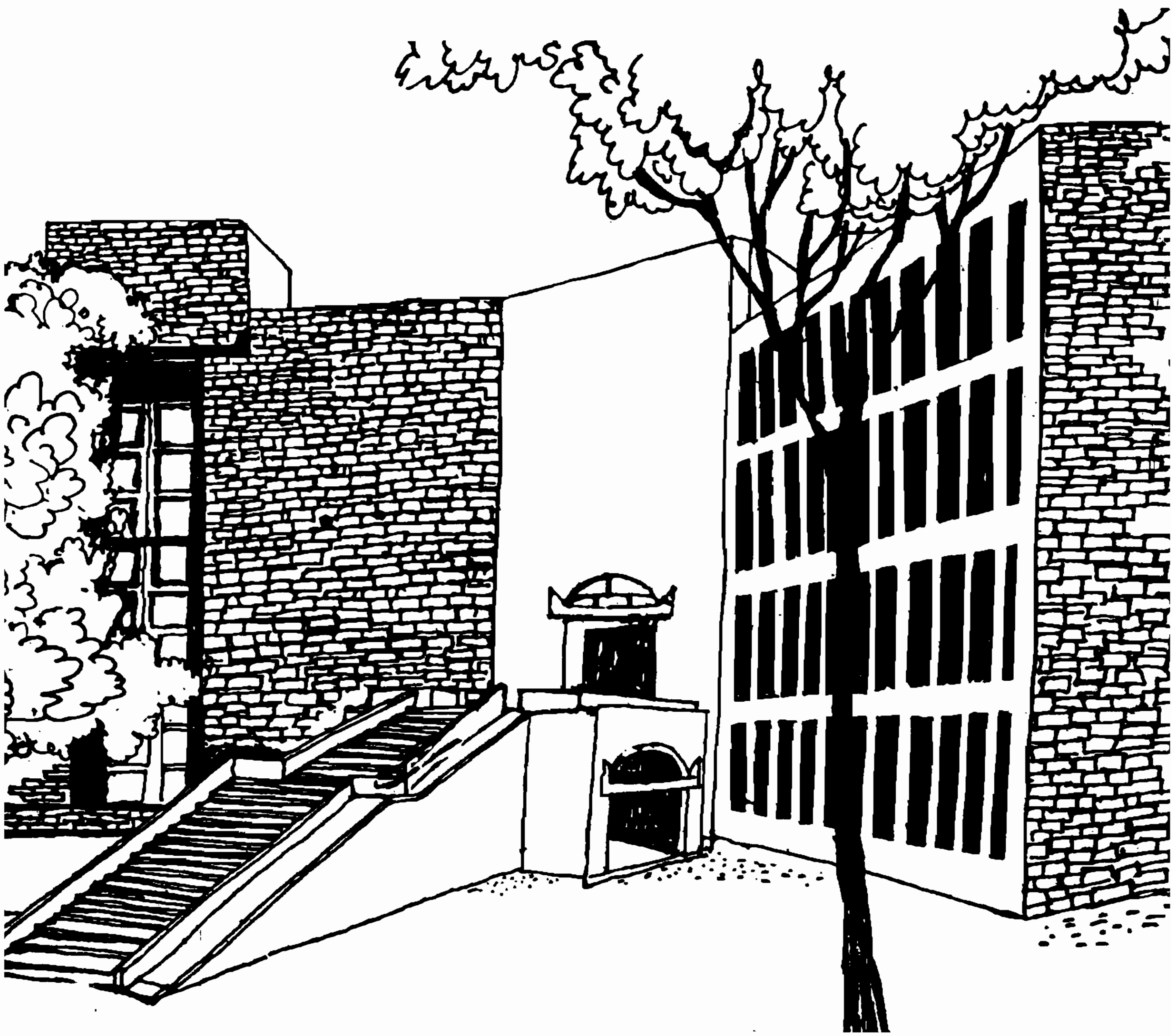
विद्याविनियोगाद्विकासः
IIM AHMEDABAD

Working Paper



EXPECTED INFLATION AND FORECAST OF GROWTH RATE IN INDIA

By

Ravindra H. Dholakia

W P No. 1083
February 1993

The main objective of the working paper series of the IIMA is to help faculty members to test out their research findings at the pre-publication stage.

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380 015
INDIA

Expected Inflation and Forecast of Growth Rate in India

- Ravindra H.Dholakia

Abstract

Under rapidly changing economic environment in India, economic decision makers at various levels are likely to consider reliable short term forecast of the growth rate of the economy as an important input. It is argued that a simple model with a few variables is likely to be more relevant and reliable for the purpose than elaborate complicated models with hundreds of equations and variables. Expected inflation rate and internal supply-shock are hypothesised to be crucial variables. Numerous alternative methods are tried to measure the expected inflation in India and final choice is made on the bases of certain criteria discussed in the paper. The growth forecasting performance of the model suggested in the paper is compared to the official estimates for the last two years. The exploratory exercise carried out in the paper shows promise and potential.

Expected Inflation and Forecast of Growth Rate in India

- Ravindra H.Dholakia
IIM, Ahmedabad

1. Introduction:

Indian economy has now reached a stage where the prediction of the growth rate for the forthcoming year is not merely of academic interest but an important input for the policy makers and a serious concern to the entrepreneurs and investors. Assessment of the immediate past performance no doubt has its own utility. What is more relevant, however, is the availability of some reliable forecast of the performance of the economy in near future. For preparation of the annual budget, such forecast can play a very crucial role. Currently also, such forecasts are made, but their bases, methodology and, most importantly, the reliability are hardly explicitly stated. They are, therefore, considered only as assumptions. The economic agents hardly take them seriously. Many of them are not even aware about such forecasts assumed by the Finance Ministry while preparing the budget. This introduces elements of imperfection due to lack of information on one hand and unknown margins of errors in basic calculations for decision making on the other hand. If the economy is on a smooth growth-path continuing more or less same economic policies, the inherent uncertainties faced by decision makers in the public as well as private sectors are considerably less. However, India is currently undergoing major structural reforms with unprecedented changes in her economic policies.

