructure industries,has probably instantaneous effect and is consumed almost without any time lag in the various industries where it is used as input. Besides, most of the thermal power stations, which are situated at nearby collieries, use direct supply of coal for the generation of electricity. It is seen from the 'input-output' table, as given in the Sixth Plan document for the year 1979-80, that 30 per cent of 'coal and lignite' and about 6 per cent of 'petroleum products' were used in 'Gas, Electricity and Water Supply' sector which are also used instantaneously. Besides, it is well known that during the study period, there was no demand constraint for the products of infrastructure industries; instead supply constraints were a known feature. Generally, time lags in consumption increase if there are no supply constraints and if supply outstrips demand. Therefore, a major part of the output of these industries and their subsequent use as intermediate inputs may well be considered as instantaneous.

II

Performance During Past Two Decades (1965-66 to 1984-85)

The data on production of infrastructure industries have been analysed for the past two decades covering the period 1965-66 to 1984-85 corresponding to non-plan periods as well as plan periods (fourth plan to sixth plan). The targets and actual production of infrastructure industries for different plans are given in the Statement-1 and corresponding growth rates are given in the Statement-2. The overall growth in the production during this period of 'saleable steel' and 'coal' were rather very sluggish, their compound growth rates during the period 1965-66 to 1984-85 being only 3.56 per cent and 4.81 per cent, respectively. The growth rates in respect of 'cement', 'petroleum products' and 'electricity' were , however, relatively high at 5.55 per cent, 6.88 per cent and 8.55 per cent, respectively. 'Crude petroleum' was the only industry which recorded a high impressive growth rate of 11.82 per cent. The growth rate of 'crude petroleum' was particularly remarkable in the Sixth Plan period. Industry-wise analysis in detail is presented below:

Coal: Considering the weightage allotted to it in the index of industrial production, it is the second most important infrastructure industry; next to electricity. The production of coal which was merely 35 million tonnes in 1951 rose to 79 million tonnes by the end of terminal year of Fourth Plan. After nationalisation of coaking coal mines in 1972 and non-coaking coal mines in 1973, re-organisation and reconstruction of the exisiting mines involving new methods and technology were taken up. As a result,production had gone up to hundred million tonnes in 1975-76 (i.e., the second year of Fifth Plan). In the later part of the Fifth Plan, stagnation of production was witnessed at around 101 million tonnes a year (Statement-5). Considering the level of demand, the target of production was fixed at 165 million tonnes for the last year of Sixth Plan. During the first two years of Sixth Plan there was a remarkable growth in production (Statement-3 & 4). The growth rate in first year (1980-81) and in second year (1981-82) was 9.6 per cent and 9.1 per cent respectively. But this growth rate could not be sustained in the remaining three years. The overall annual compound growth rate in Sixth Plan was 7.3 per cent which

is higher than those in the Fifth and Fourth Plans. The targets set for different plans and their achievement in percentage of target (POT) are given in Table-5.

Table 5: Targets and Achievements in Coal Production

End year of plan	Production (in MT)		Achievement (in POT)
	Target	Actual	
1965-66 (3rd Plan)	97.32	67.73	69.80
1973-74 (4th Plan)	93.60	79.00	84.40
1978-79 (5th Plan)	124.00	101.95	82.22
1984-85 (6th Plan)	165.00	147.45	89.36

From the above Table 5, it is observed that target set for coal production in Fourth Plan was lower than that in the Third Plan. The POT achievement in Fourth Plan onwards was higher exceeding 80 per cent of the targets. The target in Fifth Plan was higher by 30.4 million tonnes than that was in Fourth Plan and subsequently the production rose by 22.95 million tonnes in Fifth Plan. The POT achievement of Fifth Plan was 82.22 per cent, slightly lower than Fourth Plan's POT achievement. In the Sixth Plan, the target was higher by 41 million tonnes and actual production was higher by 45.5 million tonnes compared to that in the Fifth Plan and POT achievement was 89.36 per cent. The actual production rose by 44.63 per cent in the Sixth Plan over the corresponding levels in the Fifth Plan. All these show that performance of coal industry was better in Sixth Plan than in earlier three Plans.

Crude Petroleum: Starting from a meagre 0.27 million tonnes in 1951 and 0.51 million tonnes in 1961, domestic crude petroleum production went upto 7.20 million tonnes by the end of Fourth Plan (i.e., 1973-74). Upto 1975-76, the production of crude petroleum was exclusively from the fields of Cambay and Assam-Arkan basins. The major contribution came from Bombay High off-shore field which attained a production potential of 5.0 million tonnes of crude per year after completion of phase III-A of the Development in December 1978. As a result, actual production rose by 146.30 per cent during the Sixth Plan at an annual compound growth of 20 per cent (approx.) exceeding the targeted rate of production of 12.9 per cent. The actual growth rates in Fourth and Fifth Plans were 3.5 per cent and 10.0 per cent as against targeted rates of 7.0 per cent and 14.5 per

cent, respectively. The targeted growth rate in the Sixth Plan was 12.9 per cent and actual rate was much higher at 19.7 per cent. Though there was an impressive achievement in Sixth Plan, the achievements were unevenly distributed over the years (statements-3 & 4). The rate varied from—9.7 per cent in 1980-81 to 54.2 per cent in 1981-82. The targets and their achievements in POT are given in Table 6.

Table 6: Targets and Achievements in Crude Petroleum Production

End year of Plan	Production (in MT)		Achievement (in POT)
	Target	Actual	
1965-66 (3rd Plan)	—	3.47	—
1973-74 (4th Plan)	8.50	7.20	84.80
1978-79 (5th Plan)	14.18	11.60	81.80
1984-85 (6th Plan)	21.60	28.99	134.21

The POT achievement in Sixth Plan was 134.21 per cent while the same was 84.80 per cent in Fourth Plan and 81.80 per cent in Fifth Plan This shows that the production performance of crude petroleum during Sixth Plan was the best among all the earlier plans.

Saleable Steel: The production of saleable steel including the production of mini steel plants was only 2.36 million tonnes in 1951 and 3.85 million tonnes in 1961. In the Fourth Plan, there was a little progress and the annual compound growth rate of production was only 1.1 per cent (Statement - 2). In the Fifth Plan, substantial growth in production was noticed. The compound rate of growth was 9.3 per cent and India became a net exporter of steel during 1976-77 and 1977-78. In 1979-80, production fell by 13 per cent over the preceding year 1978-79. With this low production base year 1979-80, the overall growth rate achieved in Sixth Plan was 3.5 per cent. The setbacks in Sixth Plan were in 1982-83 and 1983-84 due to low production by the major/integrated steel plants. Even, if we compare the end year production of Sixth Plan with the end year production of Fifth Plan, the actual growth rate was only 1.4 per cent. Though there was no distinct trend in the industrial production in case of major steel plants there was a constant increasing trend in case of production of mini steel plants. Further the production share of mini steel plants in total production was increasing over the years. Table-7 shows the outputs of major and mini steel plants and the share of mini steel plants.

Table 7: Production of Saleable Steel

Year	Production (in MT)			Share of mini steel plant (in percentage)
	Total	Major plant	Mini plant	
1975-76	6.21	5.43	0.78	12.56
1976-77	7.62	6.61	1.01	13.26
1977-78	7.77	6.62	1.15	14.80
1978-79	8.06	6.54	1.52	18.86
1979-80	7.38	5.79	1.59	21.57
1980-81	7.82	5.93	1.89	24.17
1981-82	8.80	6.64	2.16	24.55
1982-83	9.09	6.86	2.23	24.53
1983-84	8.43	6.01	2.42	28.71
1984-85	8.77	6.31	2.46	28.05
1985-86	10.07	7.07	3.00	29.79

Source: *Financial Express*, Bombay (Text of the Welcome address by Shri S.N. Agarwal, Chairman, Steel Furnance Association of India).

