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Subsidy, Fiscal Deficit and Inflation in Developing Countries

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ABSTRACT

Proponents of the New Economic Policy are of the view that, if subsidies are reduced and funds released therefrom are used to step up public investment to give a boost to aggregate investment, then fiscal deficit will stay unchanged and there will be no disturbance to the macroeconomic stability of the economy. This paper shows that the relationship between investment, fiscal deficit and macroeconomic stability is a complex one. More precisely, the paper uses a structuralist dual economy model to show that there exist conditions under which if subsidies are reduced and public investment is stepped up to keep unchanged or raise aggregate investment, then both fiscal deficit and inflation will rise. Moreover, the conditions under which this happens are precisely those, which have been presumed to be true by the proponents of the New Economic Policy.

JEL Classification: E12, E62

Key Words: Subsidy; Fiscal Deficit; Inflation, Investment

1. INTRODUCTION

Some of the major macroeconomic problems faced by a developing country like India are the threat of internal and external debt trap, inflation, BOP deficit and low levels of investment leading to low rates of growth. Proponents of the New Economic Policy (NEP) have traced the major cause of the first three problems in the context of countries like India to large fiscal deficits. They prescribe stringent restrictions on the latter to contain the former (Joshi and Little (1994)). Regarding the fourth problem the proponents of NEP are of the view that it is not possible to rely solely on the private sector to meet all the investment requirements of a country. It is necessary to step up public investment mainly in infrastructure to sustain a high rate of growth (Ahluwalia (1998)).

Obviously, the recommendations presented above involve a policy conflict. How can the government sustain adequate levels of public investment keeping fiscal deficit under tight control. One way-out suggested by the proponents of NEP in Indian context consists in reduction in subsidies and using the funds so released to finance public investment. In fact, in a study, cited in Economic Survey (1997-98, p.24), National Institute of Public Finance and Policy (NIPFP) estimated that in 1994 explicit and implicit subsidies given by the Government of India constituted more than 14 per cent of GDP and 90 per cent of these subsidies were on non-merit goods. Clearly, in the light of this study the suggestion made by the proponents of NEP make eminent sense. In fact, in India comparing 1995/6 with 1991/2, total revenue receipts varied little, at just over 10 per cent of GDP, while total central expenditure was brought down from 19.8 per cent to 16.9 per cent. Of this cut of nearly 3 per cent of GDP 1 per cent was achieved by reducing subsidies (Joshi and Little (1996)).

Proponents of NEP recommend the policy of subsidy-cut and use of the fund released therefrom to step up public investment as a solution to the problem of low levels of aggregate investment. From the above discussion it is obvious that the policy makers in India subscribe to the view that by reducing subsidies it is possible to step up public investment and thereby aggregate investment without raising fiscal deficit or creating macroeconomic instability, which is manifested in a closed economy in the form of a rise in the rate of inflation. The objective of this paper is to subject this proposition to close scrutiny. The paper shows that the relationship between subsidy, aggregate fiscal deficit and inflation is much more complex than what is conceived by the proponents of NEP. In fact, to anticipate a conclusion of the paper, it is found that there exist conditions under which if the government seeks to reduce subsidies and raise public investment just to keep aggregate investment unchanged, it will lead to recession and also push up both inflation and fiscal deficit. Thus fiscal deficit will increase not only in absolute terms but also as a proportion of GDP. If, following a reduction in subsidies, public investment is raised not just to keep aggregate investment unchanged, but also to raise it, then under the same conditions inflation and fiscal deficit will increase even more. Ironically, the conditions under which these happen are precisely those, which have been presumed to be true by the proponents of the New Economic Policy.

This paper carries out the analysis in the structuralist dual economy framework for a closed economy as developed by Cardoso (1981), Rakshit (1982), Taylor (1983, 1991), Bose (1985, 1989), *et al.* In this kind of a framework there is mark-up pricing and excess capacity in industry. In agriculture prices clear markets and output is not perfectly price elastic and is always on the supply curve. The models were constructed to emphasize on the importance of the demand side factors in the determination of output and prices in LDCS. We hope that the demand side factors and the duality in the price adjustment processes and in the organizations of production in industry and agriculture play a key role in understanding the behavior of the macro economy in countries like India. Relevance of the closed economy assumption in this era of globalization may seriously be questioned. The assumption, however, may be justified on following grounds. First, the objective of this paper is to highlight the complexity of the relationship between subsidy, fiscal deficit and inflation. In the first attempt it is standard to study the relationship in the simplest possible

