Impact of Economic Reforms and Macroeconomic Forecasts

Pulses, Levels and Trends

The Indian economic reforms of 1991 affected the economy not only in terms of output but brought about some structural changes in the various macroeconomic relationships. We quantify here the impacts and identify which of the macro variables were significantly affected and which could not be the result of the reforms. For the analysis, the technique of interventions analysis of time-series is used. Two kinds of measures are noted: (a) the year-to-year effects, and, (b) the overall growth pattern, during 1991 to 2002-03 due to reforms for each of the variables. Private final consumption expenditure (PFCE), investment (GCF) and all the GDP variables except that of services were found to be substantially higher during the post-reforms period than what they would have been in the absence of the reforms. The reforms seem to have made only a marginal impact on investment in the agricultural sector. Unless more reforms are brought in, the GDP may grow at the most only by 6.1 per cent between 2003 and 2010.

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The Indian economic reforms of 1991 marked a major turning point for the Indian economy. Not only did it affect the economy in terms of output but it brought about some structural changes in the various macroeconomic relationships. Considering the year 1991 as a major intervention point in the course of the economy, our objective in this paper is to assess the impacts and identify which of the variables have been significantly affected and which could not be the outcome of the reforms.

Further, currently there is a curiosity about the possible future growth rate of the Indian economy. For this we conduct time-series analysis and develop forecasts for some major macroeconomic variables for the years 2004 to 2010.

Intervention Analysis and Estimation Methodology

We employ the technique of intervention analysis of time-series within ARIMA models, which leads us to identify the various policy intervention time points that have occurred in the pre- and post-reforms periods for each variable separately. We conform here only to univariate time-series analysis. Therefore, this analysis does not cover the causality aspect of the different variables; i e, which variables effect which variables. In other words, which are the endogenous and which are exogenous variables in the system? The causality issue is beyond the scope of this paper.

Intervention analysis deals with the impacts of innovations that occurred in the process underlying the time series data of the variables. Intervention analysis is also called quasi-experimental or interrupted time series analysis. Interventions could either be abrupt or gradual. And the impacts could be just for only one period (called pulse intervention), or could be a permanent change in the mean of the series (called level shift intervention) or could also be a change in the slope of the series (called trend intervention). Thus, different kinds of structural changes are analysed.

Indeed a time series could have been interrupted more than once; i e, there could be several intervention points in a given time series data. However, while analysing such interrupted time series the points of intervention may or may not be known. Econometric techniques are available for analysis of both the situations.

For example with a known single intervention point the model could be postulated as

$$Y_t = V(B).I_t + N(B).\varepsilon_t$$

where $V(B) = [\omega(B)/\delta(B)]\, B^b$, and $N(B) = [\theta(B)/\varphi(B)]$, and I_t is the variable representing intervention at time t and $\omega(B)$, $\delta(B)$, $\theta(B)$ and $\varphi(B)$ are characteristic polynomials in the backward shift operator B. $\theta(B)$ corresponds to the moving average part of the time series and $\varphi(B)$ corresponds to the autoregressive part. I_t is basically a dummy variable containing

(a) in the case of pulse intervention, zero (0) everywhere except at the intervention point $t = \tau$,

[0,0,0,.....,0,1,0,0,0.....,0]

That is, given $t = 1,2,\ldots, \tau, \ldots,n$ the intervention variable, $I_t = 0$ for $t < \tau$, $= 1$ for $t = \tau$ and $= 0$ for $t > \tau$.

(b) in the case of level shift intervention, zero everywhere and one from the point of intervention;

[0,0,0.....,0,1,1,1,.....,1]

$I_t = 0$ for $t < \tau$, $= 1$ for $t = \tau$ and $t > \tau$,

(c) in the case of trend intervention, zero everywhere and a trend (1, 2, 3, ...) from the point of intervention.

[0,0,0,....,0,1,2,3,....,n+1-τ]

$I_t = 0$ for $t < \tau$, $= t + 1 - \tau$ for $t = \tau$, and $t > \tau$.

$\omega(B) = \omega_0 - \omega_1 B - \ldots - \omega_s B^s$ and $\delta(B) = 1 - \delta_1 B - \ldots - \delta_r B^r$. b in B^b denotes the delayed effect of the intervention. $\omega_0, \omega_1, \ldots, \omega_s$ are referred to as the coefficients of the numerator lags and $\delta_1, \ldots, \delta_r$, as the coefficients of the denominator lags in the V(B) of the intervention variable I_t.

In the case of pulse intervention, if $V(B) = \omega$, the intervention effect exists for only one period. If $V(B) = [\omega/(1 - \delta B)]$ the effect will persist for a few more periods gradually dying off. In the case of level shift if $V(B) = \omega$, the intervention effect is to permanently shift the mean level of the time series from the time of intervention (τ). If $V(B) = [\omega/(1 - \delta B)]$ the intervention gradually shifts the mean level by $\omega/(1 - \delta)$. To sum up, the intervention analysis involves (1) identification of the intervention point if it is not known, (2) specification of I_t (cases a, b and c mentioned above) and (3) specification of V(B). Of course the specifications can be made more complicated.

With regard to identification of the unknown intervention points, an iterative procedure is generally adopted as follows. Let $\tau = 1$.

(i) Estimate an ARIMA model for a given data set. Collect the estimated residuals (E_t).

(ii) Regress E_t on intervention variable $I_{t=\tau}$ assuming that the intervention is at τ.

(iii) Compute the statistic,

$\lambda_{t=\tau}$ = (coefficient of the intervention variable)/(corresponding standard error).

(iv) Set $\tau = \tau + 1$ and go to (ii) if $\tau \leq n$ (number of observations). Otherwise, go to (v).

(v) Now there are n λ_ts. Observe the maximum of them. The corresponding $t = \tau$ is an outlier if

$\lambda_{t=\tau} > C$ (a critical value). C may be taken as 3 or 3.5 or 4.

(vi) If $t = \tau$ is an outlier, treat it as intervention point and then adjust the corresponding observation for the outlier effect.

(vii) Repeat the entire above procedure until no more outliers are found (i e. all λs are < C).

Two points are to be noted here: (1) The above procedure corresponds to additive outliers in the time series. (2) The procedure described above should be performed for all possible types of interventions, i e, pulse, level shift and trend intervention – which means the number of iterations over all the three types of interventions with a reasonable sample size can be quite large. After identifying the various intervention points, the corresponding intervention variables should be incorporated into the final model. For more technical details including on innovative multipliers see Bell (1983), Dowling and McLaughlin (1986), Chang and Tiao (1983), etc.

