Price Subsidies and Irrigation Investment in India

Macro Implications

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An applied general equilibrium model is used to analyse macro effects of three policy instruments, namely, fertiliser and food subsidies and investment on irrigation, for agricultural development in India. The results show that if a choice has to be made among these policy instruments, investment on irrigation has the potential of tackling two persistent problems of the Indian economy—vulnerability of agriculture to weather conditions and lack of purchasing power of a large section of the populace to buy food—by way of reducing dependence on the rain god and improving income distribution.

I
Introduction

AGRICULTURAL production in developing countries like India is characterised by outmoded techniques and uncertain conditions of production resulting in low per capita availability of food. What is more, a large section of the populace is deprived of food due to lack of purchasing power. Caught in a situation like this, governments of most developing countries pursue policies to serve two basic objectives: One is to induce farmers to produce more. The other is to make food available to all sections of the population at reasonable prices. Towards these goals, the major policy instruments that are commonly used are:

(i) subsidising important inputs such as fertilisers and seeds to encourage higher production;

(ii) giving price support to farmers to ensure a reasonable return on their investment;

(iii) undertaking investment on irrigation to bring about structural changes in production conditions; and

(iv) subsidising poor consumers by selling foodgrains through a public distribution system (PDS) at ration prices which are lower than ruling market prices.

While there is near unanimity about the desirability of PDS, the other policy options have been a subject of recurrent debates. Which is to be preferred between input subsidies and output subsidies: (i) and (ii)? Again, is it better to choose monetarist policies of price incentives: (i) and (ii) or to go for long-term structuralist options: (iii)?[1]

These debates have acquired renewed significance in India in view of the severe resource crunch faced by the government. The current account of the Indian government has been showing a deficit (equal to about 2.6 per cent of GDP in 1988-89) in recent years. One of the major reasons for the deficit is the growth in food and fertiliser subsidies which account for nearly 70 per cent of the total subsidies (the latter is more than 4 per cent of GDP). Understandably, there is great concern to stem the growth of these subsidies and search for suitable alternatives.[2]

It is in this context that we have addressed ourselves to the following questions:

(1) How would macro variables like prices and national income behave if fertiliser subsidies are totally withdrawn?

(2) What would be the impact on these variables if fertiliser (input) subsidies are withdrawn and food (output) subsidies are increased by an equivalent amount?

(3) How would the impact vary if, alternatively, investment on irrigation is stepped up by an amount equivalent to the fertiliser subsidies withdrawn?

These questions are analysed using an 18 sector computable general equilibrium (CGE) model of India[3] which is described in Section II. Section III discusses simulation results while Section IV contains a few concluding remarks.

II
The Model

The economy in our model is represented by 18 sectors—17 commodity sectors and one financial market—and three agents—household, business and government.

Commodities are broadly grouped under three heads—final goods, intermediate goods and investment goods. There are six final goods (foodgrains, consumer non-durables non-textiles, cotton textiles, synthetic textiles, consumer durables and services), nine intermediate goods (iron and steel ferro-alloys, iron and steel casting and forging, coal and lignite, crude petroleum and natural gas, electricity, fertiliser and pesticides, cement, industrial raw materials and other basic and intermediate goods) and two investment goods (construction and plant and equipment).

The supply of foodgrains (cereals and pulses) has been obtained as follows.

$$(1)\ S_{FG} = A_{FG} \times Y_{FG}$$

where S_{FG}, A_{FG} and Y_{FG} are respectively the supply of, area under and yield per unit area (hectare) of foodgrains . We assume that allocation of area depends upon farmers' response to foodgrains prices.[4] Yield per unit area, on the other hand, depends upon technological factors like use of fertilisers and irrigation facilities. Thus,

$$(2)\ A_{FG} = f(p_{FG_{-1}})$$

$$(3)\ Y_{FG} = g\left(\frac{C_{FERT}}{A_{FG}},\ IA_{FG}\right)$$

where P_{FG} is the price of foodgrains, C_{FERT} is consumption of fertilisers and IA_{FG} is irrigated area under foodgrains. The subscript -1 indicates lag of one year. The irrigated area, in turn, is a function of government expenditure on irrigation (EXP):

$$(4)\ IA_{FG} = h(EXP_{-1})$$

Consumption (demand) of fertilisers depends on own prices, foodgrains prices and the level of irrigation.[5]

$$(5)\ C_{FERT} = c(p_{FG},\ p_{FERT},\ IA_{FG})$$

For final and investment goods, demand equations are estimated as functions of prices and income. In some equations such as foodgrains and consumer non-durables, income distribution as given by the ratio of wage income to disposable income is also included as a variable.[6] For intermediate goods other than fertilisers, demands are derived using fixed input-output coefficients.