The POT achievement in Fifth Plan and Sixth Plan was 90.5 per cent and 76.2 per cent, respectively. As against the actual production capacity in 1984-85 of 12.54 million tonnes, the capacity utilisation was only 69.94 per cent which was very low in comparsion to other industrialised countries. The capacity utilisation in the intergrated steel plants was 90 per cent in 1977-78 but due to setback in production it came down to 81.59 per cent in 1978-79 and further down to 69 per cent in 1979-80. The shortfall in the production of saleable steel, particuarly in the integrated steel plants, had been primarily on account of infrastructural constraints in terms of availability of coal, power and rail transport.

Cement: The installed capacity of cement increased from 3.3 million tonnes in 1950-51 to 44.0 million tonnes in 1985-86 at an average compound growth rate of 7.7 per cent per annum. During the same period, the actual production of cement rose from 3.0 million tonnes to 33.1 million tonnes at the rate of 7.1 per cent per annum. Despite the fact that the cement industry has grown considerably over the years in respect of installed capacity and production, it has, by and large, failed in accomplishing the targets fixed for the Five Year Plans. Except during the Sixth Plan, when the target for installed capacity was almost fulfilled, the achievements in all previous plans fell short of targets. Within the domain of the study period, the POT achievement varied from 81.5 per cent in Fourth Plan to

92.8 per cent in Fifth Plan. There was an outstanding performance in the Second Plan with a growth rate of 11.5 per cent but in the subsequent plans it came down. It was 3.8 per cent in Fourth Plan, 5.6 per cent in Fifth Plan and 11.3 per cent in Sixth Plan.

Though the installed capacity over the years was increasing, the capacity utilisation of cement industry did not keep pace with the growth in installed capacity (Table-8).

Table 8: Plan Targets and Actuals of Installed Capacity and Production in Cement Industry

End year of Plan	Capacity (in MT)			Production (in MT)			Capacity utilisation (in percentage)
	Target	Actual	POT	Target	Actual	POT	
1965-66 (3rd Plan)	15.00	11.60	77.33	13.00	10.82	83.31	93.28
1973-74 (4th Plan)	21.50	19.76	91.91	18.00	14.67	81.50	74.24
1978-79 (5th Plan)	23.50	22.30	94.89	20.80	19.30	92.79	86.55
1984-85 (6th Plan)	43.00	42.50	98.84	34.50	30.17	87.45	70.99

The POT achievement in installed capacity were increasing over the plans. The achievement which was 77.33 per cent in Third Plan rose to 98.84 per cent in Sixth Plan. The POT achievement in production witnessed a different pattern. It was highest in Fifth Plan and next to that was in Sixth Plan. The capacity utilisation reduced from 93.28 per cent in Third Plan to 86.55 per cent in Fifth Plan and further reduced to 70.99 per cent in Sixth Plan. Though, the performance in Sixth Plan in respect of compound growth rate can be considered as good but capacity utilisation was the lowest at 71 per cent. Again, in the Sixth Plan, yearly growth rate varied from 2.49 per cent in 1980-81 to maximum 16.66 per cent in 1981-82, the second year of the plan (Statement- 4).

Petroleum Products: The consumption of petroleum products which was 5.2 million tonnes in 1956 registered a more than four fold increases by 1973 when it touched 23.7 million tonnes. During the same period, the actual production rose from approximately 3.5 million tonnes to 19.13 million tonnes showing around five-fold increase. Even with this record increase in production, the demand could not be fully met. After a brief respite - due to price increase - when it remained static at around 23 million tonnes, the growth in consumption has

been quite perceptible being 25.4 million tonnes in 1976-77, 27 million tonnes in 1977-78 and 29.65 million tonnes in 1979-80. The estimated demand for petroleum products was 45.5 million tonnes by 1984-85 and actual production was 33.07 million tonnes which shows that production continued to fail to catch up with the demand. During the last two decades (between 1965 and 1985) production rose from 9.65 million tonnes to 33.07 million tonnes with an annual compound growth rate of 6.35 per cent. In the first three years of Annual Plan (1966-69) at the beginning of two decades, the growth rate was comparatively high with an annual compound growth rate of 17.9 per cent (compound). Thereafter, the rate was 5.0 per cent in fourth plan, 4.2 per cent in fifth plan and 5.2 per cent in sixth plan (statement-2). The POT achievement in different plans are given in the following Table-9.

Table 9: Targets and Actual Production of Petroleum Products

End year of Plan	Production (in MT)		POT Achievement (in percentage)
	Target	Actual	
1965-66 (3rd Plan)	9.86	9.40	95.33
1973-74 (4th Plan)	26.00	19.70	75.77
1978-79 (5th Plan)	27.00	24.20	89.63
1984-85 (6th Plan)	35.30	33.30	94.33

In the Third Plan, POT achievement was the best among those in all the four plans. More or less, it was equally good in the Sixth Plan. The growth distribution in different years of Sixth Plan varied from a decline of 6.6 per cent rate in first year to 16.9 per cent in second year and it remained at same level in the last year of the plan (Statement-4).

Electricity: Among all the infrastructure industries, electricity can be considered as the most crucial industry. It carries a weightage of 11.43 per cent out of 28.77 per cent alloted for these six industries in compilation of index of industrial production. The level of electricity generated in 1951 was 5.86 billion kwh (i.e. 5.86 Twh) which rose to 16.94 Twh in 1960-61 (end year of Second Plan) indicating a three fold increase in a decade. By the end of Third Plan the level of electricity generation rose to 32.99 Twh registering a two fold increase in Third Plan itself. Again in the three annual plans (i.e. 1966-69), generation of electricity increased by an annual compound growth

rate of 12.5 per cent. Subsequently it failed to maintain this trend in the Fourth Plan. In the Fifth Plan, growth rate was higher than that was in Fourth Plan. The POT achievements in Fourth and Fifth Plans were more or less same, around 91 per cent. In the Sixth Plan, the growth rate was lower and POT achievement came down. The major constraints were non-availabilty of coal, shortage of wagons (transport) and break-down at different installations. However, growth rate in generation on the basis of indices of electricity generation was 8.2 per cent in Sixth Plan and it failed to reach targeted growth of 11.3 per cent per annum set for Sixth Plan. The POT achievement decreased from 91.96 per cent in Fifth Plan to 82.20 per cent in Sixth Plan. The total installed capacity of power generation in 1973-74 was 16,663 MW increased to 42, 491 MW in 1984-85 and is expected to rise further to 64,736 MW by 1989-90. The break-up of installed capacity for different types of power and their growth rates are given in Table-10 and Table-11, respectively. Similarly, production and growth rates are given in Table-12 and Table-13 respectively.

From Table-10 it is observed that installed capacity remained at 640 MW upto 1979-80 in case of nuclear energy, whereas in case of thermal, it increased from 9,058 MW in 1973-74 to 16,424 MW in 1979-80. In Sixth Plan,the installed capacity in nuclear energy increased to 1,095 MW but its shares in total generation was the same as in the Fifth Plan. Over the years, the share of thermal energy increased from 54.4 per cent in 1973-74 to 63.7 per cent in 1984- 85 while shares of hydel decreased from 41.8 per cent in 1973-74 to 33.7

Table 10: Installed Capacity of Power Generation (in MW)

End year of Plan	Hydel	Thermal	Nuclear	Total
1973-74 (4th Plan)	6,965	9,058	640	16,663
	(41.8)	(54.4)	(3.8)	(100.00)
1978-79 (5th Plan)	10,833	15,207	640	26,680
	(40.6)	(57.0)	(2.4)	(100.00)
1979-80 (Annual Plan)	11,384	16,424	640	28,448
	(40.0)	(57.7)	(2.3)	(100.00)
1984-85 (6th Plan)	14,314	27,082	1,095	42,491
	(33.7)	(63.7)	(2.6)	(100.00)
1989-90 (7th Plan)	19,855	43,081	1,800	64,736
(Target)	(30.7)	(66.5)	(2.8)	(100.00)

Source: Five Year Plan Documents

Note : Figures in bracket are percentage to total installations.