---

* Computational assistance provided willingly and competently by Mr.Ganesh Kumar N. is gratefully acknowledged.

The economic decision makers in India and the foreigners who wish to invest in the country are, therefore, faced with tremendous uncertainties about the impact of changes in the economic environment in the country. Moreover, India is moving in the direction of integrating her economy with the rest of the world. This is likely to introduce fresh elements of uncertainties arising out of the changes in the world economic environment. Some meaningful and reliable forecast of the economic performance as summarised in the measure of "growth rate" over the next year is the need of the hour.

Preparing and publishing the advance estimate of the growth rate of GDP at constant 1980-81 prices for the year 1992-93 by CSO on January 29, 1993 in leading dailies is a step in the right direction. However, it is not a substitute for the short-term forecast of the growth rate for the forthcoming year. It may only serve as a revision of the forecast based on information on the economy obtained upto a given point of time during the year. Such exercises by CSO are hardly unproductive. There is empirical evidence to argue that the information content of such estimates is considered relevant by the economic decision makers. (See, Shah & Dhar, 1992).

The task of forecasting the growth rate is not very simple particularly under the prevailing conditions of rapidly changing economic environment in India. Most of the relationships among macro aggregates and their time-trends tend to lose stability in the recent times. Structure of the economy has also undergone significant changes since the early eighties. Most of the relationships estimated with the help of historical data may not hold true for the future. Under such circumstances, detailed and complicated economic models with hundreds of variables may not necessarily prove more efficient than simpler models based on one or two critical variables. The issue is to identify such critical variables and then measure them appropriately. The variables most likely to be relevant in growth forecasting are the expectational variables rather than the actual or expost variables. Since both Indian producers and Indian consumers are highly concerned about the inflation rate in the economy and since the inflation rate largely determines the real aggregates like the real effective exchange rate, real rate of return, real balances, etc. given the nominal aggregates, expected inflation rate is identified as a crucial variable besides internal supply shock for short term growth forecasting. The exercise carried out in this paper should be considered only as exploratory and illustrative. In the next section, the basic model is briefly described. In the third section, then, the method of measuring expected inflation is discussed. In the fourth section, results of the empirical exercise are discussed.

2. The Model:

As already discussed above, our objective is to make reliable short-term forecast of economic growth under rapidly changing economic environment. For this purpose, a simpler model based on a few variables whose interrelationship is not likely to have undergone significant changes may prove more efficient. It is also important to note that essentially static frameworks and static variables may not be relevant in this context because the problem is basically a dynamic one. Thus, considerations of the levels of the variables are not relevant because, in estimation of such models, serious econometric problems on account of spurious correlations. multi-collinearity, autocorrelation and model mis-specification are likely to arise.

It is assumed here that the price-production relationship is likely to be stable over time in spite of rapidly changing environment. In the framework of the dynamic short-run aggregate supply curve, we may assume that price elasticity of supply remains the same over time other things being given. This implies:

$$\frac{dy/y}{dPE/PE}=\frac{dy/dt}{y}/\frac{dPE/dt}{PE}=b.$$

But

$$\frac{dy/dt}{y}=Gy \quad \wedge \frac{dPE/dt}{PE}=GPE$$

are annual growth rates in the supply (production) and expected price respectively.

$$\therefore \quad Gy=b{\cdot}GPE.....................(1)$$

If, however, there are conditions of adverse internal supply shock which is likely to depress the growth of production in the economy at a given level of expected inflation, equation (1) has to be modified to include such effects. Thus,

$$Gy=b{\cdot}GPE+c{\cdot}SS.....................(2)$$

In order to consider "other things" (assumed to be given) in the equation (2), a constant term indicating autonomous growth could be added in the equation (2), i.e.

$$Gy=a+b\cdot GPE+c\cdot SS \text{..........} (3)$$

It can be seen that equation (3) is based on the supply side only which amounts to assuming that the basic constraining factor in the Indian economy is supply rather than demand. It is the level of the dynamic aggregate demand curve which would determine the actual rate of inflation observed in the economy at the given level of output. This is important in measuring the expected inflation because under rational expectation formulation, the economic agents would consider mainly the demand side factors to form the inflationary expectations.

Before we pass on to the discussion of method of measuring expected inflation it may be noted that Gy is measured as annual growth of GDP at 1980-81 prices. It is calculated as the difference between consecutive natural logarithms of real GDP implying the assumption of continuous compounding. The SS variable represents supply shock internal to the economy. It is measured as a dummy variable taking value 1 in the year when the adverse supply shock is felt. In the normal years, it assumes the value zero. The supply shock conditions are largely felt in the Indian economy when there is a serious deficiency of rainfall (being 10% or more), a year after the oil shocks, wars and in recent times serious foreign exchange crisis leading to unprecedented import compression. The years of the supply shock over the period of 1950-51 to 1991-92 are identified to be: 1950-51, 1955-56, 1957-58, 1959-60, 1962-63, 1965-66, 1966-67, 1971-72, 1972-73, 1974-75, 1976-77, 1979-80, 1982-83, 1986-87, 1987-88 and 1991-92.

3. Measurement of Expected Inflation:

There are basically two alternative approaches to formulation of inflationary expectations viz., the adaptive expectations and rational expectations. To put the things briefly and in a simplified way, we can say that the adaptive expection model assumes that people form inflationary expectations based on past experience and consider the past observed values of the variable in formulating expectations for the current period. The rational expectation model, on the other hand, assumes that people take into account all the information available to them including possible impacts of policy changes in formulating inflationary expectations for the current period. Both the approaches, however, assume that people do not make systematic errors in their expectations. In other words, the errors that they make are purely random.