Supply of final goods are price-responsive and estimated econometrically. Bank credit enters as a variable in the supply functions of final goods. Supplies of intermediate goods are exogenously given in the first period, but endogenised in the second period by using incremental capital-output ratios and some investment allocation rules. In the absence of a capital coefficients matrix, the demand for and the supply of capital goods are empirically estimated.

The household sector consists of two broad groups—earners of wage income and earners of non-wage income. The business sector represents private producers. National income is derived as the sum of value added in the commodity sectors. The generation of value added and its distribution between wage and non-wage income earners are computed using a matrix of wage and non-wage coefficients. Total investment is obtained as the sum of the value of construction and that of machinery and equipment. Public investment is assumed to be given in real terms. Private investment is obtained by subtracting public investment from the total investment.

The financial sector comprises two assets—money and bank credit. Money is created by the central bank to meet the deficit in the government budget. We assume that whatever money is printed is readily demanded by the household sector for transaction purposes. Supply of bank credit is estimated as a function of high-powered money and household savings in financial assets. Government demand for bank credit is obtained as a fixed fraction of its investment expenditure. The business sector's demand for credit is obtained as the excess of its investment requirement over its own savings, the contribution of the household in the form of shares and debentures together with its savings in physical assets.

The supply of foodgrains (i e, equations (1) through (4)) and the demand for fertilisers (equation (5)) have been econometrically estimated and presented in the Appendix. The supply and demand equations for other sectors are taken from Chetty and Ratha [1987b]. Following Pradhan et al [1988], it is assumed that the private sector invests in final goods and partly in the investment goods according to market signals (prices) while public investment is allocated among the remaining part of capital goods and the intermediate goods according to the prevailing pattern of excess demand. It is also assumed that there is one period lag between investment and output in the public sector, while private sector production is instantaneous.

Government balances its budget by money creation. The business sector balances its budget by borrowing from commercial banks.

Equilibrium in private sector is obtained through flexible prices. The prices of goods produced in the public sector are administered according to cost plus a given mark-up rule; equilibrium in these sectors is achieved through either imports or inventory accumulation. The financial market is cleared, if necessary, through rationing of bank credit to the private sector.

The model is solved using a fixed point algorithm. Because of the one-year investment-output lag, it is necessary to solve the model for at least two periods.

Now the working of the model can be illustrated with a specific example. Suppose the government withdraws the fertiliser subsidies to reduce its budget deficit. As soon as the subsidies are withdrawn, the consumer prices of fertilisers will go up leading to a reduction in demand: equation (5). As evident from equation (3), the yield of foodgrains will fall, resulting in a left-ward shift in the supply curve—given by (1)—of foodgrains. This shift will lead to a fall in the value added originating from the food sector. Moreover, since the wage component is very high in the value added from foodgrains, the share of wage income in total disposable income (i e, income distribution) will also tend to decline. Both these effects will tend to induce a left-ward shift in the demand curves for foodgrains. Thus, the output of foodgrains will be lower. It is difficult to tell, however, the direction in which the price of foodgrains will change—its behaviour will depend upon the relative movement of supply and demand curves.

In our model, food price plays a very important role. It directly enters the demand functions of consumer non-durables and services with a negative sign (i e, if food price increases, the demand for these goods will decline). It also indirectly affects the demand for consumer durables in the opposite way (i e, increase in food price induces an increase in the demand for durables) reflecting the big farmers' preference for such goods. If food price increases as a result of withdrawal of fertiliser subsidy, therefore, the demand pattern for different goods will undergo significant changes in both directions. As a result, it is difficult to predict a priori the behaviour of macrovariables like national income and its composition. The case is complicated further in the second period when the rise in food price in the first period will also lead to allocation of a larger area for foodgrains: equation (2).

The above chain of arguments will hold, however, only if the demand for fertilisers decreases as a result of withdrawal of fertiliser subsidy. But this condition may not obtain at all if the food price increases well enough to compensate for the adverse effect of higher prices of fertilisers: equation (5).