Table 1: Pre-Reform Period 1951-90 Estimations

Sl No	Variable												
1	GDP		CONST	TR(51)	TR(81)	L(78)	MA(1)					R_bar_sq	D-W
		coefficients	120184	7973.3	17319	*16820.04	0.664					0.99	1.98
		t-statistics	19.10	21.05	13.36	1.98	5.29						
2	AGRGDP		CONST	L(63)	P(80)	L(84)	TR(51)					R_bar_sq	D-W
		coefficients	74575	-11826.00	-17320.00	11822.00	3189.00					0.98	1.72
		t-statistics	33.89	-2.98	-2.70	2.98	15.63						
3	INDGDP		CONST	TR(51)	L(78)	TR(82)	P(90)	AR(1)				R_bar_sq	D-W
		coefficients	11430.00	2502.19	*4170.581	5233.00	10195	0.576				0.99	2.04
		t-statistics	5.00	20.18	1.92	12.70	3.95	3.47					
4	D(SERGDP,2)		CONST	D(L79,2)								R_bar_sq	D-W
		coefficients	542.97	4146.00								0.28	1.57
		t-statistics	2.14	3.74									
5	GCF		CONST	TR(51)	TR(79)	AR(1)						R_bar_sq	D-W
		coefficients	14732.34	2324.37	4283.89	0.62						0.97	1.67
		t-statistics	2.03	6.13	4.07	4.04							
6	AGRGCF		CONST	L(76)	L(87)	P(77)	P(79)	P(80)	P(90)	TR(51)	AR(1)	R_bar_sq	D-W
		coefficient	2223.798	1532.82	-1021.59	2014.81	4637.44	3633.09	-1709.93	312.55	0.63	0.99	1.94
		t-statistics	3.94	3.05	-2.00	4.82	9.97	7.82	-3.27	10.64	4.53		
7	INDGCF		P(83)	P(84)	P(85)	P(88)	L(82)	TR(51)	MA(1)			R_bar_sq	D-W
		coefficient	-12891.73	-24087.49	-11590.79	-19323.24	30968.90	1316.78	0.88			0.99	2.01
		t-statistics	-4.89	-6.87	-4.17	-9.98	15.43	31.74	8.02				
8	SERGCF		CONST	TR(51)	TR(73)	AR(1)						R_bar_sq	D-W
		coefficient	9335.68	742.82	1015.40	0.60						0.95	1.68
		t-statistics	2.47	3.10	2.34	3.46							
9	GDS		TR(51)	TR(73)	AR(1)							R_bar_sq	D-W
		coefficient	1931.569	3940.435	0.8363							0.98	1.50
		t-statistics	4.62	2.96	6.25								
10	PFCE		CONST	TR(51)	TR(78)							R_bar_sq	D-W
		coefficients	122122	5899.69	10147							0.99	1.58
		t-statistics	57.29	48.12	28.05								
11	D(AGRPDFL,2)		D(P(76),2)	D(P(77),2)	D(P(80),2)	D(P(88),2)	MA(1)					R_bar_sq	D-W
		coefficient	-0.0340	-0.0217	0.0097	0.0165	0.7918					0.60	2.64
		t-statistics	-5.95	-3.83	4.04	6.58	6.04						
12	D(INDPDFL,2)		D(P(75),2)	D(L(80),2)								R_bar_sq	D-W
		coefficient	0.0154	0.0201								0.58	1.82
		t-statistics	5.84	4.40									
13	D(SERPDFL)		D(P(75),2)	D(TR(77),2)	D(TR(80),2)	D(TR(83),2)	D(TR(89),2)					R_bar_sq	D-W
		coefficient	0.0122	-0.0141	0.0209	-0.0140	0.0122					0.67	1.71
		t-statistics	6.31	-2.98	4.83	-3.24	2.81						
14	AGRTOT		Not estimated directly. See text for details										

Notes: Gross Domestic Product at Constant Prices (GDP), Industrial GDP at Constant Prices(INDGDP), Agricultural GDP at Constant Prices (AGRGDP), Service Sector GDP at Constant Prices (SERGDP), Investment at Constant Prices (GCF), Gross Domestic Savings at Constant Prices (GDS), Private Final Consumption Expenditure at Constant Prices (PFCE).

Agricultural GCF at constant prices (AGRGCF), Industial GCF at constant prices(INDGCF), Services sector GCF at constant prices (SERGCF), Agricultural price deflator (AGRPDFL), Industrial price deflator(INDPDFL), Services sector price deflator(SERPDFL), Agricultural Terms of Trade (AGRTOT)

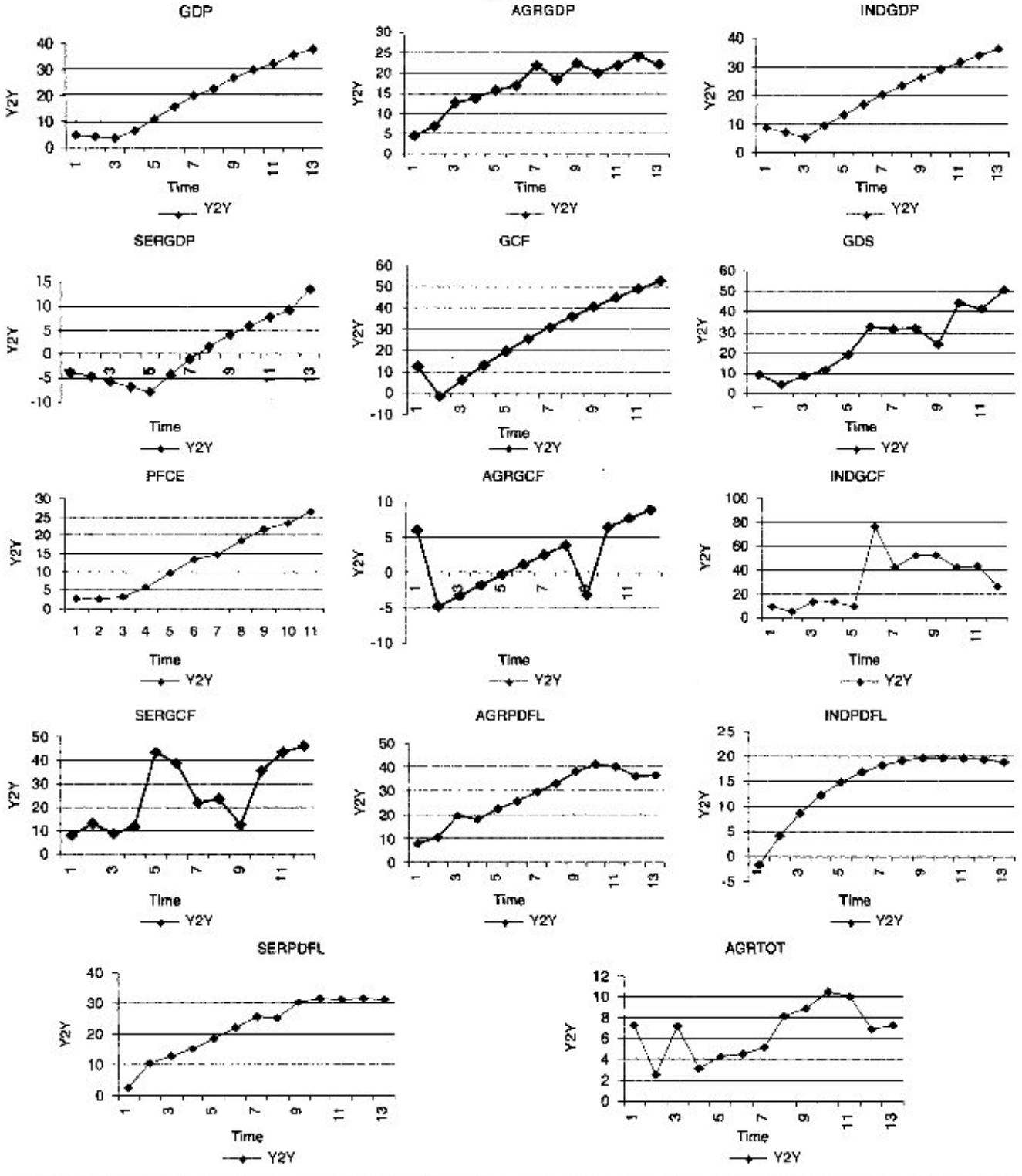
TR(YEAR): A Trend Intervention starting from YEAR, L(YEAR): level shift intervention starting from YEAR.

P(YEAR): Pulse Intervention at YEAR. D(Y,k): Y variable differenced k times to obtain stationarity.

*Insignificant coefficient at 5 per cent level of significance.

MA & AR: Moving Average & Auto Regressive terms. *** Corrected for autocorrelation.

Figure



Now using the above methodology of intervention analysis, Indian macroeconomic data are analysed below. Though the year 1991 is a major intervention point in the economic reforms (i e, the intervention point is known to us), however, whether the variable $I_{t=1991}$ is a pulse or level shift or trend intervention is not known. Besides, there could have been some more intervention points even prior to 1991 and post 1991, but not as conspicuously known as the year 1991. Such intervention points, if any, are not known. Our methodology should also enable us to identify all these intervention points, and their nature (pulse/level shift/trend).