One of the major problems in measuring the expected inflation is that it is considered context-specific in the literature. The model in which it is used has to be estimated individually following certain procedures and then the selection of the ultimate series out of various alternatives is invariably based on econometric criteria like goodness of fit and t-values of the parameters, etc. Thus, the measure of expected inflation would differ from model to model and from sample to sample. While there is some theoretical justification in treating expected inflation in this way, it would be very useful if some more general measurement of expected inflation is made available. The researchers may or may not use it for their purpose. It would at least make an option available to them. With this objective in mind, several alternatives based on the two approaches were tried and finally one of the series which was considered the best one was used in forecasting the growth rate.

Before we consider various alternatives for expected inflation, we need to define the criteria on the basis of which ultimate choice of the series could be made. The theoretical considerations, dervied from the standard sticky wage model in its dynamic form, suggest that in the short-run aggregate supply curve based on the Extended Phillips Curve hypothesis, the coefficient of GPE should be unity and the constant term should be zero. (For details, see Dholakia, 1990). Out of all such series which satisfy these criteria, we can select the one which provides maximum explanatory power to the model ensuring that other estimation problems like autocorrelation are not arising. As can be readily seen, such additional criteria involving the specific model and its explanatory power make the measurement (or the selected series) of the expected inflation model-specific or context-specific. If, instead, we use the basic definition of expected inflation to select the best series from amongst those which fulfill the theoretical criteria mentioned above, we may get a more generally usable series of expected inflation. Accordingly, we would test the following equation on those alternative series which satisfy the above-mentioned theoretical criteria:

$$GP=A+B \cdot GPE+u \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where A and B are parameters and u is a random error term with usual OLS assumptions. According to the equilibrium conditions, in the long-run GPE = GP which would imply that the expected values of estimates for A and B should respectively be 0 and 1. Thus, the best series is the one which: (i) is consistent with the null hypotheses of A = 0 and B = 1, (ii) does not reveal any problems of estimation implying that u is a purely random term satisfying all classical assumptions; and (iii) shows maximum r^2.

1) <u>Naive Models of Expectations:</u>

3 different naive models of expectations are considered here. These are as follows:

(1.1) The inflation next period will be the same as the one this period, i.e. $GPE_{t+1} = GP_t$ ....(5)

(1.2) A simple extrapolative model which assumes that inflation next period will increase by the same absolute amount as the observed latest increase,

i.e. $GPE_{t+1} - GP_t = GP_t - GP_{t-1}$

i.e. $GPE_{t+1} = 2GP_t - GP_{t-1}$ ....(6)

(1.3) A simple extrapolative model which assumes that inflation next period will increase to the same relative extent as the previous period, i.e.

$GPE_{t+1}/GP_t = GP_t/GP_{t-1}$

i.e. $GPE_{t+1} = GP_t^2 / GP_{t-1}$ ....(7)

2) <u>Distributed Lag Model with Infinite Lag Distribution:</u>

The basic model considers infinite lag distribution

$$GPE_{t+1} = b_0 GP_t + b_1 GP_{t-1} + \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

If the coefficients b_i's are taken to be geometrically declining, the special case becomes amenable to estimation. Let us consider $b_i = b_0 \lambda^i$ where λ is a positive proper fraction.

(2.1) Koyck's method which is the most widely used solution to the problem of estimation of such a model uses search procedure over λ. (For details, see Maddala, 1989). Nine different values of λ from 0.1 to 0.9 at the interval of 0.1 are chosen here.

(2.2) Another solution suggested by Dholakia (1990) is also considered here for different values of λ corresponding to the effective length of lag. Dholakia's (1990) solution essentially converts the infinite lag distribution to the finite lag distribution by ignoring all those periods in the past whose cumulative weight does not exceed 5%. Thus, effective length of the lag becomes a variable whose 10 alternative values are considered here.

3) Model based on Quantity Theory:

In its dynamic version, the quantity theory equation provides the celebrated monetary rule which defines the relationship between the inflation rate and growth of nominal money supply given the rate of growth of output in the economy, viz. $GP = GM - n.Gy$ ....(9)

where GM is growth of nominal money supply defined broadly; GY is the growth of real GDP and n is the income elasticity of demand for money which is assumed to be a parameter. This equation defines the relationship between most important macro aggregates like GP and GY with the help of a policy parameter like GM and a behavioural parameter like n which is considered to hold good in the long-run. This equation can, therefore, be used to generate expected inflation for the next period within the framework of rational expectation approach. Thus,

$$GPE_{t+1} = q + m.GM_t + n.Gy_t + v_{t+1} \quad \ldots\ldots\ldots\ldots (10)$$

where q,m and n are parameters and v_{t+1} is the random error term with usual OLS assumptions. It may be noted here that several other variables like fiscal deficit, budget deficit, supply shocks, etc. and different lags in all these variables were also tried. The estimates obtained for equation (10) which was found to be the best are as follows:

Table 1 : Regression Results For Equation (10) above

Period considered	Estimates with test-statics					
	q	m	n	R-square	Adj. R-square	D-W Stat.
1) 1951-52 to 1990-91	-0.0001 (-0.0028)	0.7258 (5.0293)*	-0.6582 (-2.5957)*	0.4653 (15.661)*	0.4356	1.8364
2) 1951-52 to 1991-92	-0.0015 (-0.0695)	0.7386 (5.0920)*	-0.6201 (-2.4445)*	0.4561 (15.513)*	0.4267	1.7841

* Significant at 5% level.

The first set of estimates excludes the latest information on the year 1991-92 whereas the second set includes it. Both the sets of estimates are reasonably close. Both these sets of estimates are generated so that we can have two extra-sample forecasts to compare the performance of our model at a later stage.