Table 11: Installed Capacity—Compound Growth

(in percentage)

Period	Hydel	Thermal	Nuclear	Total
1973-74 and 1978-79 (5th Plan Period)	9.2	10.9	0.0	9.9
1978-79 and 1979-80 (Annual Plan Period)	5.1	8.0	0.0	6.6
1979-80 and 1984-85 (6th Plan Period)	4.7	10.5	11.3	8.4
1984-85 and 1988-89* (7th Plan Period)	6.8	9.7	10.5	8.8

Source: Compiled on the basis of Table 10.
Note : * Expected growth rate.

Table 12: Power Generation

(in TWH)

End year of Plan	Hydel	Thermal	Nuclear	Total
1973-74 (4th Plan)	29.0	35.3	2.4	66.7
	(43.5)	(52.9)	(3.4)	(100.00)
1978-79 (5th Plan)	47.1	52.6	2.8	102.5
	(46.0)	(51.3)	(2.7)	(100.00)
1979-80 (Annual Plan)	45.4	56.3	2.9	104.6
	(43.4)	(53.8)	(2.8)	(100.00)
1984-85 (6th Plan)	53.8	98.8	4.0	156.6
	(34.4)	(63.1)	(2.5)	(100.00)
1989-90 (7th Plan) (Target)	—	—	—	280.4

Source: Five Year Plan Documents,

per cent in 1984-85. The annual compound growth rate in installed capacity was generally higher in case of thermal power than hydel power.

The overall growth rate in installed capacity was 9.9 per cent in fifth plan as against 8.4 per cent in sixth plan (Table- 11). Table-12 shows that sharing pattern of actual generation of electricity followed closely the pattern of sharing in total installation capacity (Table-10). During the Fifth Plan the overall growth in generation of electricity was 9.0 per cent (Table-11). The growth rate in hydel, thermal and nuclear was 10.2, 8.3 and 3.1 per cents, respectively. The performance of electricity generation was very poor in 1979-80. During this annual plan, generation of power rose by 2.0 per cent only. This is mainly due to sluggish growth of hydel power while produc-

Table 13: Power Generation—Annual Compound Growth Rate

(in percentage)

Period	Hydel	Thermal	Nuclear	Total
1973-74 and 1978-79 (5th Plan Period)	10.2	8.2	3.1	9.0
1978-79 and 1979-80 (Annual Plan Period)	-3.6	7.0	3.6	2.0
1979-80 and 1984-85 (6th Plan Period)	3.5	11.9	6.6	8.4
1984-85 and 1989-90 (7th Plan Period) (Targeted)	—	—	—	—

Source: Compiled on the basis of Table 12.

tion declined by 3.6 per cent over the previous year. In the Sixth Plan the performance of thermal power was better with a growth rate of 11.9 per cent but the performance of hydel power did not improve.

The overall growth rate in the Sixth Plan was 8.4 per cent which is much below the targeted growth rate of 11.3 per cent per annum.

Shortfall in Performence: It is observed that the infrastructure industries as a whole failed to achieve the targeted growth rate in all the three preceding plans viz., Fourth, Fifth and Sixth Plans. The shortfalls in realisation of targets have been calculated on the following basis.

$$\text{Shortfall (per cent)} = \frac{(\text{Target Rate} - \text{Actual Rate})}{\text{Target Rate}} \times 100$$

The calculated shoftfall are given in the following Table-14.

Table 14: Shortfall in Realisation of Targeted Growth

(in percentage)

Indusry	4th Plan	5th Plan	6th Plan	Average
1. Coal	64.3	44.7	25.8	44.9
2. Crude Petroleum	50.0	31.0	-52.7	9.4
3. Saleable Steel	N.A.	19.1	62.4	40.8
4. Cement	53.1	22.2	21.0	32.1
5. Petroleum Products	54.5	35.4	18.8	36.2
6. Electricity	21.5	16.7	38.1	25.4
Infrastructure Industries[1]	41.3	26.7	30.8	32.9
	(40.7)	(26.1)	(30.1)	(32.3)

Note: Figures in brackets are calculated on the basis of new weights.

1 weighted average.

Table 14 shows that barring crude petroleum which in Sixth Plan exceeded the target, all other industries failed to achieve the targets in all the three plans. Overall shortfalls in infrastructure industries was highest during Fourth Plan followed by Sixth Plan and Fifth Plan in that order. The average shortfall in infrastructure industries during these three plans was 32.3 per cent (new weights) which means that on an average two third of targets set in different plans could only be achieved.

III

Prospects in the Seventh Five Year Plan

The monthly production indices of infrastructure industries for 1985-86 and 1986-87 and their growth rates are given in statement-6. Annual compound growth rates for the Seventh Five Year Plan and yearly targeted growth rates for the first two years alongwith the growth rates already achieved in the first two years are shown in this statement. While their performance was good in the first year of the Seventh Plan with 'saleable steel', 'crude petroleum' and 'petroleum products' reaching the plan's targeted growth rates, the production in the second year of the plan was, however, much less impressive with none of the industries achieving the targets. Industry-wise analysis in detail is given below:

Coal: Considering the actual production of about 147 million tonnes of coal in 1984-85 the target level of 226 million tonnes by the end of the Seventh Plan requires a compound growth of 8.9 per cent per annum which seems to be comparatively on a high side. Actual growth rate achieved in Sixth Plan was 7.2 per cent. The growth rate in the first year (1985-86) is only 4.63 per cent with the actual production being at 154.24 million tonnes. In the second year the growth rate improved to 7.7 per cent with the actual production rising about 166 million tonnes. Therefore, to achieve the plan target in the next three years, the compound growth rate has to be of the order 10.8 per cent.

Crude Petroleum: With the discovery of the new oil fields/new wells in different parts of the country (at the off- shores of Bombay and Gujarat, at Cauvery Basin in A.P., at oil fields of Assam, and in Nagaland and Arunachal Pradesh), the prospect of achievement of the target set for the Seventh Plan has become brighter in recent times.

Like in the Sixth Plan, the actual production may exceed the target of 34.53 million tonnes in the Seventh Plan also. Though in the first year with the growth rate of 4.1 per cent the plan target rate of 3.6 per cent was exceeded, the second year witnessed a drop in growth rate to just 0.88 per cent. Thus, in the next three years the compound growth rate should be of order 4.27 per cent per annum to achieve the overall target and this may not be difficult in the present context.

Saleable Steel: In the Seventh Plan, growth rates set for total production of all types of plants and integrated plants are 7.6 per cent and 7.5 per cent, respectively. There was an impressive achievement in total production in 1985-86 with the level increasing to 10.07 million tonnes in 1985-86 from 8.77 million tonnes in 1984-85 with a growth rate of 14.82 per cent. The production of integrated steel plants also rose by 11.29 per cent in first year, though in the second year the rate of growth dwindled to 5.52 per cent. The prospect of production of mini steel plants looks somewhat brighter. In the first year of Seventh Plan, the production of mini steel plants increased by 21.95 per cent and its share in total production also increased and stood at 29.79 per cent. The production of the integrated steel plants by the end of second year reached to a level of 8.22 million tonnes and for the remaining three years, a growth rate of 6.54 per cent would be required to reach the production target of 9.94 million tonnes.

Cement: The target for capacity and production have been fixed at 62 million tonnes and 49 million tonnes, respectively, in the Seventh Plan. Thus, this industry has to add 20 million tonnes extra capacity to achieve higher production levels. This presumes that in 1989-90, our cement plants would operate at 79 per cent capacity utilisation as against 71 per cent in Sixth Plan. The production by the end of first year of Seventh Plan went upto 33.13 million tonnes and during the second year of the Seventh Plan the level has gone up to 36.4 million tonnes. In the both years, the industry failed to achieve the yearly targeted growth rates of 11.3 per cent, and 10.4 per cent respectively. It also fails to achieve the annual compound growth of 10.2 per cent set in the Seventh Plan. With the production of cement at 36 million tonnes in 1986-87, it would require a compound growth rate of 10.42 per cent during the remaining three years to reach the level of 49 million tonnes by the end of 1989- 90. As the annual growth rates in the first and second years were 9.71 per cent and 9.29 per

cent, respectively, which were pretty close to the targeted growth rate, improvement in capacity utilisation may help to achieve the target.