III

Simulation Results

It is clear from the above discussion that the questions posed earlier need to be empirically examined incorporating general equilibrium interactions. Corresponding to the questions, we discuss the following policy options (schemes).

Scheme 1

Fertiliser subsidies are withdrawn in periods[7] 1 and 2 with the objective of reducing government budget deficit.

Scheme 2

The input subsidy is replaced by an output subsidy, i e, fertiliser subsidy is withdrawn and food subsidies are stepped up by an equivalent amount in both periods.

Scheme 3

Fertiliser subsidy is withdrawn and an equivalent amount is invested by the government for creating irrigation facilities in both periods.

We examine these schemes under two situations:

Case I:

Wages are not protected.

Case II:

Wages are indexed to the food price, the indexation factor being 0.25 (i e, for every one per cent increase in the food price, wage rate is revised by a quarter per cent).

Fertiliser subsidy scheme as is prevalent in India is intended to serve two objectives: to ensure a reasonable consumer price to induce the farmers to use fertilisers and to ensure a reasonable return on investment so as to facilitate the growth of the fertiliser industry. Keeping these objectives in view, uniform consumer prices of fertiliser are fixed on the one hand, while retention price based on certain normative capacity utilisation level (e g, 80 per cent for Ammonia plants) and post-tax return of 12 per cent on net worth is fixed for each unit of the fertiliser industry. "The difference between the net realisation (consumer price minus distribution margin)...and the retention price plus equated freight...is mopped up from or paid to each unit by the government"[Government of India (1987, p 70)] in the form of subsidy.

Since fixed costs will decrease as the level of capacity utilisation increases, producers operating above (below) the normative capacity levels benefit (lose) from the subsidy scheme. Under the circumstances, there are two ways of reducing fertiliser subsidy: (i) by increasing the normative level of capacity utilisation while calculating normative costs and reducing energy and marketing and distribution costs as indicated by the high powered committee [Government of India (1987, p 72)] and (ii) by increasing the consumer prices of fertilisers. In the present paper, we will discuss the implications of the second way of withdrawing fertiliser subsidy. The first alternative involves detailed micro-level cost studies which are beyond the scope of this paper.

Food (output) subsidies as provided in India also have twin objectives: one is to give incentive prices to farmers while the other is to make food available to the poor at ration prices. The former is achieved through support prices and the latter through the PDS.

Support price amounts to giving implicit subsidy to the farmers selling to the government agency to the extent of the cost of carrying the stock (which includes storage, maintenance, interest and risk premium) until the market price firms up to the level of the support price.

Subsidies to the consumers, on the other hand, is the difference between the market price[8] and the ration price inclusive of the transport and distribution cost.

Keeping this in view, we define food subsidies as follows:

$$(6)\ FS = (p_{FG} - p_r)\,Q + \lambda R p_s$$

where FS is food subsidy, P_{FG} the market price, P_r the ration price, Q the quantity distributed through the PDS, R the government stock in excess of Q and p_s the support price announced by the government. λ is the carrying cost of a rupee worth of stocks.[9] Note that the first term on the r h s of (a) shows consumer subsidy while the second term the implicit producer subsidy.

As mentioned earlier, in Scheme 2, food subsidies are stepped up by an amount exactly equal to the amount of fertiliser subsidy withdrawn by suitably manipulating p_s and p_r—it is necessary to adjust p_r

because we assume downward rigidity in p_s and Q.[10]

In Scheme 3, the amount withdrawn is added to the expenditure on irrigation, EXP, in equation (4). As indicated earlier, the irrigated area under foodgrains responds to irrigation expenditures with a lag of one year. The increase in such expenditures, nevertheless, generates value added in the current year itself. We assume that the value added coefficient for irrigation is the same as in the construction sector.

While interpreting the simulation results, we use the following measure (μ) of income distribution:

$$\mu = \frac{WY/p_{FG}}{DY/GPI}$$

where WY = post-tax wage income, DY = total disposable income and GPI = general price index.[11]

The results of the three schemes under Cases I and II are presented in Tables 1 and 2 respectively. It is observed that:

(1) Under both Cases I and II in Scheme 1, withdrawal of fertiliser subsidy results in a fall in the supply of foodgrains accompanied by a rise in the food price. Output of foodgrains falls because, as mentioned earlier, both supply and demand curves shift to the left. The food price increases because the supply curve shifts more in comparison to the demand curve. Expectedly, the budget deficit is reduced. But, GDP declines throughout, except for period 2 under Case II where it increases marginally. Income distribution worsens due to the increase in the food price even when wages are indexed (recall that wages are only partially protected). The overall implication is that in the absence of a more effective alternative spending programme, fertiliser subsidy has to be maintained even if it involves a high budget deficit.