4. Empirical Results

Here inflation is basically measured in terms of the whole-sale price index. All alternative series of expected inflation generated as described above in section 3 were considered one by one in the following dynamic aggregate supply equation based on the extended Philips Curve hypothesis (See, Dholakia, 1990):

$$GP = a_0 + a_1 GPE + a_2 (y-\bar{y})/\bar{y} + a_3(Gy-G\bar{y}) + u \quad \ldots\ldots\ldots\ldots (11)$$

where y and $\bar{y}$ represent respectively the real GDP and the trend value of real GDP series at the same point of time; Gy and $G\bar{y}$ represent respectively the annual growth in real GDP and trend-rate of growth of real GDP; u is a random error term with usual assumptions; and a_i's are parameters. Out of all the alternative series of expected inflation as described in section 3 above, only the following gave significant fit at 5% level of significance:

Table 2 : Regression Results for Equation (11) above

GPE Based on	Estimates with test-statistics						
	a_0	a_1	a_2	a_3	R-Square	Adj. R-Square	D-W Stat.
1.Eq.(6) above	6.2483 (5.3571)*	0.3060 (2.3587)*	-37.513. (-1.3258)	-35.559 (-1.0271)	0.2919 (3.711)*	0.2133	2.1906
2.Eq. (10) above	-0.0025 (-0.1839)	1.0625 (5.5063)*	0.0021 (0.0085)	-0.4207 (-1.3390)	0.5044 (11.874)*	0.4619	1.8317

* Significant at 5% level of significance.

It should be noted here that the statistical significance reported in the above table refers to the usual null hypothesis of the coefficient value being zero. For our purpose, however, the relevant hypotheses are: $a_0 = 0$ and $a_1 = 1$. Estimates of regression (1) above are consistent with neither of these hypotheses whereas the ones for regression (2) are consistent with both these hypotheses [1]. None of the other series of expected inflation could provide significant results. Given the nature of the results, therefore, only one series of expected inflation which is based on equation (10) above, fulfills the theoretical criteria of being consistent with the long-run equilibrium in the framework of dynamic aggregate demand and supply theory. We may, therefore, examine only this series of expected inflation for the other test of its satisfying the basic definition as given by equation (4) above. The estimated equation (4) is as follows:

$$\hat{GP} = -0.13\text{ E-}6 + 1.0000 \quad GPE$$

t-values (0.4531) (5.6738)

R-Square = 0.4653	Adjusted R-Square = 0.4508
F(1,37) = 32.193	D-W Statistic = 1.8408

Goldfeld-Quandt λ = 1.0015.

As it can be readily seen, the fit is highly significant and both the test criteria, viz. intercept being zero and slope coefficient being statistically equal to unity are clearly satisfied by the GPE series based on equation (10) above. Moreover, it can also be seen from the results reported above that the Derbin-Watson test for autocorrelation and Goldfeld-Quandt test for heteroscedasticity also indicate absence of these estimation problems. We can, thus, safely interpret the

---

[1] The t-value with null hypothesis of $a_1 = 1$ turns out to be 0.324 which is insignificant even at 74% level of significance. Thus, we may accept the null hypothesis of $a_1=1$.

deviations of expected inflation from the actually observed inflation rate as purely random. We may, therefore, accept the series of GPE based on equation (10) above as the series of expected inflation for the Indian economy.

We are now in a position to estimate our basic growth equation (3) above. Again we may consider two sets of estimates corresponding to the exclusion and inclusion of the latest information on the year 1991-92. The results are reported as under:

Table 3 : Regression Results with Gy as Dependent Variable (Eq.3)

Period considered	Estimates with test statistics					
	a	b	c	R-Square	Adj. R-Square	D-W Stat.
1)1952-53 to 1990-91	0.0493 (7.9342)*	0.1459 (1.9315)**	-0.0494 (-6.93)*	0.5902 (25.93)*	0.5674	1.8866
2)1952-53 to 1991-92	0.0492 (7.8264)*	0.1428 (1.8926)**	-0.0495 (-6.925)*	0.5887 (25.76)*	0.5658	1.9006

* Significant at 5% level of significance.

** Significant at 7% level of significance.

As can be readily observed from Table 3, our basic growth equation fits the data very well. The expected inflation turns out to be statistically a significant positive influence on the growth of real income in India along with the internal supply shocks. We may now examine the performance of our model by comparing the forecasts of the Gy with the recently available estimates from CSO. Table 4 presents the results.

Table 4: Our Forecast of Gy and Official Estimates

Year	Nature of Estimate	Our Forecast		Official Estimates	
		Without Supply-shock	With Supply-shock	First	Revised
1991-92	Expected Value	5.84%	0.90%	2.5%	1.2%
	Standard Error	(0.42)	(0.57)	(Not Available)	
1992-93	Expected Value	6.56%	1.61%	4.2%	(?)
	Standard Error	(1.74)	(1.86)	(Not Available)	

It can be seen from Table 4 that our forecast for the year 1991-92 is much closer CSO's quick estimate of Gy = 1.2% (Jan.15, 1993) than the first estimates of the Finance Ministry of Gy = 2.5% (Economic Survey, 1991-92).[2] This is because the year 1991-92 was expected to be a year of severe supply shock on account of unprecedented import compression measures consequent upon the prevailing balance of payments position at the beginning of the year. On the other hand, the year 1992-93 was not expected to be such a bad year but was also not likely to be a very normal year as we used to have in the near past. It so happens that the CSO's advance estimate of Gy for the year 1992-93 falls almost at the arithmatic average of our estimates with and without a supply-shock. It only suggests that we need better measurement of the supply shock variable in our model rather than treating it as a

[2] It may be mentioned here that CSO provided the estimate of Gy for 1991-92 as 1.2% which was based on downward revision of its quick estimate of real GDP for the year 1990-91. If we ignore this downward revision, Gy turns out to be 0.87% which is almost the same as our forecast.

dichotomous qualitative variable.[3] A possible way to incorporate this concern explicitly is to extend our model by considering the sectoral dimension. Some further work can be done along this line.