Petroleum Products: Considering the past trend in consumption, the projection of demand for 1989-90 is estimated at 62 million tonnes and target of production, however, fixed at 45.5 million tonnes by that year. As against the targeted compound growth rate of 6.4 per cent per annum, the actual rate in the first year of Seventh Plan was as much as 20.67 per cent, exceeding the targeted growth rate for the first year (i.e., 18.5 per cent). In the second year also the actual growth rate at 6.3 per cent exceeded the target growth rate for the second year of 4.7 per cent. Accordingly, for the remaining three years of the Plan, a compound growth rate of 2.31 per cent only is necessary to achieve the overall plan target, and this seems to be quite feasible judged by the industry's growth rates so far.

Electricity: Considerable emphasis has been laid on electricity in Seventh Plan. In order to meet the requirements of electricity for industry, transport, agriculture and other sectors of the economy, target for electricity generation has been fixed at 280 billion kwh considering a low level capacity utilisation of 49.38 per cent. The actual installed capacity in 1984-85 was 42,491 MW which could produce electricity of 371 billion kwh and targeted capacity for Seventh Plan has been fixed for 64,736 MW which would be able to produce electricity of 567 billion kwh. Therefore, the expected annual compound growth rates in installed capacity and electricity generation works out to 8.8 per cent and 12.3 per cent, respectively. The capacity utilisation during the Sixth Plan was 42.2 per cent which showed the poor performance of the industry.

The actual generation of electricity in the first year rose to 170.05 billion kwh indicating a growth rate of 8.6 per cent. In the second year, the growth rate was of 10.3 per cent and the generation reached the level of 187.57 Twh. Therefore, to achieve the Plan's targeted rate of 12.3 per cent (compound) the growth rate will have to be of order 14.29 per cent in the next three years, which would be rather a difficult task. The targets for installed capacities for thermal and nuclear have been set on the higher sides which would require 9.7 per cent and 10.5 per cent compound growth rates in thermal and nuclear, respectively. The expected share of nuclear energy seems to remain, more or less, at the same level as it was in Sixth Plan.

The share of thermal power is likely to increase from 63.7 per cent in Sixth Plan to 66.5 per cent in Seventh Plan.

IV

Conclusions

The study shows that there exists a high degree of correlation between the production of this infrastructure group of industries and the overall industrial production. The growth and development of these industries set the trend of growth and development of the industrial sector as a whole.

The performance of the infrastructure industries over the past two decades fell short of the expectations in terms of the various plan targets. The shortfall exceeded 25 per cent for all the industries constituting the infrastructure group except for crude petroleum where the shortfall was around 9 per cent. In the Fourth Plan, the shortfall in infrastructure industries as a whole was 40.7 per cent (base: 1980-81 = 100). The performance of coal, petroleum products and cement were very subdued where the shortfalls were more than 50 per cent. In the Fifth Plan, the overall shortfall in the infrastructure industries was 26.1 per cent which was lower than that in the previous plan. Like in the earlier plan, the maximum shortfall was noticed in coal industry in the Fifth Plan. In the Sixth Plan, the performance of coal, cement and petroleum products was better compared to those in the earlier two plans. The production of crude petroleum which exceeded the target set forth in the Sixth Plan by 52.7 per cent established a unique performance in the industry in recent times. The good performance of these four industries was counter acted by the low performance of saleable steel and electricity. Thus, the overall shortfall of 30.1 per cent in the infrastructure industries group in the Sixth Plan showed 4.0 per cent deterioration in performance from that in the Fifth Plan.

Though, some signs of recovery were witnessed in the first year of the Seventh Plan, the same tempo could not be sustained in the second year. In the light of their recent performance, it appears that except cement, crude petroleum and petroleum products, it would be difficult for other industries in the infrastructure group to reach the targets. High growth rates, ranging from 10 to 14 per cent would have to be achieved in coal, cement and electricity in the remaining

three years of the Seventh Plan period to offset the low growth rates in first two years of the Seventh Plan, if they have to achieve the overall targeted growth rates envisaged in the Seventh Plan. Failure of these industries to achieve the targeted growths would, in turn, cast its impact on the overall growth of industrial production in the Seventh Plan.