Broadly, our methodology consists of the following steps: (1) The data were split into two parts: data for 1951 to 1990 (pre-reforms) and data for 1991 to 2002-2003 (post-reforms). We assume here that the intervention points, if any, within these two data sets are not known and are to be identified.

(2) Estimate an appropriate stationary time series model for the pre-reforms data simultaneously identifying the unknown intervention points and compute the forecasts for the post-reforms time period.
(3) Estimate an appropriate stationary time series model for the post-reforms data simultaneously identifying the unknown intervention points and compute the fitted values for the same time period.
(4) Compare the forecasts of the pre-reforms models for the post reforms period with the fitted values of the post-reforms models. Let the differences between the forecasts and the fitted values be denoted as d1. Observe the discernible patterns if any in d1 so as to identify appropriate I_t's between 1991 and 2002/2003 (i e, pulses or level shifts or trend?).
(5) Re-estimate an appropriate stationary time series model by incorporating if necessary the appropriate I_t's identified in step 4 for the entire time period using full data (1951-03). This we refer to as comprehensive final model.

Data and the Variables Considered

The variables included in our analysis are GDP, industrial GDP (INDGDP), agricultural GDP (AGRGDP), service sector GDP (SERGDP), gross capital formation (GCF/investment), gross domestic saving (GDS), private final consumption expenditure (PFCE), agricultural GCF (AGRGCF), industrial GCF (INDGCF), service sector GCF (SERGCF), agricultural price deflator (AGRPDFL), industrial price deflator (INDPDFL), services sector price deflator (SERPDFL) and agricultural terms of trade (AGRTOT) – all at constant prices (base year 1993-94). The data were collected from Business Beacon, CMIE database. Data for the years 1950-51, etc, are shown against 1951, etc. To obtain gross domestic savings at constant prices, the total GDP price deflator was used. For the post-reforms period, there are only 12/13 observations available, though one would like to have more observations for estimating stationary time series models. For estimation FREEFORE, EVIEWS and WINRATS software packages were used.

Estimation Results

The results indicate that different kinds of interventions prevailed during both pre-reforms and post-reforms periods for all the variables. Estimated results are reported in Table 1 (pre-reforms period) and Table 2 (post-reforms period).
Gross domestic product (GDP): We start with a detailed explanation in the case of total GDP (the same procedure is followed in the case of other variables also). The pre-reforms and the post-reforms models of the GDP have a high (R-bar).[2] Since auto-correlation is anyway expected, the D-W may not be the right indicator. Hence the Ljung-Box Q-statistics (up to 30 lags) was utilised to check for the residual auto-correlations and for the models' adequacy. The pre-reforms model (Table 1) shows a trend from 1951 onwards and later in 1978 a level-shift intervention and further, another trend intervention in 1981. Besides a MA(1) term has become relevant. The post-reforms model (Table 2) shows trend interventions in 1991 and 1994 with an MA(1) term.

For the analysis of the impacts, two kinds of measures are noted. (a) What are the year-to-year effects during 1991 to 2002-03 due to reforms for each of the variables? And, (b) what is the impact on the overall growth pattern during 1991 to 2002-03 due to reforms for each of the variables? These two are different.

Towards answering (a) above (i e, year-to-year effects) in the case of GDP, Table 3 presents forecasts of the pre-reforms models for the period 1991-2002-03 (Forecast), and fitted values of the post-reforms models along with the actual data for the period 1951-2002-03. The forecasts of the pre-reforms models for the reforms period are dynamic forecasts; not static forecasts. The dynamic forecasts and static forecasts would be different whenever autoregressive (AR) and/or moving average (MA) terms appear in the estimated equations. The dynamic forecast figures are completely free from any of the reforms effects since the actual realised data of the reforms period do not get used while making these forecasts. The fitted values are however static forecasts based on the reforms period actual data, and thus contain the reforms effects. Therefore the differences between the dynamic forecasts and the fitted values are only due to the reforms.

The fifth column in Table 3 shows percentage differences (year to year or y2y) between fitted and forecasts for each year of the post-reforms period. These are also shown in Table 4 and the Figure. These percentages indicate the year-to-year impacts of the economic reforms. In principle, one may compute the Y2Ys using the actual data (instead of the fitted values) and the dynamic forecasts. However that may not be proper for the reason that the actual data contain random disturbances. Thus, the fitted values, which are free from the random disturbances, are considered for computing the year-to-year effects. Towards answering (b) above (overall growth pattern), Table 3 also presents the annual compound growth rate (CAGR) for the GDP between 1991 and 2003, besides the estimated semi-log trend growth rate (SLT).

As can be seen from Table 3 the pre-reforms model forecasts for the post-reforms period seem to be quite in line with the actual data (i e, without a change of the past regime) from 1951 to 1990. These forecasts for 1991 to 2003 show that the GDP would have grown at a growth rate 3.11 per cent CAGR (3.12 SLT). While the actual data for the period 1991-2003 shows that the GDP has grown at 5.52 per cent CAGR (5.79 per cent SLT), the fitted model shows that the corresponding growth rates are 5.50 per cent (5.79 per cent). And, individual yearwise also, the fitted series and the actual data are quite close. Thus the post-reforms model seems to fit the actual data quite closely. Therefore the year-to-year effects (percentage deviations denoted as Y2Y in Table 3), computed using the forecast figures and the fitted values, can be reliable. The Y2Ys are not only positive but also have kept increasing over time. For example, the percentage rise in the GDP due to reforms was only 3.62 per cent in 1993, whereas the reforms' effect gradually rose up to 37.84 per cent in 2003. The effect on the overall growth pattern of the GDP is a rise of 2.67 per cent in the growth rate – i e, from 3.12 per cent to 5.79 per cent (according to SLT).

Now we want to generate forecasts up to 2010 and see what is the likely rate at which the GDP can grow. For this it is not possible to use the post-reforms models estimated above. That model is only based on 13 observations (1991 to 2003) and hence cannot be used for forecasting for seven years into the future. Therefore, using the entire data (from 1951 to 2003 – 53 observations), a comprehensive model for the GDP may be estimated. These results are reported in the first row of Table 5. The comprehensive final model turns out as a simple ARMA(2,1) model which passes all the tests of adequacy including the residual auto correlations (these tests will be elaborated later).

This may be used for forecasting up to 2010. The forecasting performance of this model has been tested based on dynamic simulation for the recent history period. That is, while the dynamic forecasts have been computed for the years 1996 to 2010, for the years 1996 to 2003 these forecasts have been checked for their closeness with the actual data. The last column (COMPFOR9610) in Table 3 shows these forecasts. Comparing the CAGR growth rate between 1995 and 2003, the actual data shows the growth rate as 5.85 per cent while the forecasts show 5.82 per cent. The individual yearwise observations also, for the period 1996 and 2003, are reasonably close. Thus these forecasts can be taken as reliable, which show that the GDP would grow between 2003 and 2010 at a rate of 6.10 per cent.

Other macro variables: Similar exercises have been conducted for 13 other macroeconomic series apart for the GDP. The estimation procedure is just the same as explained in the case of the GDP above, except for AGRTOT. The pre-reforms model estimations are presented in Table 1, post-reforms model estimations in Table 2, the Y2Y effects in Table 4, comprehensive models in Table 5 and finally the dynamic forecasts for the future up to 2010 in Table 6, for all the series. We have not directly estimated any models for the AGRTOT. Instead it was computed as follows:

$$\text{AGRGDP PDFL} = (\text{AGRGDP}_{\text{Curr}}/\text{AGRGDP}_{\text{Const}})$$

$$\text{Non-AGRGDP} = \text{INDGDP} + \text{SERGDP}$$

$$\text{Non-AGRGDP PDFL} = (\text{Non-AGRGDP}_{\text{Curr}}/\text{Non-AGRGDP}_{\text{Const}}) = w_1.\text{INDPDFL} + w_2.\text{SERPDFL}$$

where $w_1 = \text{INDGDP}_{\text{Const}}/(\text{INDGDP}_{\text{Const}}+\text{SERGDP}_{\text{Const}})$ and $w_2 = 1.-w_1 = \text{SERGDP}_{\text{Const}}/(\text{INDGDP}_{\text{Const}}+\text{SERGDP}_{\text{Const}})$ where subscripts 'Curr' and 'Const' refer to current prices and 1993-94 prices respectively. Since the AGRGDP, INDGDP, SERGDP, AGRPDFL, INDPDFL and SERPDFL have been anyway modelled, those forecast and fitted values could be used in computing the AGRTOT using the above relations.

$$\text{AGRTOT} = \text{AGRGDP PDFL} / \text{Non-AGRGDP PDFL}$$

The results of all the variables are briefly discussed below. The estimated interventions observed from these tables can be summarised as in Table A.