(2) In Scheme 2 (i e, where fertiliser subsidy is replaced by increase in food subsidies), the open market price of foodgrains increases considerably. This increase more than offsets the adverse effect of increase in the price of fertilisers on the consumption of fertilisers in that yield of foodgrains rises—equations (5) and (3)—in both periods. In addition, the increase in food price in period 1 leads to higher area allocation in period 2: (equation (2). Consequently, output of foodgrains increases (instead of decreasing, as in Scheme 1) in both periods under both cases.

The behaviour of macro-variables in this scheme differs widely between Case I and Case II. Under Case I, the high food price brings down the demand for consumer non-durables and services, but increases the demand for consumer durables. The net effect, however, is a fall in GDP. The high food price is also responsible to the worsening of income distribution in this case. Thus, when wages are not protected, an input subsidy in the form of fertiliser subsidy is superior to an output subsidy in the form of food subsidies.

The results, however, are reversed under Case II where wages are protected. In this case, although GDP and income distribution worsen in period 1, both exhibit significant improvement in period 2. When compared with Case I, Case II shows improvement in growth and equity in both periods. While the improvement in income distribution as a result of wage indexation is an expected result, the increase in GDP needs an explanation. When the food price increases, wage rates in all sectors are revised upwards, giving rise to higher (nominal) wage income. That induces higher demand for foodgrains and consumer non-durables and services. The price of food rises further and wages are revised again. Since there is only partial indexation, the chain stops after some time, but, by then, the economy is on a higher growth path. This process is accompanied by higher food prices as well as general inflation as can be observed from the tables.

Considering both the cases together, it may be concluded that food subsidy with partial indexation of wages, which is close to Indian realities [Pradhan et al (1988)] is preferable to fertiliser subsidy. Incidentally, it may be pointed out that larger impact of Case II on growth, income distribution and reduction in budget deficit works through strong income effects due to protection of real wages and this observation is true in all three schemes.

(3) The results of Scheme 3 (where the fertiliser subsidy is replaced by investment on irrigation) are interesting. Supply of foodgrains falls in the first period for the same reasons as in Scheme 1, but increases in the next period when the irrigated area under foodgrains expands as a result of expenditure on irrigation. Food price rises in the first period, but falls in period 2 owing to larger supplies. (Under Case II in period 2, food prices register a small increase owing to higher demand induced by wage indexation.) GDP and income distribution follow the same pattern as supply of foodgrains, i e, both worsen in period 1 but improve in period 2.

Since the impact of investment on irrigation is felt in period 2, for comparison, only the results with respect to period 2 need be considered. Comparing with other schemes, it can be observed that investment on irrigation contributes to higher growth and better income distribution under Case I. However, under Case II, there seems to be a trade-off between growth and equity in the sense that while income distribution is the

TABLE 1: CASE I—RESULTS WHEN WAGES ARE NOT INDEXED
(Per cent changes over corresponding benchmark levels)

Schemes	(1)	(2)	(3)
Period 1			
Supply of foodgrains	−0.868	0.567	−0.782
Price of foodgrains	5.232	12.203	5.621
General price index	0.555	−0.622	−0.564
Gross domestic product	−0.930	−1.695	−0.661
Income distribution	−4.844	−12.231	−6.113
Government budget deficit	−10.559	−4.960	−1.768
Period 2			
Supply of foodgrains	−0.470	0.743	0.367
Price of foodgrains	2.767	7.165	−0.865
General price index	−0.307	−0.325	−0.360
Gross domestic product	−0.448	−0.887	−0.493
Income distribution	−3.207	−7.509	1.492
Government budget deficit	−6.919	−4.391	−6.019

Notes: Scheme 1: Fertiliser subsidy is withdrawn.
Scheme 2: Equivalent amount allocated on food subsidy.
Scheme 3: Equivalent amount is invested on irrigation. In Scheme 3, procurement price is increased in both periods.