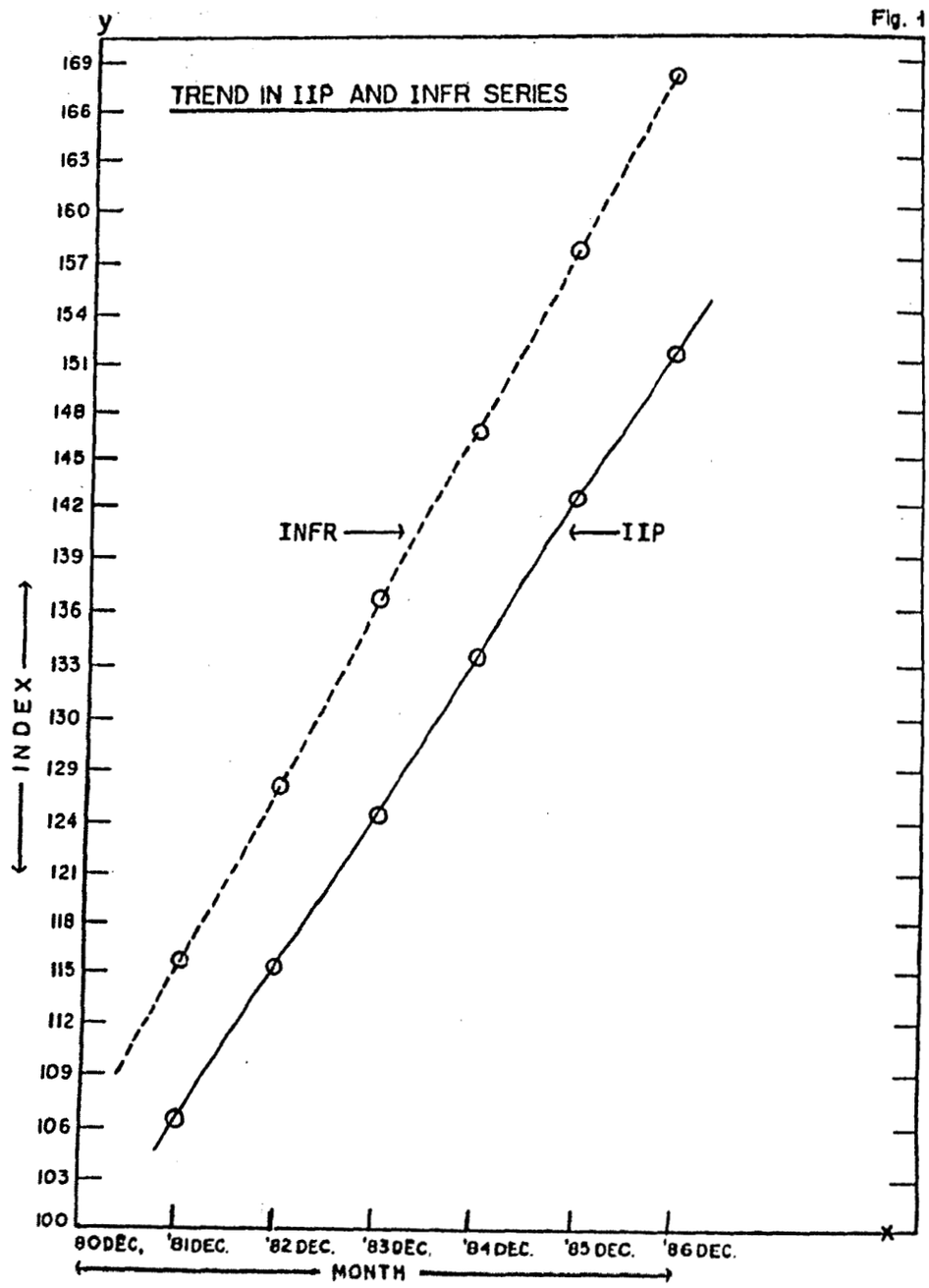
Fig. 1
TREND IN IIP AND INFR SERIES
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INDEX
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166
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160
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129
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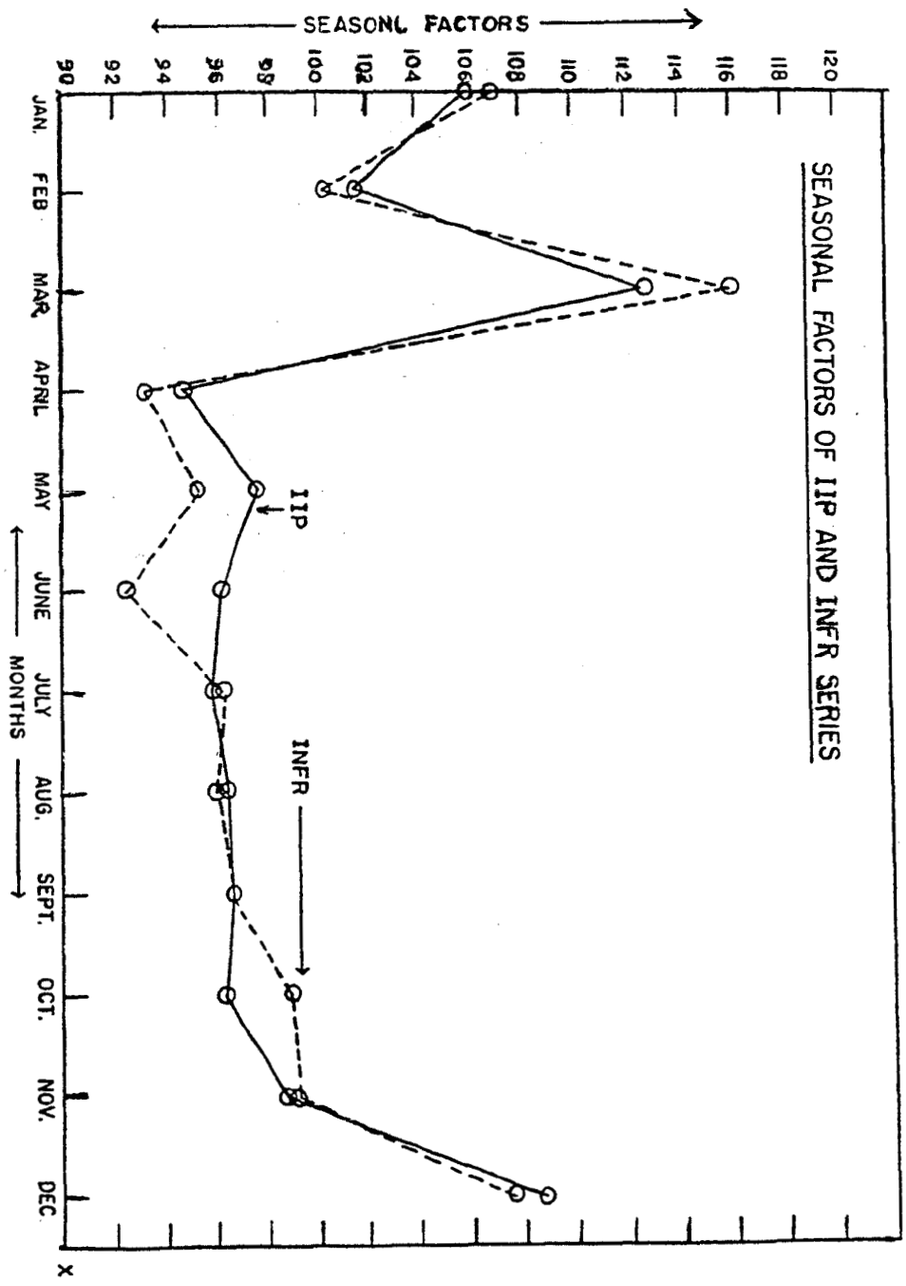
MONTH


SEASONAL FACTORS OF IIP AND INFR SERIES
SEASONL FACTORS
90
92
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JAN.
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MAR.
APRIL
MAY
JUNE
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AUG.
SEPT.
OCT.
NOV.
DEC
MONTHS
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INFR
X

Fig. 2

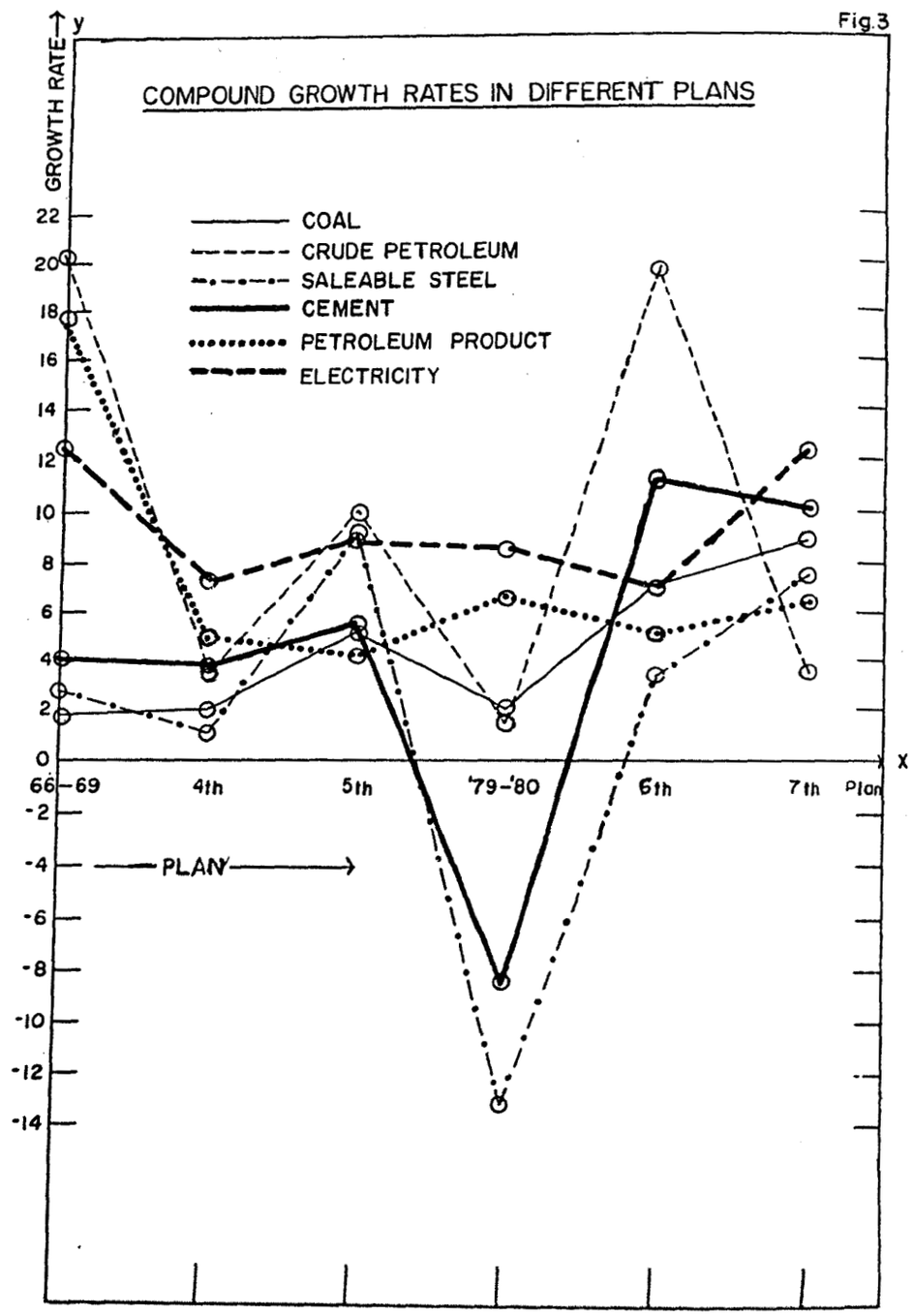
Fig.3
COMPOUND GROWTH RATES IN DIFFERENT PLANS
GROWTH RATE→
y
x
COAL
CRUDE PETROLEUM
SALEABLE STEEL
CEMENT
PETROLEUM PRODUCT
ELECTRICITY
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
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66-69
4th
5th
'79-'80
6th
7th Plan
PLAN