framework. This is one reason why this paper does not bring in the complications of foreign trade. The other point is that, despite relaxation of controls over external trade and investment and efforts at integrating the country to the world economy, LDCs like India are still among the least open economies in the world. As foreign trade accounts for no more than twenty percent of GDP, domestic factors are still by far the most important in the determination of the behavior of and interrelationships among the macro variables. The paper also focuses exclusively on the real sector. We have, however, discussed later the likely implications of incorporation of the external and monetary sector for the results of the paper. The paper is arranged as follows. Section 2 develops the model. Section 3 identifies the optimum mix of subsidy, fiscal deficit, and public investment, which minimizes inflation keeping investment at a target level. It also examines how fiscal deficit and inflation behave when the government reduces subsidies and steps up public investment to raise or keep unchanged aggregate investment. Section 4 discusses the relevance of the model developed here in the context of developing countries like India at the current juncture. Section 5 summarizes the major results and contains the concluding comments.

2. MODEL

The economy consists of two broad sectors: industry and agriculture; and is closed to the outside world. Industry produces a single good - the output of which is denoted by Y-using a fixed coefficient production function as shown below:

$$Y = \left(\frac{L_Y}{a}, \frac{K_Y}{b} \right) \tag{1}$$

where L_Y and K_Y denote respectively quantities of labor and capital available to industry, while 'a' and 'b' stand respectively for fixed quantities of labor and capital required per unit of Y. Henceforth for simplicity we shall assume 'a' to be equal to unity. Industry is oligopolistic and the price of Y is set on a mark-up basis. Thus

$$\overline{P}_Y = (1 + \alpha)\ W \tag{2}$$

where W and $\overline{P}_Y$ denote respectively the money wage rate in industry and the price of Y announced and received by the producers, while α denotes the fixed mark-up, which is applied to the average variable cost of production, W. Here our focus is only on the short run where capital stocks in both the sectors are fixed. $\overline{P}_Y$ is the supply price of Y in the absence of any taxes or subsidies. However, there is a subsidy applied on an ad valorem basis to Y or to $\overline{P}_Y$ at the rate, s. Hence the buyers do not face $\overline{P}_Y$ but P_Y.

$$P_Y = \overline{P}_Y\ (1 - s) = (1 - s)(1 + \alpha)W \tag{3}$$

From (3) we can compute shares of profit, wage and subsidy in industrial output, as shown below:

$$\text{Share of Wages in } Y \equiv \frac{W}{P_Y} = \frac{1}{(1+a)(1-s)} \tag{4}$$

$$\text{Share of Profit in } Y \equiv \frac{W\alpha}{P_Y} = \frac{\alpha}{(1+a)(1-s)} \tag{5}$$

$$\text{Share of Subsidy in } Y \equiv \frac{s(1+\alpha)W}{P_Y} = \frac{s}{1-s} \Rightarrow$$

$$S = \frac{s}{1-s} Y;\ S \equiv \text{aggregate subsidy in terms of } Y \tag{6}$$

Agriculture is assumed to produce a single commodity, which is referred to as food. For simplicity we assume that farmers produce it with their own labor and land. The size of their land is given. They also supply just a fixed amount of labor to food production. Along with land and labor they also use the industrial good as an intermediate input.

Food market is perfectly competitive. Each farmer maximizes profit, which we denote by Π_X.

Given our assumptions, profit of a representative farmer is given by

$$\Pi_X = PX - M_X(X);\ M_X' > 0 \text{ and } M_X'' < 0 \text{ (by assumption)} \tag{7}$$

where $P \equiv P_X / P_Y$, $P_X \equiv$ nominal price of food and $M_X(X)$ gives the amount of intermediate input used as a function of X. The farmer takes both prices as given and chooses X to maximize profit.

From the first order condition of profit maximization we get

$$M_X' = P \tag{8}$$

From (8) we get

$$X^s = X^s(P);\ X^s > 0 \tag{9}$$

or

$$P^s = P^s(X);\ P^s > 0 \tag{10}$$

where X^s denotes the planned supply of X and P^s denotes the supply price of X.