Another important thing to note from Table 4 is that the standard error of our estimates are higher with supply-shock than without it. Thus, when supply-shock is expected, the environment and expectations about the future growth is surrounded by much more uncertainty than otherwise. Such features of the growth forecasting and their implications on business expectations are missed whenever estimates without standard errors are provided. It would be nice if the CSO considers providing some information - preferably quantitative - on the reliability of the estimates, particularly of forecasts.

References

Dholakia Ravindra H. (1990): "Extended Phillips Curve for the Indian Economy," ***Indian Economic Journal***, Vol.38, No.1, July-Sept.

Maddala G.S. (1989): ***Introduction to Econometrics***, Maxwell-Macmillan International Edition.

Shah, K.J. & Dhar, M.K. (1992):"***The Indian Stock Markets***: Can Technical Analysis and Economic Indicators be combined to Develop a More Efficient Portfolio Decision-making Model?" Report of Independent Project Study (PGP-II), IIM, Ahmedabad, Oct.

[3] For example, if we take SS = 0.52, our forecast of Gy would coincide with the advance estimate of CSO for the year 1992-93.

Appendix Table 1: Regression Results for Eq.(11) above (Extended Phillips Curve)

Estimates with Test-Statistics							GPE Based on
a_0	a_1	a_2	a_3	R-Square	Adj. R-Square	D-W Stat.	
I. NAIVE MODELS							
5.9666 (3.4108)	0.2430 (1.2715)	-38.353 (1.2101)	-26.052 (0.6931)	0.1943 (2.170)	0.1048	1.8735	Eq.(5)
6.2483 (5.3571)	0.2060 (2.3587)	-37.513 (1.3258)	-35.559 (1.0271)	0.2919 (3.711)	0.2138	2.1908	Eq.(6)
8.4161 (4.4602)	0.0019 (1.5903)	-27.072 (0.9068)	-23.796 (0.6166)	0.1868 (2.068)	0.0965	1.6450	Eq.(7)
II. KOYCK'S MODEL							λ Value
6.1840 (3.3153)	0.2134 (1.0192)	-40.600 (1.2575)	-22.644 (0.5959)	0.1777 (1.944)	0.0863	1.7980	0.1
6.4905 (3.2343)	0.1718 (0.7418)	-43.554 (1.3246)	-18.922 (0.4920)	0.1631 (1.754)	0.0701	1.7180	0.2
6.9352 (3.1737)	0.1113 (0.4295)	-47.487 (1.4197)	-14.508 (0.3725)	0.1518 (1.611)	0.0576	1.6340	0.3
7.5885 (3.1402)	+0.0225 (0.0763)	-52.622 (1.5503)	-9.0156 (0.2289)	0.1462 (1.541)	0.0514	1.5483	0.4
8.5319 (3.1360)	-0.1062 (0.3111)	-58.944 (1.7184)	-2.3354 (0.0588)	0.1491 (1.577)	0.0545	1.4663	0.5
9.7745 (3.1423)	-0.2774 (0.6912)	-65.675 (1.9066)	4.6990 (0.1182)	0.1609 (1.726)	0.0676	1.3982	0.6
10.912 (3.0790)	-0.4391 (0.9334)	-69.742 (2.0383)	8.8372 (0.2242)	0.1727 (1.879)	0.0808	1.3664	0.7
10.595 (2.7967)	-0.4111 (0.7812)	-65.100 (1.9659)	4.2867 (0.1112)	0.1649 (1.777)	0.0721	1.4110	0.8
8.1948 (2.3922)	-0.0739 (0.1355)	-54.758 (1.7714)	-6.4320 (0.1737)	0.1468 (1.545)	0.0518	1.5164	0.9

Estimates with Test-Statistics							GPE Based on
a_0	a_1	a_2	a_3	R-Square	Adj. R-Square	D-W Stat	
III. DHOLAKIA'S (1990) MODEL							No.of Lags
6.0428 (3.3535)	0.2361 (1.1662)	-39.511 (1.2403)	-24.379 (0.6470)	0.1870 (2.070)	0.0966	1.8371	1
6.2987 (3.2547)	0.2008 (0.8974)	-41.983 (1.2923)	-20.879 (0.5474)	0.1708 (1.853)	0.0786	1.7584	2
6.6563 (3.1790)	0.1515 (0.6088)	-45.252 (1.3685)	-17.085 (0.4418)	0.1576 (1.684)	0.0640	1.6786	3
7.1153 (3.1444)	0.0881 (0.3203)	-49.079 (1.4645)	-12.842 (0.3288)	0.1493 (1.579)	0.0547	1.6052	4
7.6063 (3.1190)	0.0204 (0.0674)	-52.773 (1.5584)	-8.8609 (0.2252)	0.1462 (1.541)	0.0513	1.5461	5
8.0850 (3.0942)	-0.0458 (0.1390)	-56.046 (1.6420)	-5.3880 (0.1362)	0.1466 (1.547)	0.0518	1.5016	6
8.5714 (3.0904)	-0.1132 (0.3195)	-59.088 (1.7224)	-2.1907 (0.0552)	0.1492 (1.579)	0.0547	1.4654	7
9.0374 (3.0912)	-0.1781 (0.4716)	-61.761 (1.7946)	0.5878 (0.0148)	0.1530 (1.626)	0.0589	1.4367	8
9.4491 (3.0853)	-0.2358 (0.5904)	-63.917 (1.8535)	2.7953 (0.0703)	0.1569 (1.675)	0.032	1.4162	9