The results with respect to the year-to-year effects from Table 4 may be categorised as in Table B.

Table 2: Post-Reforms Period 1991-2002-03 Estimations

Sl No	Variable							
1	GDP		CONST	TR(91)	TR(94)	MA(1)	R_bar_sq	D-W
		coefficients	672507.00	17135.00	42662.40	-0.99	0.99	2.22
		t-statistics	36.43	2.67	6.50	-296.82		
2	AGRGDP		CONST	TR(91)	TR(98)	AR(1)	R_bar_sq	D-W
		coefficients	209060	6510.1	-3101.5	*-0.601	0.97	2.03
		t-statistics	79.43	15.20	-2.83	-1.95		
3	INDGDP		CONST	TR(91)	TR(94)		R_bar_sq	D-W
		coefficients	181991.00	*4697.308	115299.00		0.99	1.17
		t-statistics	24.63	1.62	3.63			
4	SERGDP		CONST	TR(91)	TR(96)		R_bar_sq	D-W
		coefficients	260018.00	18598.00	19797.70		0.99	1.72
		t-statistics	45.82	12.24	9.53			
5	GCF		CONST	TR(91)	P(91)		R_bar_sq	D-W
		coefficients	136411.00	18980.00	40258.50		0.97	1.96
		t-statistics	15.75	16.83	2.86			
6	AGRGCF		CONST	P(91)	P(99)	TR(91)	R_bar_sq	D-W
		coefficient	-8521.43	1925.72	-1510.38	561.26	0.92	2.42
		t-statistics	-3.64	3.16	-2.75	11.26		
7	INDGCF		CONST	P(96)	AR(1)		R_bar_sq	D-W
		coefficient	131673.30	40939.87	0.81		0.82	1.43
		t-statistics	6.00	4.30	5.81			
8	D(SERGCF)		CONST	D(P(95))	D(P(96))	D(P(99))	R_bar_sq	D-W
		coefficient	3596.25	16999.00	12727.00	-10916.00	0.79	1.21
		t-statistics	3.15	5.26	3.94	-3.90		
9	GDS		CONST	TR(91)	P(99)	MA(1)	R_bar_sq	D-W
		coefficients	-459106.00	15144.07	-27200.17	0.98	0.99	2.13
		t-statistics	-10.25	15.41	-3.61	20.54		
10	PFCE		CONST	TR(91)	TR(95)	RHO***	R_bar_sq	
		coefficients	506536	15679	20878.7	*-0.657	0.99	
		t-statistics	98.15	9.97	11.23	-2.19		
11	AGRPDFL		CONST	AR(1)			R_bar_sq	D-W
		coefficient	3.6109	0.9641			0.99	1.82
		t-statistics	2.25	40.68				
12	INDPDFL		CONST	AR(1)	MA(1)		R_bar_sq	D-W
		coefficient	2.8372	0.9522	-0.9899		0.99	1.65
		t-statistics	10.01	114.45	-3932.77			
13	SERPDFL		CONST	P(98)	AR(1)	MA(1)	R_bar_sq	D-W
		coefficient	3.1408	-0.0200	0.9586	0.9520	0.99	1.57
		t-statistics	4.81	-8.29	69.19	36.87		
14	AGRTOT		Not estimated directly. See text for details					

Notes: Gross Domestic Product at Constant Prices(GDP), Industrial GDP at Constant Prices(INDGDP), Agricultural GDP at Constant Prices(AGRGDP), Service Sector GDP at Constant Prices(SERGDP), Investment at Constant Prices(GCF), Gross Domestic Savings at Constant Prices(GDS), Private Final Consumption Expenditure at Constant Prices(PFCE).

Agricultural GCF at constant prices (AGRGCF), Industial GCF at constant prices(INDGCF), Services sector GCF at constant prices(SERGCF), Agricultural price deflator(AGRPDFL), Industrial price deflator(INDPDFL), Services sector price deflator(SERPDFL), Agricultural Terms of Trade (AGRTOT).

TR(YEAR): A Trend Intervention starting from YEAR, L(YEAR): level shift Intervention starting from YEAR.

P(YEAR): Pulse Intervention at YEAR. D(Y,k): Y variable differenced k times to obtain stationarity.

*Insignificant coefficient at 5 per cent level of significance.

MA & AR: Moving Average & Auto Regressive terms. *** Corrected for autocorrelation.

Comparing the annual growth rates (CAGR and/or SLT) of forecast series, fitted series and actual data in Table 4 for each variable, private final consumption expenditure (PFCE), investment (GCF) and all the GDP variables except that of services have in general been found to be substantially higher during the post-reforms period than what they would have been in the absence of the reforms. Besides, apart from the GDP, AGRGDP, INDGDP, Investment, PFCE and even GDS have experienced +ve Y2Y's. Services GDP and agricultural GCF had negative year-to-year impacts in the early 1990s but later they also gained due to the reforms.

The following discussion with respect to the overall growth pattern is based on the estimated semi-log annual growth rates (SLT) between the years 1991 and 2002-03. Due to reforms, total GDP growth rate has increased by around 2.67 percentage points (from 3.12 per cent to 5.79 per cent), agricultural GDP growth rate has risen by 1.25 per cent (from 1.42 per cent to 2.68 per cent), industrial GDP growth increased by 2.26 per cent (3.56 per cent to 5.83 per cent). Reforms led to near doubling of the growth rate of agricultural GDP (from 1.42 per cent to 2.68 per cent). Services GDP registered a 1.59 per cent rise in its growth rate (from 6.02 per cent to 7.61 per cent). Total investment registered a huge jump in its growth by 3.76 per cent indicating the significant effect reforms had on investment (from 2.96 per cent to 6.72 per cent). This however is not the case for the sectoral GCFs (Table C).

Sectoral levels of the investment show that agricultural GCF growth rate only increased by 0.75 percentage points (from 1.84 per cent to 2.59 per cent), industrial GCF growth rate by 2.89 percentage points (from 1.52 per cent to 4.41 per cent) and services GCF growth rate by 2.26 percentage points (from 2.03 per cent to 4.30 per cent). But, it must be noted that the total investment (GCF) is not merely the sum of the AGRGCF, INDGCF and the SERGCF, but also contains adjustments made for the errors and omissions. The industrial GCF, anyway, contributed mainly to the high rise in total investment followed by the services investment. Industrial GCF as well as the industrial GDP show high Y2Y's in most years (Table 4). Actual data shows that the INDGCF went up abnormally in the years 1996 to 2001 and later fell in the year 2002 to the same level as in the year 1995; [INDGCF data: 1994: 90735, 1995:117734, 1996:172568, 1997:145520, 1998:148666, 1999:139182, 2000:142754, 2001:124298, 2002:117508 – all in crores]. FDI also seems to have a role in pushing up the total investment levels in India during the post-reforms period.