Assuming that workers spend their entire income on food and ignoring producers' food consumption for standard reasons, food market clearing condition may be written as (using (4) and (6)):

$$PX = \frac{1}{(1+\alpha)(1-s)}\ Y = \frac{1}{1+\alpha}\ [\{1+(\frac{s}{1-s})\}Y] = (\frac{1}{1+\alpha})\ (Y+S) \qquad (11)$$

The above equation yields the food market clearing value of P, which is denoted by P^d.

$$P^d = \frac{\frac{1}{1+\alpha}\ (Y+S)}{X} \qquad (12)$$

Agriculture is in equilibrium when

$$\frac{\frac{1}{1+\alpha}\ (Y+S)}{X} = P^s\ (X) \qquad (13)$$

It is assumed that there exists excess capacity in industry. Accordingly, its output is demand determined. Industrial good is demanded for purposes of consumption by the producers of both X and Y; it is also used for purposes of investment and as an intermediate input in agriculture. Thus industry equilibrium condition is given by (using (5) and (7)).

$$Y = C_1 \left[\frac{\alpha}{(1-s)\ (1+\alpha)}\right] Y + C_2\ (PX-M_x) + M_x + I_p + I_g$$

$$= C_1\ [\ (\frac{\alpha}{1+\alpha})\ (Y+S)] + C_2PX + (1 - C_2)M_x + I_p + I_g$$

$$[(\frac{1}{1-s})Y = \left[1+\left(\frac{s}{1-s}\right)\right]\ Y = Y + S;\ \text{see (6)}] \qquad (14)$$

where C_1 and C_2 stand for average and marginal consumption propensities of capitalists and landlords respectively; and Ip and Ig denote respectively private and public investment[1] We assume that Px clears food market at every instant so that (11) is always satisfied. Accordingly, the value of P at every instant will equal that of p^d as yielded by (12). Since adjustments in X and Y are time consuming, it is only appropriate that demand for Y is reckoned at the market clearing P, p^d (see Rakshit (1982)). Substituting for P the value of p^d as given by (12) and for M_x its value as given by (7) in (14), we get:

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1 Since there is public investment, government should have a share in profit in both the sectors. It is assumed in this paper that the government invests only in infrastructure and sets the prices of infrastructural inputs on a mark-up basis. Hence share of the government in industrial profit will be determined by the mark-ups charged by the government and the private producers. In case of agriculture, the share will be determined by the government's mark-up and agricultural prices. However, we have assumed for simplicity that the government's mark-up and therefore its profit share are zero.

$$Y = C_1 \left(\frac{\alpha}{1+\alpha}\right)(Y+S) + C_2 \left(\frac{1}{1+\alpha}\right)(Y+S) + (1 - C_2)M_x(X) + I_p + I_g \qquad (15)$$

Government's budget constraint is given by

$$I + S = D \qquad (16)$$

where D = the amount of fiscal deficit

The budget constraint is obviously grossly understated. We have ignored for simplicity many important items such as taxes and public sectors enterprises' profit on the receipt side and public consumption and interest payments on the expenditure side. We have discussed later the implications of this omission in section 4.

Now we introduce the inflation-mechanism as developed by Cardoso (1981), and Taylor (1983, 1991). Accordingly, we assume here that industrial workers bargain for a higher money wage if wage rate in units of food falls below a minimum level, h* This may be formally expressed as follows:

$$\hat{W} = Q.\left(h^* - \frac{w}{p}\right);\ 0 < Q < 1;\ \hat{W} \equiv \left(\frac{1}{W}\right)\left(\frac{dW}{dt}\right);\ h^* > \frac{w}{p} \quad \text{(by assumption)} \qquad (17)$$

where $w \equiv (W/P_y)$ and $t \equiv$ time. We shall presently explain that in our model $\hat{W}$ also equals the rate of inflation in equilibrium. Therefore (as follows from (17))

$$r = r\left(\frac{w}{P}\right);\ r' < 0 \qquad (18)$$

where r denotes the rate of inflation. As P_y is given by the mark-up pricing rule and s should be stable in equilibrium, $\hat{P}_Y = \hat{W}$ in equilibrium (see (2) and (3)). In equilibrium P is also stable. Hence in equilibrium $\hat{P}_x = \hat{W}$. Therefore $r = \hat{W}$ in equilibrium. Substituting for P the value P^d as given by (12), and for w its value that we get from (4) in (18) and manipulating terms we have

$$r = r\left(\frac{X}{Y}\right);\ r' < 0 \qquad (19)$$

In what follows we assume that $(X/Y) < h^*$. This is a boundary condition of our model. We believe that the inflation-mechanism described here captures the major route through which inflationary forces operate in countries like ours. We have discussed in details its

relevance in the context of LDCs like India later in section 4.