TABLE 2: CASE II—RESULTS WHEN WAGES ARE INDEXED

Scheme	(1)	(2)	(3)
Period 1			
Supply of foodgrains	−0.654	0.388	−0.566
Price of foodgrains	6.964	13.654	7.369
General price index	0.074	1.566	−0.078
Gross domestic product	−0.733	−0.533	−0.466
Income distribution	−5.240	−6.240	−5.606
Government budget deficit	−8.125	−0.512	0.690
Period 2			
Supply of foodgrains	0.107	0.687	0.936
Price of foodgrains	6.496	10.412	2.821
General price index	1.362	3.908	2.055
Gross domestic product	0.122	1.266	1.036
Income distribution	−1.939	1.966	2.712
Government budget deficit	−4.016	−2.620	−3.133

Notes: Scheme 1: Fertiliser subsidy is withdrawn.
Scheme 2: Equivalent amount allocated on food subsidy.
Scheme 3: Equivalent amount is invested on irrigation. In Scheme 3, procurement price is increased in period 1, but ration price is increased in period 2.

best, growth is somewhat lower in this scheme than in Scheme 2.

Higher growth in national income in Scheme 2 can be explained as follows: With sharp increase in food prices, there is need for continual revision of wages. This, in turn, generates strong, income effects resulting in higher growth. Food prices being lower under Scheme 3, this kind of income effect is somewhat weak and hence the slightly lower growth. However, it will be useful to note here that we have not used the capitalised value of the irrigation investment and, to that extent, the computed value of GDP growth would be an underestimate. If this is taken into account, the mild trade-off between growth and equity as observed is more apparent than real.

Uniformly better income distribution in Scheme 3 can be explained in terms of low food prices on the one hand, and high wage component of the value added from irrigation on the other. A low food price also induces higher production of consumer nondurables and plant and equipment. Since these sectors contribute a significant portion of the excise tax revenue, the government budget deficit is also reduced considerably in Scheme 3 as compared to Scheme 2. In this regard, it may be noted that price subsidies are recurrent expenditures which in the long run are likely to prove costlier than a one-shot investment on irrigation.

It may be mentioned in this context that Janvry and Subbarao [1986] found, using a CGE model of India, that investment on irrigation with downward flexible food price is preferable to price subsidies as far as growth and equity are concerned. They arrived at the same conclusion by using a partial equilibrium frame similar to Hayami et al [1977]. The findings of Chetty and Ratha [1987a] are also similar.

IV

Conclusion

In this paper we analysed the desirability of fertiliser subsidies and also explored the implications of two alternative policies using a CGE model of India. We found that:

(1) It is not desirable to abolish fertiliser subsidies if the objective is just to ease the burden of budget deficit.

(2) When wages are not protected (fertiliser) input subsidy is better than (food) output subsidy. Strong income effect which is generated by wage indexation results in the reversal of this conclusion, that is, output subsidy becomes preferable to input subsidy.

(3) In comparison to price subsidies, investment on irrigation certainly promotes income distribution and perhaps, also growth.

For almost two decades from the 1960s, India followed a structuralist path in the sense of making heavy investments on irrigation as also on promotion of high yielding varieties of seeds. Of late, say from the 1980s, the emphasis has been more on monetarist policies such as price subsidies on foodgrains and fertilisers. With all shift and twist, the policies can be regarded as

successful in terms of agricultural growth—production of foodgrains has trebled in the last 30 years. Two basic problems persist however: food production is still vulnerable to the vagaries of weather, and a sizeable population still cannot consume food due to lack of purchasing power. Price subsidies can surmount the latter problem to some extent, but the recurrent expenditures on this account will impose great burden on the government budget which is already strained. Investment on irrigation, on the other hand, has the potential of tackling both the problems by way of improving income distribution and reducing the dependence on the rain god.

Appendix

Supply of foodgrains

(1) $S_{FG} = A_{FG} \times Y_{FG}$

(2) $\log A_{FG} = \underset{(294.1)}{11.451} + \underset{(7.045)}{0.056} \log p_{FG_{-1}}$

$\bar{R}^2 = 0.63 \quad DW = 2.29 \quad DF = 22$

(3) $Y_{FG} = \underset{(3.02)}{389.719} + \underset{(2.70)}{3.947} \frac{C_{FERT}}{A_{FG}} + \underset{(2.30)}{12.014}\, IA_{FG}$

$\bar{R}^2 = 0.904 \quad DW = 1.92 \quad DF = 23$

(4) $\log IA_{FG} = \underset{(54.05)}{2.226} + \underset{(32.71)}{0.113} \log (EXP_{-1})$