Appendix Table 2: Basic Data

Year	GDP at 1980-81 prices	Nominal Money Stock(M3)	WPI	In Differences: GDP	M3	WPI	GPE *
1950-51	42871	2353.997	16.88588				
1952	43872	2206.356	17.91681	0.023080	-0.06477	0.059261	
1953	45117	2189.837	15.67721	0.027982	-0.00751	-0.13353	0.027982
1954	47863	2271.401	16.42374	0.059083	0.036569	0.046520	0.059083
1955	49895	2456.210	15.28617	0.041578	0.078222	-0.07177	0.041578
1956	51173	2770.076	14.50408	0.025291	0.120255	-0.05251	0.025291
1957	54086	2962.113	16.53039	0.055363	0.067027	0.130770	0.055363
1958	53432	3266.687	17.02808	-0.01216	0.097873	0.029663	-0.01216
1959	57487	3588.813	17.70351	0.073149	0.094045	0.038899	0.073149
1960	58745	4009.022	18.37895	0.021647	0.110725	0.037442	0.021647
1961	62904	4092.651	19.58762	0.068403	0.020645	0.063691	0.068403
1962	64856	4381.739	19.62317	0.030559	0.068252	0.001813	0.030559
1963	66228	4700.767	20.36971	0.020933	0.070280	0.037337	0.020933
1964	69581	5200.475	21.64948	0.049388	0.101024	0.060932	0.049388
1965	74858	5676.437	23.99573	0.073101	0.087573	0.102894	0.073101
1966	72122	6333.079	25.84429	-0.03723	0.109462	0.074213	-0.03723
1967	72856	7038.245	29.43476	0.010125	0.105572	0.130086	0.010125
1968	78785	7702.114	32.84749	0.078237	0.090135	0.109698	0.078237
1969	80841	8575.571	32.45645	0.025761	0.107422	-0.01197	0.025761
1970	86109	9639	33.70067	0.063129	0.116899	0.037618	0.063129
1971	90426	10958	35.54923	0.048917	0.128252	0.053400	0.048917
1972	91339	12690	37.53999	0.010046	0.146744	0.054488	0.010046
1973	91048	15033	41.34376	-0.00319	0.169433	0.096514	-0.00319
1974	95192	17571	49.66228	0.044509	0.156002	0.183324	0.044509
1975	96297	19462	62.17561	0.011541	0.102214	0.224717	0.011541
1976	104968	22286	61.50017	0.086218	0.135494	-0.01092	0.086218
1977	106280	27279	62.77995	0.012421	0.202158	0.020595	0.012421
1978	114219	32905	66.05047	0.072040	0.187507	0.050783	0.07204
1979	120504	39890	66.08602	0.053565	0.192501	0.000538	0.053565
1980	114236	46792	77.35513	-0.05341	0.159586	0.157449	-0.05341
1981	122427	55358	91.46818	0.069248	0.168106	0.167584	0.069248
1982	129889	62426	100	0.059165	0.120160	0.089178	0.059165
1983	133915	72868	104.9	0.030525	0.154667	0.047837	0.030525
1984	144865	85899	112.9	0.078597	0.164522	0.073494	0.078597
1985	150469	101957	120.1	0.037954	0.171378	0.061822	0.037954
1986	156600	118336	125.4	0.039937	0.148993	0.043183	0.039937
1987	162711	140633	132.7	0.038280	0.172608	0.056582	0.03828
1988	170041	162660	143.6	0.044063	0.145508	0.078940	0.044063
1989	187725	192085	154.2	0.098938	0.166275	0.071218	0.098938
1990	197419	231343	165.7	0.050350	0.185963	0.071928	0.05035
1991	210477	267247	182.7	0.064048	0.144271	0.097666	0.064048
1991/92	212316	315084	207.5	0.008699	0.164665	0.127285	0.008699

* Based on regression results for Eq.(10) as reported in Table 1 for the period 1950-51 to 1991-92.

Appendix Table 3: Expected Inflation Rates Based on Naive Models (in %)

	Actual Inflation Rate*	Expected Inflation Rates		
		X_t	$2X_t - X_{t-1}$	X_t^2 / X_{t-1}
1947-48				
1949	22.1289			
1950	2.5229	22.1289		
1951	6.2640	2.5229	-17.0829	0.287642
1952	6.1053	6.2640	10.00502	15.55230
1953	-12.5000	6.1053	5.946544	5.950565
1954	4.7619	-12.5000	-31.1052	25.59267
1955	-6.9264	4.7619	22.02380	-1.81405
1956	-5.1163	-6.9264	-18.6147	10.07477
1957	13.9706	-5.1163	-3.30615	-3.77920
1958	3.0108	13.9706	33.05745	-38.1482
1959	3.9666	3.0108	-7.94908	0.648836
1960	3.8153	3.9666	4.922441	5.225899
1961	6.5764	3.8153	3.663925	3.669698
1962	0.1815	6.5764	9.337543	11.33580
1963	3.8043	0.1815	-6.21342	0.005008
1964	6.2827	3.8043	7.427207	79.74657
1965	10.8374	6.2827	8.761097	10.37565
1966	7.7037	10.8374	15.39215	18.69413
1967	13.8927	7.7037	4.569968	5.476114
1968	11.5942	13.8927	20.08171	25.05384
1969	-1.1905	11.5942	9.295696	9.675977
1970	3.8335	-1.1905	-13.9751	0.122236
1971	5.4852	3.8335	8.857507	-12.3445
1972	5.6000	5.4852	7.136948	7.848609
1973	10.1326	5.6000	5.714767	5.717169
1974	20.1204	10.1326	14.66515	18.33376
1975	25.1969	20.1204	30.10818	39.95327
1976	-1.0863	25.1969	30.27332	31.55414
1977	2.0809	-1.0863	-27.3695	0.046836
1978	5.2095	2.0809	5.248184	-3.98610
1979	0.0538	5.2095	8.338101	13.04180
1980	17.0522	0.0538	-5.10187	0.000556
1981	18.2445	17.0522	34.05053	5402.632
1982	9.3276	18.2445	19.43679	19.52015
1983	4.9000	9.3276	0.410780	4.768824
1984	7.6263	4.9000	0.472366	2.574072
1985	6.3773	7.6263	10.35262	11.86951
1986	4.4130	6.3773	5.128339	5.332889
1987	5.8214	4.4130	2.448653	3.053705
1988	8.2140	5.8214	7.229754	7.679231
1989	7.3816	8.2140	10.60666	11.59006
1990	7.4578	7.3816	6.549214	6.633569
1991	10.2595	7.4578	7.534078	7.534865
1991-92		10.2595	13.0162	14.1137