Table 4 reveals that the agriculture, though it had a poor rise in its GCF, experienced a relatively higher increase in its GDP during the reforms period. According to the forecast series (based on pre-reforms data) the AGRGCF and the AGRGDP could have grown only at the rate of 1.84 per cent and 1.42 per cent respectively. However, according to the fitted series (based on reforms period data) these rates have been 2.59 per cent and 2.68 per cent respectively. The effect of the reforms in the agricultural sector investment is minimal. Agricultural GCF shows relatively small Y2Y effects with occasional negatives also (particularly in the early 1990s), indicating that reforms had very little impact on the agricultural GCF – at least until 1999. Thus the reforms have made only marginal impact on the investment in the agricultural sector. The Y2Y effects for AGRGCF are much smaller than for the AGRGDP.

The Y2Y effects of the services GCF are substantially positive for each year in the post-reforms period indicating that the reforms had significant effect on the sector. However, the same is not the picture in the case of the services GDP. An important question that arises here is that, despite high Y2Y effects in the services GCF, why the relatively much smaller Y2Y effects in the corresponding SERGDP? This is quite contrary to the performance of the agricultural sector (where the story is reverse)! The impact of the reforms on the service sector GDP seems to be relatively unimpressive compared to agriculture and industry, given the rise in the respective GCFs. The SLT of the SERGDP is quite high for its forecast (6.02 per cent) as well as for the fitted series (7.61 per cent). This means reforms or no reforms, the service sector GDP could have continued to grow at high rates anyway.

While the total investment has been experiencing increasing impact levels over time, the trend is the same with the gross

Table 3: Estimated Y2Ys and Forecast for Total GDP

Year	GDP	Forecast	Fitted	Y2Y	Year	COMPFOR9610
1951	140466					
1956	167667					
1961	206103					
1966	236306					
1971	296278					
1972	299269					
1973	298316					
1974	311894					
1975	315514					
1976	343924					
1977	348223					
1978	374235					
1979	394828					
1980	374291					
1981	401128					
1982	425073					
1983	438079					
1984	471742					
1985	492077					
1986	513990					
1987	536257					
1988	556778					
1989	615098					
1990	656331					
1991	692871	663460	694417	4.67	1991	692871
1992	701863	679511	708307	4.24	1992	701863
1993	737792	704803	730291	3.62	1993	737792
1994	781345	730095	776284	6.33	1994	781345
1995	838031	755387	838497	11.00	1995	838031
1996	899563	780680	903765	15.77	1996	885125
1997	970083	805972	967261	20.01	1997	935522
1998	1016399	831264	1020105	22.72	1998	989381
1999	1082472	856557	1086363	26.83	1999	1046892
2000	1148371	881849	1146345	29.99	2000	1108273
2001	1198685	907141	1200284	32.31	2001	1173761
2002	1265429	932434	1263670	35.52	2002	1243619
2003	1320313	957726	1320144	37.84	2003	1318128
CAGR (91-03)	5.52	3.11	5.50		2004	1397594
SLT	5.79	3.12	5.79		2005	1482340
					2006	1572717
					2007	1669085
					2008	1771873
					2009	1881475
					2010	1998352
CAGR (95-03)	5.85					5.82
CAGR (03-10)						6.10

Notes: Forecast: Dynamic forecast for post-reforms period from pre-reforms model.
COMPFOR9610: Dynamic forecast for the period 1996-2010 from comprehensive model.
Fitted: Predicted values from post-reforms model. SLT: Estimated semi-log trend growth rate.
CAGR(91-03)/(95-03)/(03-10): Annual compound growth rate during the post reforms period 1991-2003/1995-2003/2003-10.
Y2Y = [(Fitted value – forecast)/forecast] x 100; Data: Rs crore at 1993-94 prices.

domestic savings. The rise in the GDS growth rate due to reforms is 3.20 percentage points (from 2.68 per cent to 5.88 per cent). This rise implies that the average savings ratio (GDS/GDP) rose marginally during the reforms period (1.032/1.0267 = 1.005. implying a less than 1 per cent rise in the savings ratio). Simultaneously rising is the private final consumption expenditure (PFCE), which also has experienced higher growth during the post-reforms period as indicated by the higher SLT's as well as the rising Y2Y effects over time. The growth rate of PFCE has increased by 2.29 percentage points (from 2.71 per cent to 5.00 per cent) during the reforms period. Obviously, in per capita terms also this indicates a substantial rise. However this rise does not seem to be at the expense of savings and investment.

One may ask: where does the rise in the PFCE come from? Is it only from urban areas? Is there any evidence that the purchasing power of the relatively poorer sections of the population, particularly in rural areas, has been going up after the reforms? Is the 'feel good' feeling only for a few? Such questions may however be answerable only when disaggregated data are examined.

The story in the case of the price deflators (PDFL) seems to be same for all the three sectors. All of them (agriculture, industry and services) have rising Y2Y effects during the reforms period. Reforms have also led to a faster rise; compare their SLT's between the forecasts and the fitted values in Table 4. The rise in the price deflator is the highest for the agriculture at 2.15 per cent (from 5.25 per cent to 7.4 per cent), followed by the services' 1.98 per cent (from 4.86 per cent to 6.84 per cent) and then the industry's 1.37 per cent (from 5.23 per cent to 6.60 per cent). This has led to higher agricultural terms of trade (AGRTOT) – which is the ratio of the agriculture GDP price deflator to the

Table A: Estimated Intervention Years

Variables	Pre-reforms Interventions Data: 1951-1990			Post-reforms Interventions Data: 1991-2002/03		
	Pulse (P)	Level (L)	Trend (TR)	Pulse (P)	Level (L)	Trend (TR)
Gross domestic product (GDP)		1978	1951, 81			1991, 94
Industrial GDP (INDGDP)	1990	1978	1951, 82			1991, 94
Agricultural GDP (AGRGDP)	1980	1963, 84				1991, 98
Service sector GDP (SERGDP)		1979				1991, 96
Investment/gross capital formation (GCF)			1951, 79	1991		1991
Gross domestic savings (GDS)			1951, 73	1999		1991
Private final consumption Expenditure (PFCE)			1951, 78			1991, 95
Agricultural GCF (AGRGCF)	1977, 79, 1980, 90	1976, 87	1951	1991,99		1991
Industrial GCF (INDGCF)	1983, 84 1985, 88	1982	1951	1998		
Services sector (SERGCF)			1951, 73	1995,96 1999		
Trade balance (TB)	1967, 77 1980, 85 1986, 88	1981, 86	1951	1999 2002		1991
Agricultural price deflator (AGRPDFL)	1976, 77 1980, 88					
Industrial price deflator (INDPDFL)	1975	1980				
Services sector price deflator (SERPDFL)	1975		1977, 80 1983, 89	1998		

Table B: Year-to-Year Effects in Individual Variables

Year to Year Effects in the Post-reform Values (Y2Y)	Variables
All periods +ve and generally rising over time	GDP, AGRGDP, INDGDP, GDS, PFCE, AGRPDFL, SERPDFL
Mostly +ve and generally rising over time	GCF, INDPDFL
Moved from –ve to +ve	SERGDP, AGRGCF
All periods +ve but fluctuating	INDGCF, SERGCF, AGRTOT