$\bar{R}^2 = 0.985 \quad DW = 1.61 \quad DF = 15$

Demand for fertilisers

(5) $\frac{C_{FERT}}{A_{FG}} = \underset{(-4.47)}{-99.224} + \underset{(3.915)}{422.255} \frac{IA_{FG}}{A_{FG}} + \underset{(3.697)}{0.245}\, p_{FG} - \underset{(-2.745)}{0.146}\, p_{FERT}$

$\bar{R}^2 = 0.942 \quad DW = 1.87 \quad DF = 14$

Notes: Subscripts FG and FERT refer to foodgrains and fertilisers respectively. Subscript '−1' in equations (2) and (4) indicates lag of one year. Other variables are as follows:

S = Supply in million tonnes
A = Area in million hectares
Y = Yield in kilograms per hectare
p_i = Price index of i with base 1970-71 = 100, i = FG, FERT
C = Consumption in thousand tonnes
IA = Irrigated area in million hectares
EXP = Government expenditure on irrigation in lakhs of rupees

Equations (2) and (3) are estimated for the period 1961-62 to 1986-87, while (4) and (5) are for 1969-70 to 1986-87. All the equations are estimated using ordinary least squares. Figures in parentheses indicate t-values. DW stands for Durbin-Watson statistic and DF is degrees of freedom.

All the variables (except EXP) in the above equations are endogenously determined in the model. For obvious reasons, $p_{FG_{-1}}$ in (2) is taken to be exogenous in the initial period.

Notes

1 **There is a good discussion of these debates in the Indian context in Narayan [1985] and Janvry and Subbarao [1986, pp 92-97].** Narayan argues in favour of fertiliser subsidies, while Janvry and Subbarao advocate structuralist policies. The findings of Chetty and Ratha [1987a] also have a structuralist leaning.

2 In the Long Term Fiscal Policy document [Government of India (1985)] it is indicated that the total amount of food and fertiliser subsidies should be contained at a level of one per cent of GDP by 1989-90. But it has reached the level of around 3 per cent in 1988-89 (revised estimates) itself.

3 Food prices play a very important role in the generation and distribution of income and also in the determination of demand for non-food sectors in the economy. A CGE model (as proposed to a partial equilibrium set up) provides a suitable framework for capturing the complex interlinkages between food and non-food sectors. See also Chetty and Ratha [1987a, p 1] and Janvry and Subbarao [1986, p 62] for the desirability of a general equilibrium framework.

4 We tried a number of other variables such as relative prices of competing crops, yield per hectares—both with various lags—, lagged dependent variable, rainfall index etc. But none of them could be accepted either because it did not have a meaningful sign or because it was not statistically significant. Therefore we had to accept equation (2), although this specification is far from satisfactory. But considering the fact that acreage response has been found to be significant in a number of studies carried out in the context of India [Kahlon and Tyagi (1983, pp 24-40)], we thought it proper to use the present equation.

5 Area sown with HYVs and cropping pattern are also factors which determine farmers' demand for fertilisers [see Government of India (1987), p 5]. While the introduction of the former gives rise to the problem of multicollinearity, the latter is difficult to use in an aggregative equation.

6 The demand equation for foodgrains has been modified to take account of the fact that there is a public distribution system through which a given quantity of foodgrains is sold at a fixed price which is lower than the market price.

7 The two periods in our model correspond to 1980-81 and 1981-82 during which fertiliser subsidies were 5050 and 3750 millions of rupees respectively.

8 We have used market price instead of procurement price for the problem of valuation which arises because of continuous replacement of stock at different times. For further details, see Chetty and Ratha [1987a].

9 In our simulation, we have used $\lambda = 0.143$. This value is computed from the information contained in Kahlon and George (1985, p 233).

10 Under Case I, p_s is increased by 12 per cent and 7 per cent to step up FS by 5050 and 3750 million rupees respectively in periods 1 and 2. Under Case II, p_s has to be increased by 13.7 per cent in period 1, but in period 2 the market price increases so much that the resultant increase in FS is higher than 3750 million rupees. The only way other than reducing p_s or Q to bring down the increase in FS to the required level is to increase the ration price p_r by 3 per cent.

11 It is desriable to have income group specific price indices instead of P_{FG} and GPI. However, given the difficulty in generating such indices in our model, we have used P_{FG} and GPI as proxies. This measure of income distribution is rather crude.

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