Statement 1: Targets and Actual Productions of Infrastructure Industries from 1965-66 to 1989-90

Industry	Unit	End of 3rd Plan 1965-66		Annual Plan	End of 4th Plan 1973-74		End of 5th Plan 1978-79		Annual Plan	End of 6th Plan 1984-85		End of 7th Plan
		Target	Actual	1968-69 Actual	Target	Actual	Target	Actual	1979-80 Actual	Target	Actual	1989-90 Target
1. Coal@	MT	97.32	67.73	71.41	93.60	79.00	124.00	101.95	104.00	165.00	147.45	226.00
2. Crude Petroleum	MT	—	3.47	6.06	8.50	7.20	14.18	11.60	11.77	21.60	28.99	34.53
3. Saleable Steel*	MT	—	4.51	4.90	—	5.17	8.91	8.06	7.38	11.51	8.77	12.64 (9.94)**
4. Cement	MT	13.00	10.82	12.20	18.00	14.67	20.80	19.30	17.68	34.50	30.17	49.00
5. Petroleum Products	MT	9.86	9.40	15.40	26.00	19.70	27.00	24.20	25.83	35.30	33.30	45.50
6. Electricity	Billion Kwh (Twh)	—	33	47	73.32	67	112	103	112	191	157	280

Source: Planning Commission Reports/Publications.

*Note:** Including Mini Steel Plant.

** Figure in bracket is the target for Integrated plants only.

@ Excluding Lignite.

Statement 2: The Target and Actual Rates of Growth (Compound) per annum in different plan periods

Industry	Between 3rd Plan & 1968-69	During 4th Plan (1969-74)		During 5th Plan (1974-79)		During (1979-80)	During 6th Plan (1980-85)		During 7th Plan (1985-90)
	Actual	Target	Actual	Target	Actual	Actual	Target	Actual	Target
1. Coal@	1.8	5.6	2.0	9.4	5.2	2.0	9.7	7.2	8.9
2. Crude Petroleum	20.4	7.0	3.5	14.5	10.0	1.5	12.9	19.7	3.6
3. Saleable Steel*	2.8	—	1.1	11.5	9.3	-13.0	9.3	3.5	7.6
4. Cement	4.1	8.1	3.8	7.2	5.6	-8.4	14.3	11.3	10.2
5. Petroleum Products	17.9	11.0	5.0	6.5	4.2	6.7	6.4	5.2	6.4
6. Electricity	12.5	9.3	7.3	10.84	9.0	8.7	11.3	7.0	12.3

Source: Compiled on the basis of Statement-1.

Note:* Including Mini Steel Plant.

@ Excluding Lignite.

Statement 3: Average Monthly Indices of Infrastructure Industrial Production from 1979-80 to 1984-85

(Base: 1970 = 100)

Industry Year	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
1. Coal@	140.93	154.51	168.50	177.28	187.63	200.15
2. Crude Petroleum	171.05	154.49	238.25	309.36	382.14	425.78
3. Saleable Steel (Main Plant/Integrated Plant)	129.68	136.23	146.18	128.03	112.29	122.68
4. Cement	126.24	129.38	150.93	167.33	193.88	216.08
5. Petroleum Products	150.40	140.48	164.23	177.84	190.98	192.58
6. Electricity	191.83	202.93	223.62	236.53	254.58	285.03
Infrastructure Industries	159.80	166.92	188.51	199.41	213.92	234.96

Source : Compiled on the basis of Monthly Production figures supplied by Ministry of Industries and Company Affairs.

Note:@ Excluding Lignite.

Statement 4: Yearly Growth Rates (%) of the Infrastructure Industries from 1980-81 to 1984-85

Industry	1980-85		1980-81	1981-82	1982-83	1983-84	1984-85
	Compound rate (Target)	Compound rate (Achieved)					
1. Coal@	9.7	7.27	9.64	9.05	5.21	5.84	6.67
2. Crude Petroleum	12.9	20.00	-9.68	54.22	29.85	23.54	11.42
3. Saleable Steel (Integrated/Main Plant)	9.3	-1.10	5.05	7.30	-12.42	-12.29	9.25
4. Cement	14.3	11.35	2.49	16.66	10.87	15.87	11.45
5. Petroleum Products	6.4	5.07	-6.60	16.90	8.29	7.39	0.84
6. Electricity	11.3	8.24	5.79	10.20	5.77	7.63	11.96
Infrastructure Industries	—	8.02	4.46	12.93	5.78	7.28	9.84

Source : Compiled on the basis of Statement-3.
Note:@ Excluding Lignite.

Statement 5: Productions of Infrastructure Industries at different time intervals

Year (Calendar/Financial)	Coal (in MT)	Cement (in MT)	Crude Petroleum (in MT)	Petroleum Products (in MT)	Saleable Steel* (in MT)	Electricity (in Twh)
1951	34.86	3.25	0.27	0.25	2.36	5.86
1955	38.84	—	0.35	3.02	2.76	7.11
1961	56.07	8.25	0.51	6.09	3.85	16.94 (1960-61) End year of 2nd Plan
1965 } Relate to 3rd Plan	67.16	10.58	3.02	9.11	5.52	32.99 (1965-66)
1966 }	67.97	11.06	4.65	11.26	5.84	End year of 3rd Plan
1968	70.81	11.94	5.85	14.95	5.55	47.43 (1968-69)
1969	75.41	13.62	6.72	16.37	5.94	
1971 }	71.82	14.93	7.19	18.23	5.54	55.83 (1970-71)
1973 } Relate to 4th Plan	77.87	15.01	7.20	19.13	5.59	66.69 (1973-74)
1974 }	84.11	14.36	7.49	19.39	5.74	End of 4th Plan
1975-76	99.62	17.24	—	21.04	6.21	79.23
1976-77	101.06	18.67	—	21.61	7.62	88.33
1978-79 (End of 5th Plan)	102.17	19.42	12.84 (1979)	24.21	8.06	102.52
1979-80	103.97	17.62	9.40 (1980)	25.82	7.38	104.63
1980-81	113.88	18.66	—	—	7.82	110.84
1984-85 (End of 6th Plan)	147.42	30.17	28.99	33.07	8.77	156.63
1985-86	154.29	33.07	30.18	39.91	10.07	170.05

Source: (1) Monthly Statistics Abstract, C.S.O., Ministry of Planning, New Delhi.
(2) Annual Statistical Abstract, C.S.O., Ministry of Planning, New Delhi.

Note : * Including Mini Steel Plants.