Table 4: Per Cent Year to Year Effects (Y2Y) Due to Reforms

Sl No	Variable	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	CAGR/SLT Forecast	Fitted	Data
1	GDP	4.67	4.24	3.62	6.33	11.00	15.77	20.01	22.72	26.83	29.99	32.31	35.52	37.84	3.11	5.50	5.52
															3.12	5.79	5.79
2	AGRGDP	4.42	6.82	12.63	13.74	15.68	16.88	21.88	18.40	22.27	20.01	21.85	24.08	22.02	1.43	2.76	2.28
															1.42	2.68	2.67
3	INDGDP	8.72	6.95	5.20	9.46	13.36	16.96	20.28	23.37	26.25	28.95	31.47	33.84	36.07	3.63	5.58	5.48
															3.56	5.83	5.86
4	SERGDP	-3.66	-4.74	-5.82	-6.90	-7.98	-4.20	-0.98	1.76	4.09	6.07	7.74	9.14	13.42	6.25	7.70	7.51
															6.02	7.61	7.63
5	GCF	12.58	-1.68	6.20	13.25	19.62	25.45	30.81	35.79	40.44	44.78	48.87	52.72	NA	2.92	5.81	5.59
															2.96	6.72	6.80
6	AGRGCF	6.02	-4.86	-3.32	-1.80	-0.32	1.12	2.51	3.86	-3.20	6.43	7.65	8.83	NA	1.87	2.11	2.33
															1.84	2.59	2.59
7	INDGCF	8.97	5.31	13.39	12.58	9.18	76.23	41.76	51.73	52.31	42.30	43.34	26.40	NA	1.65	3.03	3.41
															1.52	4.41	4.36
8	SERGCF	7.86	13.05	8.54	11.72	43.52	38.78	21.95	23.59	12.37	35.51	43.35	46.08	NA	1.89	4.74	4.26
															2.03	4.30	4.60
9	GDS	9.03	4.46	8.50	11.48	19.43	32.69	31.58	32.12	23.84	44.60	41.54	51.02	NA	2.69	5.78	5.84
															2.68	5.88	6.06
10	PFCE	NA	2.59	2.70	3.11	5.81	9.64	13.40	14.81	18.66	21.74	23.27	26.55	NA	2.72	4.89	4.91
															2.71	5.00	4.81
11	AGRPDFL	8.05	10.65	19.25	17.82	22.27	25.56	29.38	33.19	37.81	40.90	39.96	36.15	36.37	5.45	7.51	7.79
															5.25	7.40	7.48
12	INDPDFL	-1.63	4.11	8.65	12.14	14.84	16.79	18.12	19.03	19.54	19.62	19.59	19.23	18.79	5.43	7.10	6.89
															5.23	6.60	6.59
13	SERPDFL	2.25	10.91	12.92	15.30	18.47	21.81	25.67	25.28	30.25	31.75	31.14	31.62	31.31	5.02	7.23	7.11
															4.86	6.84	6.85
14	AGRTOT	7.25	2.51	7.08	3.13	4.25	4.53	5.16	8.11	8.92	10.47	10.04	6.84	7.25	0.30	0.30	0.71
															0.29	0.64	0.73

Notes: Gross Domestic Product at Constant Prices (GDP), Industrial GDP at Constant Prices (INDGDP), Agricultural GDP at Constant Prices (AGRGDP), Service Sector GDP at Constant Prices (SERGDP), Investment at Constant Prices (GCF), Gross Domestic Savings at Constant Prices (GDS), Private Final Consumption Expenditure at Constant Prices (PFCE).
Agricultural GCF at constant prices (AGRGCF), Industial GCF at constant prices(INDGCF), Services sector GCF at constant prices (SERGCF).
Agricultural price deflator (AGRPDFL), Industrial price deflator (INDPDFL), Services sector price deflator (SERPDFL), Agricultural Terms of Trade (AGRTOT).
CAGR : Annual compund growth rate during the post-reforms period 1991-2002/03, SLT: Estimated semi-log trend growth rate (1991-2002/03).

non-agricultural GDP price deflator. Agricultural producers seem to have benefited through relative prices rather than in terms of the agricultural investment. The Y2Y effects for all the post-reforms years have turned out positive though there is no consistent pattern in them. They ranged from 2.51 in the year 1992 to as high as 10.47 in 2000. The pre-reforms forecasts indicate that the AGRTOT would have grown at a lower rate over time had the reforms not been implemented (SLT for the forecast series is 0.29 per cent and that of the fitted series is 0.64 per cent while the actual data showed a rise of 0.73 per cent).

Comprehensive Models using Full Data

Finally, the intervention specifications may now be incorporated and using the entire data (1951-03), a comprehensive model for each of the variables estimated. Several difficulties arise while assessing the estimated final models with regard to their reliability for forecasting purpose.

First, we start with identifying a reasonably good ARIMA model for each series. This is mostly based on residual auto-correlations and sample ACF (auto correlation function) and sample PACF (partial ACF). But this still does not account for the intervention points if any during the data period. However, such intervention points, which could not be accounted for in the ARIMA model must be shown up in the estimated residuals. Therefore towards identifying the intervention points, the estimated residuals have been subjected to the intervention analysis (using FREEFORE package). The identified intervention points if any have been incorporated into the earlier ARIMA model and the series re-estimated. The re-estimated models have now been subjected to the model-adequacy tests. Several criteria for assessing a model's adequacy may be followed: (a) R-bar square, (b) D-W statistics, (c) Residual auto-correlations (Ljung-Box Q-statistics), (d) Akaike Information Criterion (AIC), and (e) Schwartz Information Criterion (SIC).

Table C

	Change in the Per Cent Growth Rates Due to Reforms (in Percentage Points)	
	GDP	GCF
Total	2.67	3.76
Agricultural	1.25	0.75
Industrial	2.26	2.89
Services	1.59	2.26

Table D: Estimated CAGRs – 2002-03 to 2010

(in per cent)

GDP	6.10	Agricultural GDP	1.74
Industrial GDP	5.37	Services GDP	8.13
Investment (GCF)	7.11	Agriculture GCF	3.50
Industrial GCF	7.15	Services GCF	1.86
G domestic savings	7.24	Private final consumption expenditure	6.16
Agricultural PDFL	5.45	Industrial PDFL	5.60
Services PDFL	5.17	Agricultural TOT	0.13

Table 5: Comprehensive Models for the Period 1951-2002/03

Sl No	Variable											
1	GDP		CONST	GDPFC(-1)	GDPFC(-2)	MA(1)					R_bar_sqr	D-W
		coefficient	-2718.9170	1.7271	-0.7046	-0.9532					0.99	1.85
		t-statistics	-2.34	13.92	-5.32	-25.18						
2	AGRGDP		TR(51)	P(80)	AR(1)	AR(2)					R_bar_sqr	D-W
		coefficient	5463.9550	-21049.0900	0.4295	0.4685					0.99	2.03
		t-statistics	22.23	-3.34	3.26	3.75						
3	D(INDGDP)		TR51^2	D(L80)	D(L92)	AR(1)	AR(2)				R_bar_sqr	D-W
		coefficient	6.7766	-8076.5190	-10864.2900	0.5017	-0.3592				0.79	2.02
		t-statistics	17.72	-3.17	-4.19	3.49	-2.34					
4	D(SERGDP)		TR(80)	TR(91)	TR(91)^2	D(TR(96))	AR(1)	MA(1)	MA(2)		R_bar_sqr	D-W
		coefficient	1774.434	-2953.279	183.0572	14947.1000	-0.2589	0.8810	0.9668		0.92	2.06
		t-statistics	5.74	-1.94	1.76	4.72	-1.77	32.94	30.83			
5	GCF/GDP		CONST	TR51	AR(1)	MA(1)					R_bar_sqr	D-W
		coefficient	0.165823	0.002377	-0.399947	0.961313					0.82	1.79
		t-statistics	23.72	10.52	-2.81	21.30798						
6	D(AGRGCF)		P(77)	P(79)	P(81)	D(P(91))	L(95)				R_bar_sqr	D-W
		coefficient	2942	4911	-3125	2221.5	736.375				0.64	2.26
		t-statistics	4.01	6.70	-4.26	4.28	2.84					
7	INDGCF		TR(51)^2	P(82)	P(88)	P(96)	P(01)	P(02)	AR(1)	MA(1)	R_bar_sqr	D-W
		coefficient	56.72142	17681.02	-20039.42	34779.28	-27240.96	-37106.16	0.3297	0.9897	0.99	2.06
		t-statistics	30.68	9.62	-8.98	14.30	-4.44	-3.83	2.36	27.23		
8	SERGCF		TR(51)	TR(73)	P(88)	P(95)	P(96)	L(00)	AR(1)		R_bar_sqr	D-W
		coefficient	1128.367	1055.532	-9367.588	17059.83	12793.62	17344.79	0.6779		0.99	1.73
		t-statistics	5.18	2.37	-5.00	7.93	5.94	6.55	13.06			
9	GDS/GDP		CONST	TR51	L74	AR(1)	AR(2)	MA(1)			R_bar_sqr	D-W
		coefficient	0.095185	0.002833	0.026822	1.356314	-0.666644	-0.989949			0.97	1.80
		t-statistics	43.71	16.75	5.81	11.95	-5.87	-2159.40				
10	D(PFCE)		CONST	L(78)	P(80)	P(83)	TR(94)	P(97)	P(98)	P(01)	R_bar_sqr	D-W
		coefficient	5981	13772.02	-27066.02	-16127.02	3505.203	16854.17	-19560.03	-22867.64	0.85	2.46
		t-statistics	5.92	8.35	-5.09	-3.03	8.07	3.12	-3.55	-3.81		
11	D(AGRPDFL,2)		P76	D(P92,2)	P77	P80					R_bar_sqr	D-W
		coefficient	-0.0521	0.0437	0.0458	0.0436					0.57	2.12
		t-statistics	-3.22	6.62	2.83	2.69						
12	D(INDPDFL,2)		MA(1)								R_bar_sqr	D-W
		coefficient	-0.4948								0.22	2.07
		t-statistics	-4.02									
13	D(SERPDFL,2)		D(P(75),2)	D(P(98),2)							R_bar_sqr	D-W
		coefficient	0.0099	-0.0239							0.51	2.03
		t-statistics	2.79	-6.78								
14	AGRTOT		Not estimated directly. See text for details									