*Annual % change in WPI (Base : 1981/82)

Appendix 4: Expected Inflation Rates Based on Koyk's Model (in %)

Year	Actual Inflation Rate	Expected Infaltion Rates with Lambda =								
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1947-48										
1949	22.1289									
1950	2.5229	19.9160	17.7031	15.4902	13.2773	11.0644	8.8515	6.6387	4.4258	2.2129
1951	6.2640	4.2622	3.7887	3.3151	2.8415	2.3679	1.8943	1.4207	0.9472	0.4736
1952	6.1053	6.0638	5.3901	4.7163	4.0425	3.3688	2.6950	2.0213	1.3475	0.6738
1953	-12.5000	6.1011	5.4232	4.7453	4.0674	3.3895	2.7116	2.0337	1.3558	0.6779
1954	4.7619	-10.6399	-9.4577	-8.2755	-7.0933	-5.9110	-4.7288	-3.5466	-2.3644	-1.1822
1955	-6.9264	3.2217	2.8638	2.5058	2.1478	1.7898	1.4319	1.0739	0.7159	0.3580
1956	-5.1163	-5.9116	-5.2547	-4.5979	-3.9411	-3.2842	-2.6274	-1.9705	-1.3137	-0.6568
1957	13.9706	-5.1958	-4.6185	-4.0412	-3.4639	-2.8866	-2.3092	-1.7319	-1.1546	-0.5773
1958	3.0108	12.0539	10.7146	9.3753	8.0360	6.6966	5.3573	4.0180	2.6787	1.3393
1959	3.9666	3.9151	3.4801	3.0451	2.6100	2.1750	1.7400	1.3050	0.8700	0.4350
1960	3.8153	3.9614	3.5213	3.0811	2.6410	2.2008	1.7606	1.3205	0.8803	0.4402
1961	6.5764	3.8299	3.4043	2.9788	2.5533	2.1277	1.7022	1.2766	0.8511	0.4255
1962	0.1815	6.3018	5.6016	4.9014	4.2012	3.5010	2.8008	2.1006	1.4004	0.7002
1963	3.8043	0.7935	0.7053	0.6172	0.5290	0.4408	0.3527	0.2645	0.1763	0.0882
1964	6.2827	3.5033	3.1140	2.7248	2.3355	1.9463	1.5570	1.1678	0.7785	0.3893
1965	10.8374	6.0048	5.3376	4.6704	4.0032	3.3360	2.6688	2.0016	1.3344	0.6672
1966	7.7037	10.3542	9.2037	8.0532	6.9028	5.7523	4.6019	3.4514	2.3009	1.1505
1967	13.8927	7.9688	7.0833	6.1979	5.3125	4.4271	3.5417	2.6563	1.7708	0.8854
1968	11.5942	13.3003	11.8225	10.3447	8.8669	7.3891	5.9113	4.4334	2.9556	1.4778
1969	-1.1905	11.7648	10.4576	9.1504	7.8432	6.5360	5.2288	3.9216	2.6144	1.3072
1970	3.8335	0.1051	0.0934	0.0817	0.0700	0.0584	0.0467	0.0350	0.0233	0.0117
1971	5.4852	3.4607	3.0762	2.6916	2.3071	1.9226	1.5381	1.1536	0.7690	0.3845
1972	5.6000	5.2828	4.6958	4.1088	3.5219	2.9349	2.3479	1.7609	1.1740	0.5870
1973	10.1326	5.5683	4.9496	4.3309	3.7122	3.0935	2.4748	1.8561	1.2374	0.6187
1974	20.1204	9.6761	8.6010	7.5259	6.4508	5.3756	4.3005	3.2254	2.1503	1.0751
1975	25.1969	19.0760	16.9564	14.8369	12.7173	10.5978	8.4782	6.3587	4.2391	2.1196
1976	-1.0863	24.5848	21.8531	19.1215	16.3898	13.6582	10.9266	8.1949	5.4633	2.7316
1977	2.0809	1.4808	1.3162	1.1517	0.9872	0.8227	0.6581	0.4936	0.3291	0.1645
1978	5.2095	2.0209	1.7964	1.5718	1.3473	1.1227	0.8982	0.6736	0.4491	0.2245
1979	0.0538	4.8907	4.3472	3.8038	3.2604	2.7170	2.1736	1.6302	1.0868	0.5434
1980	17.0522	0.5375	0.4778	0.4181	0.3583	0.2986	0.2389	0.1792	0.1194	0.0597
1981	18.2445	15.4007	13.6895	11.9783	10.2671	8.5560	6.8448	5.1336	3.4224	1.7112
1982	9.3276	17.9601	15.9645	13.9690	11.9734	9.9778	7.9823	5.9867	3.9911	1.9956
1983	4.9000	10.1909	9.0586	7.9262	6.7939	5.6616	4.5293	3.3970	2.2646	1.1323
1984	7.6263	5.4291	4.8259	4.2226	3.6194	3.0162	2.4129	1.8097	1.2065	0.6032
1985	6.3773	7.4066	6.5836	5.7607	4.9377	4.1148	3.2918	2.4689	1.6459	0.8230
1986	4.4130	6.4803	5.7602	5.0402	4.3202	3.6001	2.8801	2.1601	1.4401	0.7200
1987	5.8214	4.6197	4.1064	3.5931	3.0798	2.5665	2.0532	1.5399	1.0266	0.5133
1988	8.2140	5.7012	5.0677	4.4343	3.8008	3.1673	2.5339	1.9004	1.2669	0.6335
1989	7.3816	7.9627	7.0780	6.1932	5.3085	4.4237	3.5390	2.6542	1.7695	0.8847
1990	7.4578	7.4397	6.6131	5.7865	4.9598	4.1332	3.3065	2.4799	1.6533	0.8266
1991	10.2595	7.4560	6.6276	5.7991	4.9707	4.1422	3.3138	2.4853	1.6569	0.8284
1991/92		9.9792	8.8704	7.7616	6.6528	5.5440	4.4352	3.3264	2.2176	1.1088