Statement 6: Indices of Infrastructure Industries and their targeted/achieved growth rates in the first two years of the Seventh Plan

(Base: 1980 = 100)

Month	Coal		Cement		Crude Petroleum		Saleable Steel		Petroleum Products		Electricity		Infrastructure	
	1985-86	1986-87	1985-86	1986-87	1985-86	1986-87	1985-86	1986-87	1985-86	1986-87	1985-86	1986-87	1985-86	1986-87
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
April	109.12	118.49	155.50	180.45	287.84	296.79	89.58	92.65	150.98	153.71	142.83	162.00	138.71	151.32
May	115.33	124.07	168.81	178.01	283.03	308.60	91.73	103.50	159.73	153.51	146.68	163.07	142.86	155.83
June	114.80	123.12	170.68	177.68	259.40	282.68	101.80	87.28	157.19	161.02	143.18	152.72	141.16	146.77
July	113.65	121.65	176.01	184.95	261.93	290.71	125.29	114.60	155.55	173.80	149.58	161.03	148.11	156.43
August	112.60	118.49	174.79	165.92	268.00	287.96	127.20	116.26	168.88	175.45	151.11	164.74	149.97	156.28
September	113.75	126.28	171.06	184.18	279.70	290.02	120.14	134.99	156.49	179.13	155.55	172.19	150.84	165.80
October	124.80	136.80	184.37	196.85	292.09	295.78	122.23	141.56	166.09	186.89	152.46	171.91	154.81	170.89
November	136.64	149.85	170.68	204.31	282.45	284.06	127.20	143.61	169.03	178.53	159.98	165.79	156.26	170.82
December	152.26	170.68	186.69	207.20	307.11	294.50	137.13	149.66	175.45	187.83	160.30	177.13	168.81	182.72
January	165.42	178.89	186.49	212.41	315.48	288.88	135.22	151.40	174.50	191.61	161.40	178.16	172.56	185.36
February	167.33	173.73	174.47	204.24	293.81	270.87	131.98	148.36	162.56	166.84	146.82	165.51	163.51	175.33
March	196.57	206.46	209.04	230.23	331.88	302.29	175.33	183.03	189.23	202.01	168.86	182.96	193.34	201.99
Average	135.27	145.71	177.38	193.87	288.56	291.10	123.74	130.58	165.47	175.87	152.40	168.10	156.75	168.30
Yearly Growth rates (in % age)	4.63	7.72	9.71	9.29	4.14	0.88	11.29	5.52	20.70	6.28	8.55	10.30	8.1	7.37
Yearly Target rates (in % age)	4.8	8.1	11.3	10.4	4.0	0.1	10.0	15.2	18.5	4.7	8.5	11.7	—	—
Compound growth rates (7th Plan)	8.9	8.9	10.2	10.2	3.6	3.6	7.5	7.5	6.4	6.4	12.3	12.3	—	—

Source : Compiled from Production data supplied by Min. of Industry and Company Affairs.

Note: 1) Saleable Steel relates to Integrated Steel Plants only.

2) Coal Production excludes Lignites.

BOOK REVIEWS

Sensitivity Analysis in Linear Regression

by Samprit Chatterjee and Ali S. Hadi
(John Wiley & Sons, 1988; Price $ 29.95, Pp. 315)

THE techniques of linear regression analysis have undoubtedly been the most widely used tools for statistical model building over the years. The application of these techniques have been ever increasing in various fields of physical and social sciences. Such applications demand a generalisation of the classical framework of the regression analysis as the analyst is quite often faced with intricate technical problems of errors in measurement of response and explanatory variables, non-normality of error laws and so on. Besides, the presence of outliers, influential observations (defined later on), etc., may further complicate the task of selection of variables and building of suitable models. Of late, a wide range of diagnostic techniques have been put forward by different researcher to help the data analyst tackle such problems effectively at different stages of the model building exercise. In the above context, a highly readable and well-written book such as the above on a highly relevant area in statistical theory and applications is extremely welcome and deserves to be studied by all research workers.

In the book under review, the authors have examined in detail the factors that determine the fit of a regression model and have studied the sensitivity of the fitted model with respect to these factors in the context of linear regression model fitted by the widely-used method of ordinary least squares.

According to the authors, '--- regression analysis should be viewed as a set of data analytical techniques used to study the complex interrelationships that may exist among variables in a given environment. It is a dynamic iterative process; one in which the analyst starts with a model and a set of assumptions and modifies them in the light of the data as the analysis proceeds ---'. The elements that determine a regression equation are the observations, the variables and

the model assumption. The authors have systematically presented the impact of changes in any one or a combination of these factors on the parameter estimates of the model and their statistical properties, drawing upon the vast amount of research work in this field, including their own, that has taken place in the last two decades or so.

The first two chapters are devoted to the basic set-up of the linear regression, $Y = X\beta + \varepsilon$, the statistical properties of the estimates under standard assumptions and the important properties of the matrix $P=X (X^TX)^{-1}X^T$ termed as 'Prediction Matrix'. Its role in the diagnostic analysis has been well brought out.

Chapter 3 deals with the roles of variables in a regression equation. Selection of appropriate explanatory variables is of crucial importance in a regression analysis. It is shown through illustrations how underfitting or overfitting (as against the true model) affects the properties of the estimates like unbiasedness, variance of estimates etc. However, it is to be conceded that the true model is almost never known, and for underfitted models, the predicted values may not be unbiased. In this context, the C_p criterion developed by Mallow for comparing the predicted values in different underfitted models has been presented.

Another important feature of this Chapter is a highly interesting discussion of the various diagnostic plots used for assessing the effects of variables. This includes Mosteller and Tukey's Added variable (partial regression) plot, Residual versus predictor plot, Component plus residual plot and Augmented partial residual plot. These plots throw light on the magnitude of the regression coefficient for an additional variable introduced and also suggests whether the variable should be transformed before its introduction into the model. Thus, for example, in the model $Y=X\beta + \varepsilon$, a new explanatory variable V is being introduced. In the Added variable plot $e_{Y.X}$ is plotted against $e_{V.X}$ where $e_{Y.X}$ is the residual in Y after fitting X and $e_{V.X}$ denote the residual in V after fitting X. It is shown that the expected slope of the scatter of all points in this plot is equal to the regression co-efficient of V. It provides a visual impression of the importance of different points in determining the slope. The component plus residual plot and the Augmented partial residual plot which indicate the need for transformation of the new explanatory variable are briefly discussed. However, even though each of these plots serves different diagnostic purposes in model building exercises, which is illustrated through examples in this book, the authors emphasise the fact that

the best way to modify the model on the basis of this has to be devised by the analyst himself.

Chapters 4 and 5 are devoted to a rigorous discussion on the effects of a single or multiple observations on a regression equation. Specifically, the discussion centres on the concept of outliers, influential observations, high leverage points and measures to identify these. The nature of these concepts are rather complicated to be brought under a single precise definition to cover the entire gamut of applications. The broad definitions set out by the authors are as follows:

An influential observation is the one which excessively influences the fitted equations as compared to the other observation. Sometimes a subset of observations may be jointly influential. Besides, the same observation may influence different parameter estimates e.g. β, estimated variance of β, the predicted values or the goodness-of-fit statistics, differently. *An Outlier* is a data point very much different from the remaining set of observations. It is defined as an observation for which the studentised residual (r_i or r_i^*) is large in magnitude compared to other observations, where

$$r_i = e_i / \hat{\sigma} \sqrt{1-P_{ii}},$$

$$r_i^* = e_i / \hat{\sigma}_{(i)} \sqrt{1-P_{ii}}, \text{ where}$$

e_i = i-th residual = $Y_i - \hat{Y}_i$,

$\hat{\sigma}$ = estimate of σ

$\hat{\sigma}(i)$ = estimate of σ based on all observations excluding the i-th observation

P_{ii} = i-th diagonal element of the prediction matrix P.

High leverage points are those for which the input vector x_i is, in some sense, far from the rest of data.

In the last decade or so, a very large number of methods have been proposed to study influential observations, outliers and high leverage points in regression analysis. It can often be a very difficult task for the analyst to interpret the results based on all these procedures and integrate them into a coherent set of recommendations and conclusions. The authors have substantially simplified his task by presenting the results in a compact form and to that end have classified the methods based on any one of the following characteristics:

i) Residuals, ii) Remoteness of points in the X–Y space, iii) Influence Curve, iv) Confidence ellipsoids, v) Likelihood function, vi) Subsets of regression co-efficients, and vii) Eigen structure of X.