R-bar square may be used for goodness of fit in the cases where dependent variable is at levels (i e, undifferenced form). However, in the cases of differenced data R-bar square cannot be relied on. The D-W statistics have been used to check for auto-correlation wherever applicable. For example, D-W should not be trusted in the presence of lagged dependent variable. The Ljung-Box Q-statistics have been used for checking the residual auto-correlations up to 30 lags. There could be many models that could

Table 6: Historical Simulations for 1996-2002/03 and Forecasts

	GDP		AGRGDP		INDGDP		SERGDP		GCF/GDP)		GCF		AGRGCF		INDGCF	
Year	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast
1991	692871	692871	223114	223114	188601	188601	281156	281156	0.2824	0.2824	195650	195650	16416	16416	81289	81289
1992	701863	701863	219660	219660	187560	187560	294643	294643	0.2444	0.2444	171553	171553	14965	14965	91728	91728
1993	737792	737792	232386	232386	194994	194994	310411	310411	0.2541	0.2541	187478	187478	16141	16141	92688	92688
1994	781345	781345	241967	241967	205162	205162	334216	334216	0.2539	0.2539	198412	198412	15249	15249	90735	90735
1995	838031	838031	254090	254090	226051	226051	357890	357890	0.2910	0.2910	243882	243882	16785	16785	117734	117734
1996	899563	885125	251892	255597	252359	245045	395312	392948	0.3013	0.3027	271015	267887	17669	17521	172565	163536
1997	970083	935522	276091	262481	270218	259776	423774	426640	0.2767	0.2666	268435	249370	18326	18258	145520	128177
1998	1016399	989381	269383	266701	281788	273598	465228	463678	0.2844	0.2843	289058	281303	18294	18994	148666	131636
1999	1082472	1046892	286094	272296	292346	269055	504032	502177	0.2704	0.2805	292703	293700	17470	19731	139182	136501
2000	1148371	1108273	286883	277233	306445	306232	555043	543085	0.2948	0.2854	338542	316282	19289	20467	142754	141907
2001	1198685	1173761	285877	282532	326618	324268	586190	586617	0.2880	0.2868	345209	336606	19578	21203	124298	120326
2002	1265429	1243619	302054	287679	337509	342713	625866	633178	0.2811	0.2895	355720	360086	21140	21940	117508	116280
2003	1320313	1318128	292310	292929	357783	361662	670220	683126	NA	0.2918	NA	384586	NA	22676	NA	159334
2004	NA	1397594	NA	298152	NA	381335	NA	736827	NA	0.2942	NA	411182	NA	23412	NA	165401
2005	NA	1482340	NA	303413	NA	401822	NA	794648	NA	0.2966	NA	439601	NA	24149	NA	171583
2006	NA	1572717	NA	308677	NA	423098	NA	856955	NA	0.2989	NA	470157	NA	24885	NA	177879
2007	NA	1669095	NA	313960	NA	445132	NA	924114	NA	0.3013	NA	502930	NA	25622	NA	184288
2008	NA	1771873	NA	319252	NA	467928	NA	996491	NA	0.3037	NA	538114	NA	26358	NA	190811
2009	NA	1881475	NA	324556	NA	491511	NA	1074452	NA	0.3061	NA	575871	NA	27094	NA	197447
2010	NA	1998352	NA	329873	NA	515904	NA	1158364	NA	0.3085	NA	616395	NA	27831	NA	204197
CAGR (95-2002/03)	5.85	5.82	1.77	1.79	5 91	6.05	6.16	8.42			5.54	5.72	3.35	3.90	4.34	4.00
CAGR (2002/03-10)		6.10		1.74		5.37		8.13				7.11		3.50		7.15

	SERGCF		(GDS/GDP)		GDS		PFCE		AGRPDFL		INDPDFL		SERPDFL		AGRTOT	
Year	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast
1991	68372	68372	0.2571	0.2571	178137	178137	525641	525641	0.7160	0.7160	0.7488	0.7488	0.7468	0.7468	0.9578	0.9578
1992	66170	66170	0.2443	0.2443	171488	171488	536980	536980	0.8455	0.8455	0.8286	0.8286	0.8416	0.8416	1.0107	1.0107
1993	69419	69419	0 2417	0.2417	178351	178351	550828	550828	0.8962	0.8962	0.9228	0.9228	0.9182	0.9182	0.9742	0.9742
1994	75149	75149	0.2478	0.2478	193621	193621	574772	574772	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1995	95360	95360	0.2739	0.2739	229535	229535	601481	601481	1 0971	1.0971	1.0995	1.0995	1.0890	1.0890	1.0037	1.0037
1996	94300	92881	0.2779	0.2721	249946	240812	638938	631750	1.2033	1.1943	1.1958	1.1888	1.1849	1.1780	1.0119	1.0102
1997	84785	81924	0.2552	0.2657	247520	246527	669566	682378	1.3134	1.2914	1.2625	1.2782	1.2738	1.2670	1.0346	1.0158
1998	89591	83802	0.2538	0.2591	257921	256313	707285	700097	1.4366	1.3886	1.3433	1.3675	1.3420	1.3321	1.0701	1.0320
1999	87045	85718	0.2366	0.2553	256091	267244	752440	740881	1.5467	1.4857	1.4488	1.4569	1.4517	1.4451	1.0662	1.0250
2000	106331	105011	0.2546	0.2554	292392	283062	793709	785170	1.6097	1 5629	1.4872	1.5462	1.5211	1.5341	1.0667	1.0289
2001	110977	106988	0.2566	0.2590	307620	303998	818636	810097	1.6345	1 6800	1.5506	1.6356	1.5854	1.6231	1.0391	1.0322
2002	108394	108991	0.2628	0.2646	332495	329123	866911	861397	1.7097	1.7771	1.5909	1.7249	1.6512	1.7121	1.0489	1.0353
2003	NA	111015	NA	0.2708	NA	356958	NA	916202	1.7620	1.8743	1.6662	1.8143	1.7038	1.8011	1.0422	1.0380
2004	NA	113059	NA	0.2763	NA	386110	NA	974512	NA	1.9714	NA	1.9036	NA	1.8902	NA	1.0405
2005	NA	115120	NA	0.2804	NA	415721	NA	1036328	NA	2.0686	NA	1.9930	NA	1.9792	NA	1.0427
2006	NA	117197	NA	0 2834	NA	445642	NA	1101649	NA	2.1657	NA	2.0823	NA	2.0682	NA	1 0448
2007	NA	119286	NA	0.2854	NA	476351	NA	1170474	NA	2.2629	NA	2 1717	NA	2.1572	NA	1.0467
2008	NA	121387	NA	0.2871	NA	508701	NA	1242905	NA	2.3600	NA	2.2611	NA	2.2462	NA	1.0484
2009	NA	123498	NA	0.2889	NA	543613	NA	1318642	NA	2.4571	NA	2.3504	NA	2.3352	NA	1.0501
2010	NA	125617	NA	0 2912	NA	581832	NA	1397983	NA	2.5543	NA	2 4398	NA	2.4243	NA	1.0516
CAGR(95-2002/03)	1.85	1.93			5.44	5.28	5 36	5.26	6.10	6.92	5.33	6.46	5.75	6.49	0.47	0.42
CAGR (2002/03-10)		1.86				7.24		6.16		5 45		5.60		5.17		0.13

Note: #1 The CAGR for INDGCF has been computed between the years 1991 to 2001 instead of 1995 to 2002.
The CAGR(2002/03-10) has been computed for all series between the last available actual data (2002 or 2003) and the forecasted value for 2010.