Annual % change in WPI (Base : 1981/82)

Appendix 5 : Expected Inflation Rates Based on Dholakia's (1990) Model (in %)

		Expected Inflation With									
	Lag=	1	2	3	4	5	6	7	8	9	10
Year	Lambda	0.070710	0.170997	0.265914	0.346572	0.413518	0.469117	0.515669	0.555047	0.588704	0.617753
1949-50											
1951		3.798639									
1952		5.986835	6.086908								
1953		6.085166	6.010400	6.140943							
1954		-11.2149	-9.34522	-7.62431	-6.01638						
1955		3.603803	2.323655	1.458964	0.954148	0.833494					
1956		-6.12372	-5.36997	-4.71960	-4.20346	-3.78243	-3.30025				
1957		-5.20964	-5.10784	-5.03320	-4.82038	-4.57210	-4.32309	-3.97814			
1958		12.64652	10.68848	8.963078	7.438207	6.284470	5.382009	4.661391	4.169160		
1959		3.715877	4.352336	4.576085	4.586025	4.346592	4.106523	3.855826	3.604492	3.442147	
1960		3.883954	4.053764	4.154092	4.165716	4.160387	4.016032	3.894306	3.759998	3.612343	3.528672
1961		3.806129	3.798136	3.924140	3.959348	3.944013	3.942626	3.841237	3.770651	3.690614	3.595926
1962		6.362083	6.088845	5.819848	5.686119	5.508171	5.328212	5.176232	5.005495	4.864645	4.730380
1963		0.600794	1.175190	1.669760	2.043597	2.399173	2.614291	2.755906	2.886849	2.925926	2.979611
1964		3.547265	3.338953	3.222170	3.184283	3.182314	3.259652	3.280472	3.284498	3.312923	3.283195
1965		6.088453	5.752085	5.454872	5.195929	4.991817	4.827464	4.746944	4.633976	4.524597	4.453643
1966		10.48395	9.967103	9.381996	8.869782	8.408534	8.010063	7.662925	7.405605	7.135287	6.884723
1967		7.871105	8.074970	8.149320	8.086348	7.983976	7.836893	7.675384	7.507164	7.379596	7.211013
1968		13.41656	12.87184	12.35149	11.87979	11.43005	11.04169	10.67702	10.34173	10.02968	9.774844
1969		11.68726	11.76775	11.77251	11.68075	11.52579	11.31755	11.11200	10.89019	10.66697	10.44358
1970		-0.34443	0.993418	2.216797	3.249809	4.056780	4.676775	5.137607	5.506381	5.781894	5.990756
1971		3.484218	3.290280	3.375330	3.595811	3.907416	4.219005	4.505556	4.747404	4.972688	5.158578
1972		5.349270	5.061842	4.873185	4.805242	4.800996	4.874546	4.970830	5.075298	5.169971	5.276148
1973		5.564458	5.512910	5.364173	5.279169	5.247006	5.230910	5.260342	5.300302	5.346467	5.387370
1974		9.784074	9.326734	8.868956	8.412639	8.071563	7.812670	7.593870	7.436457	7.307150	7.200860
1975		19.36347	18.25195	17.11438	16.06668	15.10397	14.30974	13.64218	13.05609	12.56425	12.13202
1976		24.73728	23.98607	23.02747	22.02006	21.02674	20.05874	19.20482	18.44101	17.73770	17.11399
1977		0.646182	3.158987	5.305328	6.903784	8.046593	8.836347	9.349114	9.721360	9.979611	10.13627
1978.		1.862397	2.181871	2.901150	3.734098	4.531754	5.239834	5.831789	6.295933	6.702343	7.042426
1979		4.977883	4.587352	4.521834	4.665070	4.912825	5.209177	5.521118	5.815176	6.064504	6.315249
1980		0.392336	0.833547	1.149449	1.586217	2.033397	2.457423	2.859855	3.243117	3.594783	3.899683
1981		15.84994	14.27020	12.82739	11.60978	10.78263	10.17863	9.720072	9.375292	9.121872	8.929449
1982		18.07491	17.54329	16.79636	15.94862	15.08498	14.40724	13.82416	13.30920	12.86268	12.48275
1983		7.669026	8.771560	9.558342	10.07004	10.32447	10.38807	10.45212	10.46267	10.42444	10.36217
1984		5.011027	5.491346	6.138524	6.674773	7.137020	7.477432	7.702041	7.942784	8.131424	8.263576
1985		7.409031	7.185613	7.168097	7.296358	7.408703	7.550945	7.667993	7.745911	7.882296	8.000618
1986		6.427510	6.486680	6.520638	6.640124	6.803661	6.914062	7.037843	7.139372	7.211490	7.341666
1987		4.520002	4.747274	4.947888	5.125245	5.351572	5.586143	5.753930	5.921631	6.062712	6.174033
1988		5.699718	5.606092	5.571114	5.557366	5.573600	5.665758	5.786463	5.865430	5.959170	6.041306
1989		8.015724	7.741633	7.483238	7.277285	7.101738	6.970156	6.920907	6.910320	6.875866	6.867839
1990		7.399405	7.424885	7.385231	7.320541	7.251512	7.170111	7.099860	7.082087	7.083768	7.054271
1991		7.415548	7.428081	7.422339	7.389425	7.350160	7.309858	7.256383	7.208692	7.202557	7.208433
1992		10.02410	9.741291	9.463693	9.250396	9.037736	8.855531	8.699021	8.550670	8.422348	8.342103