For each of these different characteristics, several procedures available in the literature have been presented with a well-articulated discussion on their statistical properties useful in diagnosing an influential observation or an outlier. The studentized residuals r_i and r_i^* defined earlier have been discussed in detail and it is shown that for all i, $r_i^2/n\text{-}k$ follows the data distribution and r_i^* follows the t-distribution under certain assumptions. The results provide a ready means for detecting outliers. Graphical methods on the basis of residuals are also presented and illustrated with examples. Different distance measures based on remoteness of observations in the X–Y space are also discussed. Hampel's influence curve has been derived for parameter estimates $\hat{\beta}$ and $\hat{\sigma}^2$ and methods to approximate the influence curve on the basis of the sample data are presented. Measures of the influence of the ith observation on the regression coefficients based on the influential curve, e.g., Cook's distance, Welsch-Kuh's distance, etc., have also been presented at length. All these different measures have been extensively illustrated with examples to demonstrate their diagnostic power. At the end of the Chapter, a summary of the measures has been included.

In chapter 6, the joint impact of a variable and an observation has been studied in the context of variable selection problem. The interrelationships between variables and observations are studied in terms of the effects of simultaneous omission of a variable and an observation on the estimated parameters, residual sum of squares, the fitted values and the predicted value of the omitted observation, respectively. A statistic to test the significance of the jth variable when the ith observation is omitted has been examined. This is useful in detecting a variable which influences the model through only one (or a few) observation(s). However, the authors have generally not recommended discarding variables or observations on this basis alone, since this may affect the interpretation, the precision or bias of the estimates. Instead, it is suggested to collect more data, if possible and/or downweight influential observations by using robust regression or weighted least square methods.

Chapter 7 deals with the problem of assessing the effects of errors of measurements. Measurement errors in the response variable and

the explanatory variables have been treated separately and for the latter, apart from the conventional asymptotic approach, the perturbation approach and the simulation approach, have also been discussed. In the perturbation approach, the effects of measurement errors are studied numerically by examining the differential changes in the regression coefficients as a result of perturbing one column of X matrix at a time. Bounds for the change in the coefficients are derived in terms of the error in X using first order approximation theory and are illustrated through examples.

In Chapter 8, the generalised linear models (GLM) proposed by Nelder and Wedderburn are considered, in which the error terms are assumed to follow a probability law belonging to the exponential family. This includes most well-known distributions like Gaussian, Gamma, Poisson, binomial, beta, negative binomial, χ^2 and inverse Gaussian distributions. It should be noted that the maximum likelihood estimation procedure followed in GLM generally gives rise to non-linear equations in β for non-normal errors, which can be solved numerically. A list of estimating equations for different error laws has been provided and two goodness of fit statistics both of which are asymptotically χ^2, have been presented. Model sensitivity has been illustrated through example in which the same set of data has been fitted with different error laws and the coefficients compared.

Although many of the results presented in this book are available elsewhere also, the authors have presented them in a compact form incorporating the latest developments in the field at one place and also have given ample references for further studies. The book is rich in examples. Most of the concepts discussed are illustrated with examples to bring out their salient features. The authors have admitted the omission of topics like robust regression and by now classical problems of multicollinearity, heteroscedasticity and autocorrelation, etc., for which excellent texts are already available, as mentioned in the preface. The book also contains a chapter on computational aspects of model building.

The entire book has been written keeping in mind the needs of the regression practitioners without sacrificing the theoretical fervour. Thus the book should prove valuable to theoreticians and to applied statisticians alike. Its usefulness could be further enhanced if software packages for the techniques discussed were also provided in keeping with the similar practice followed by some authors. Apart

from these, the book is timely and highly commendable. It should constitute a good addition to the statistical libraries of universities, academic institutes and research organisations.

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Money and Finance in World Economic Order

Edited by
V.R. Panchamukhi, K. M. Raipuria and Rameshwar Tandon

Issued under the auspices of Research and Information System for the Non-Aligned and other Developing countries (RIS); India Publishing Company, New Delhi, 1987; Pp xxxiii & 468, Rs. 325

COLLECTION of articles is becoming an important part of the publishing world. When they are built around a theme, as often are, the collections have an enduring impact on the reader, particularly when the original sources and regular books are getting increasingly out of reach. How many university libraries can afford to buy IMF publications, Chemical AMEX Bank Review, Euro-Money or even *Financial Times* and *Economist*? Collection of articles on issues such as the one brought out in the publication under review go to fill such information gap.

Intensive debate and analysis is taking place on the directions of the global monetary system. This volume includes select papers from various experts from different parts of the world on five dimensions of the world monetary order, namely, debt and aid, international reserves and SDRs, institutional issues, exchange rate fluctuations, and monetary cooperation amongst developing countries. The collection is thus disjointed in the sense that it lacks any consistent framework, thus making the task of the reviewer rather difficult. Perhaps the merit of such a collection is that the papers are available for a larger number of researchers. But, on the whole collection remains uneven and some of the papers are familiar rehashes or extensions of similar work done elsewhere. As they have already received some attention we will focus on selected papers and hope that others will receive the attention that is due to them elsewhere.

A number of developments occurred in the previous decade, the

more important of them are listed in the following :

1) Inception of the system of managed float in 1972-73;
2) Oil price increse during 1973 & 81;
3) The structural changes in the pattern of current account balances such as, large deficit of US and surpluses of West Germany and Japan;
4) Flow of resources to middle-income LDCs from private credit markets; and
5) Reliance on monetarism as macro economic policy tool in industrial nations which began around 1978.

It is this series of events that led to the present situation to which the world economy is subjected. Editors rightly admit that this work does not cover all aspects of world monetary order; its avowed objective rather is to project the concern of the developing countries.

Discussion in the last few years in the annual meetings of the International Monetary Fund and the World Bank centred around the debt problem. Even India which has hitherto enjoyed a relatively comfortable debt service ratio, is now faced with the prospect of a rise in the years to come. The seven papers give exhaustive information about the debt situation and the emerging scenario. Arjun Sengupta observes that the basis of the Brandt Commission Report is questionable, especially against the weak link between the growth of North & South. Discussion relating to the debt utilisation pattern of the developing countries would have thrown light on the process that led many countries into the debt trap. Latin American scholars have contributed a great deal to the discussion which should have found a place in the publication. A discussion based on classification of the developing countries according to income/geographical region would have indicated the order of importance of severity in the context of country acutally analysed.

Coming to IMF conditionality, there are in all six articles on the subject by Dell, Donovan, Eckaus, Gulati, Williamson, and Gerster. Donovon & Eckaus assess the conditionality programme from the angles of balance of payment viability, inflation and growth performance. Gulati argues that rigour of conditionality has increased and burden has fallen on the low-income developing countries. Sidney Dell, in an extremely forthright article, points out the inconsistency in IMF policy stances like encouraging exports of developing countries and protectionist policy of developed countries. He also brings

out that these programmes have generated a process of deflation.

Articles containing discussion on the genesis of conditionality and a few country case studies would have been a useful addition considering the amount of information now available in this respect. A major controversy between the developed and developing countries is whether the present regime of floating exchange rates has reduced the instability of the system even with the IMF surveillance. There is a feeling that currency swings have been excessive and also that there have been persistent currency misalignments. Panchamukhi's paper analyses exchange rate behaviour of rupee vis-a-vis major trade partners in the light of purchasing power parity theory, which neglects the flows in capital accounts. The relevance of this frame for analysing behaviour of exchange rates in a country like India is itself questionable. The author should have explained the rationale for undertaking an exercise like this. The feasibility of multiple exchange rates is nowhere discussed specially in view of the Latin American countries experimenting with it now for over a decade.

Finally, the World Bank, which ought to be most important source of development finance for the indebted countries, does not find any place in the collection of papers.

To conclude, the factual presentation provided herein are a useful source of information for the researchers in India. It also serves as a good introduction to the themes under respective subheads. However, the lack of adequate care in editing, annotation, proper citation of references is jarring to the reader. The book was published in 1987 but the papers and data seem to have been confined to the period upto 1982. There is total silence about this gap of five year 1982-87 in the editorial introduction.

These problems encountered by the reviewer should not, however, underestimate the importance of the publication as an attempt to transmit information to the researchers in the Third World, laying the basis for the emergence of a Third World angle in perceiving the burning issues of international finance.

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