Table E: Comparison of Actual and Forecast CAGRs

(In per cent)

CAGR	GDP	AGR.GDP	IND.GDP	SER.GDP	GCF	AGR.GCF	IND.GCF	SER.GCF	GDS	PFCE	AGRPDFL	INDPDFL	SERPDFL	AGRTOT
1951 to 1960	3.56	2.62	5.68	4.08	5.78	0.48	11.21	4.85	6.49	3.66	0.54	1.90	2.41	-1.62
1961 to 1970	3.55	1.80	5.95	4.76	4.79	6.05	5.71	1.41	6 33	2.88	8 71	4.73	4 85	3.76
1971 to 1980	2.63	0.30	3.92	4.40	4.11	8.13	6.46	3.64	6.35	2.70	8.08	9.32	7.79	-0.28
1981 to 1990	5 62	3.35	7.02	6.87	6.25	-0.65	8.94	5.43	7.61	4.20	8 07	8.34	8.47	-0.32
1991 to 2000									5.66	4.69	9.42	7.92	8.22	1.20
1991 to 2002	5.63	2 79	5.43	7.55	5.59	2.33	3.41	4.28	5.84	4.65	8.23	7.09	7.48	0.83
2003-2010 Forecasts	6.10	1.74	5.37	8.13	7.11	3.50	7.15	1.86	7.24	6.16	5.45	5.60	5.17	0.13

pass these tests. Then, the model with the minimum AIC and/or SIC could in principle be chosen as the final model. In general, AIC (SIC) is said to be a better indicator in the case of small (large) samples. Thus, the AIC was useful for the earlier post-reforms models (12/13 observations only). In the case of comprehensive models with more than 50 observations the SIC is more appropriate. Still one cannot be sure that the models that were selected as above would be good enough for forecasting purposes. It was indeed found that many models passing the above tests turned out to be poor for forecasters. So, to choose one final model from a variety of them with reasonably close values to the observed minimum AIC/SIC, dynamic forecasts using each model have been computed from 1996 to 2002-03 (dynamic simulation over historical period). The forecasts for these years have been compared with the actual data both by the compound annual average growth rate (CAGR) (between 1995 and 2002-03) and year-to-year values. The model which gave the CAGR value closest to the CAGR from the actual data and which also gave yearwise forecast values close enough to the actual data has been chosen as the final comprehensive model. The estimated final models are presented in Table 5.

As mentioned earlier, the comprehensive final model for total GDP turned out to be an ARMA(2,1) model, which passed all the tests of adequacy including the residual auto correlations. The sectoral GDPs, i.e, AGRGDP, INDGDP and SERGDP turned out basically mixtures of difference and trend (deterministic) stationary processes, the deterministic variables being either pulse, or level or trend interventions. The effect of reforms in terms of interventions in the comprehensive models can be noted though the effect on any variable may not be shown up in the year 1991 itself. It could be some years before the effect could significantly be noticed. For several variables, interventions during the early 1990s came out significant. All such interventions turned out to be positive except for INDGDP – which had a negative level shift in 1992 and showed up as a slump in Y2Y effects in 1992 and 1993 (Table 4). Data shows that both AGRGDP and INDGDP (and several others also) actually fell down in the year 1992.

The estimation of comprehensive models for total GDS and GCF were done in terms of their ratio to the GDP (Table 5). The forecast values of these ratios over the historical period (1996-2002) are quite close to the actual figures (Table 6).

Earlier, the actual data on INDGCF for the years 1994 to 2002 were presented and the abnormal rise and fall during the years 1996 to 2002 were pointed out. Also, the levels of the INDGCF were of the same order in the years 1995 and 2002 [INDGCF data: 1995:117734, 2002:117508 – all in crores]. Data actually shows a negative CAGR between 1995 and 2002! Though the comprehensive model's forecasts also show a negative CAGR over the same period, however, it was not proper to compare the actual data and the forecasts by merely looking at such unusual CAGRs between the 1995 and 2002. For this reason, the CAGR between 1991 and 2001 (instead of 1995 to 2002) was used for comparison in the case of INDGCF. However, more important is to check whether the estimated model could retrace the year-to-year path actually taken by the data. Table 6 shows that the model could reasonably do so. The comprehensive model accounted for the unusual rise and fall by appropriate pulse variables in the years 1996, 2001 and 2002. The same feature also prevailed in the case of services' GCF (SEGCF) also, though somewhat at a lesser extent - SERGCF rose in 1995 and then declined and rose again (SERGCF data: 1994:75149, 1995:95360, 1997:84785, 2001:110977; all in crores). The comprehensive model accounted for this feature by huge pulse variables in 1995 and 1996 and a level shift variable in 2000.

While in general it is quite difficult to account for such downturns and upturns in macro-economic series (where ARCH and GARCH models generally remain inapplicable), our comprehensive models incorporating appropriate intervention variables seem to be satisfactory. Therefore, these models have now been used for further simulation up to 2010. The simulation results are presented in Table 6. The CAGRs between the years 2002-03 (actual data value) to 2010 (forecast value) have been worked out, which turn out as in Table D.

Juxtaposing these forecasts along with the CAGRs of the actual data of the previous periods, the picture in Table E emerges.

Basically this is the inner strength of the economy right now. If planners want the economy to grow at a rate higher than 6.1 per cent, say 8 per cent or so, then some more reforms may have to be brought in. The agriculture sector shows signs of not being able to grow in the next 6 years even at the rate at which it did in the last 20 years or so. This sector requires immediate attention – both in terms of raising investment and productivity. Even industry is not likely to grow anywhere near 8 per cent despite high investment levels – thus resulting in high capacity under-utilisation. Demand management is more important here. Coming to services, the reforms process has hardly touched this sector so far. It is disappointing that the services' GCF is forecast to grow only at 1.86 per cent between 2002 and 2010, which is almost the same rate (1.85 per cent) that was recorded between 1995 and 2002 (Table 6). However, the expected returns to investments made in this sector are likely to be quite impressive. Though the services sector will continue to grow anyway, it however may not be able to grow so much that it can compensate for the underperformance of the other two sectors.

The forecasts indicate that the savings ratio is likely to go up to 28.54 per cent in 2007 and to 29.12 per cent in 2010 (Table 6). The corresponding forecasts for the total investment ratio are 30.13 per cent (2007) and 30.85 per cent (2010). This implies that the total savings would grow at 7.24 per cent, and investment will grow at 7.11 per cent between 2002 and 2010. Besides, the difference between the forecast savings and investment ratios of 29.12 per cent and 30.85 per cent in 2010 indicates the importance of the net capital inflow. These figures may be contrasted with the forecast of 6.1 per cent growth in the total GDP. If more growth than 6.1 per cent rate is to be achieved, the current patterns of savings and investment may not be adequate. EPW

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[We have benefited from discussions with Abdul Azeez and M P Vithal and Sanjoy Nath. Errors (sure to remain) are of course ours.]

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