The specification of our model is now complete. It consists of the following key equations, (13), (15), (16) and (19). We are for the present concerned with the short run where capital stocks are given. There are four endogenous variables in the model: Y, X, D and r. Exogenous variables of the model are I_p, C_1, C_2, and production functions in industry and agriculture, while Ig and S are policy parameters. The government by assumption can directly control S and Ig. We regard I_p (aggregate private investment) as given here. This will suffice for the present. Later we shall relax this assumption and make Ip an increasing function of the rates of profit in industry and agriculture and of Ig (public investment). Equations (13), (15), (16) and (19) can be solved for the equilibrium values of the endogenous variables. These equations may be solved as follows. From (13) and (15) we can solve for equilibrium values of X and Y, given Ig, Ip etc. Substituting these equilibrium values in (19), we get the equilibrium value of r. The equilibrium value of D is given by (16). The solution is shown diagrammatically in Figures 1 and 2. The combinations of X and Y, which satisfy (13) and (15) are shown by $\overline{XX}$ and $\overline{YY}$ respectively in Figure 1. The signs of the slopes of $\overline{XX}$ and $\overline{YY}$ are quite self-evident. However, as we have shown in Appendix in section A.1, $\overline{YY}$ in the (Y,X) plane has to be steeper than $\overline{XX}$ for the equilibrium to be stable. The curve RR in Figure 2 gives the locus of $(X/Y, r)$ satisfying (19). The equilibrium values of X and Y correspond to the point of intersection of $\overline{XX}$ *and* $\overline{YY}$. The equilibrium value of r is given by the point on RR corresponding to the equilibrium value of (X/Y).

Trade-off between Inflation and Growth

We now show that there exists a trade-off between inflation and investment or growth. If investment goes up, there takes place an increase in the equilibrium rate of inflation. Note first that the ratio, (X/Y), gives the wage rate in terms of food in our model. It follows from (13) that this ratio falls along $\overline{XX}$ (Figure 1) with an increase in Y. Let us prove this point. Denoting (X/Y) by Z, we can rewrite (13) as

$$\left(\frac{1}{1+\alpha}\right)\left(1+\frac{S}{Y}\right) = P^S(ZY)\,Z$$

Taking total differential of the above equation treating α and S as fixed and solving for (dZ/dY), we get

$$\frac{dZ}{dY} = -\frac{\left(\frac{1}{1+\alpha}\right)\frac{S}{Y^2} + P^{S'}Z^2}{ZP^{S'}Y + P^S} < 0$$

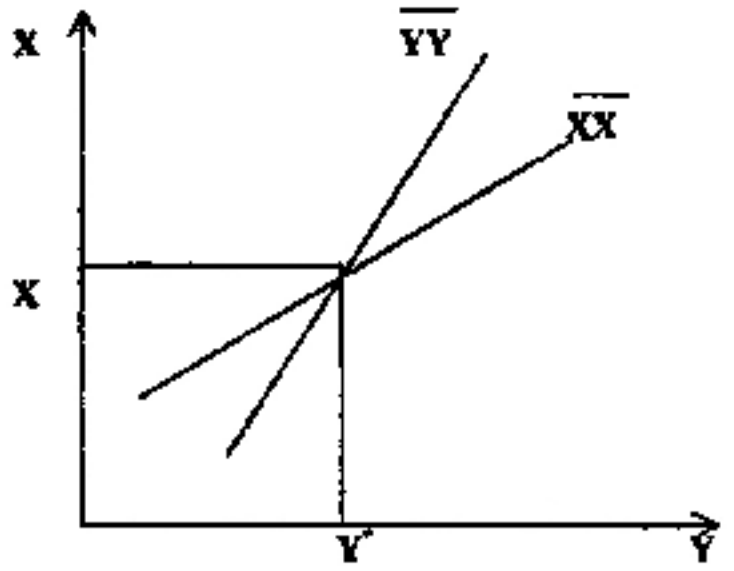

Fig 1. Determination of Equilibrium values of Y and X

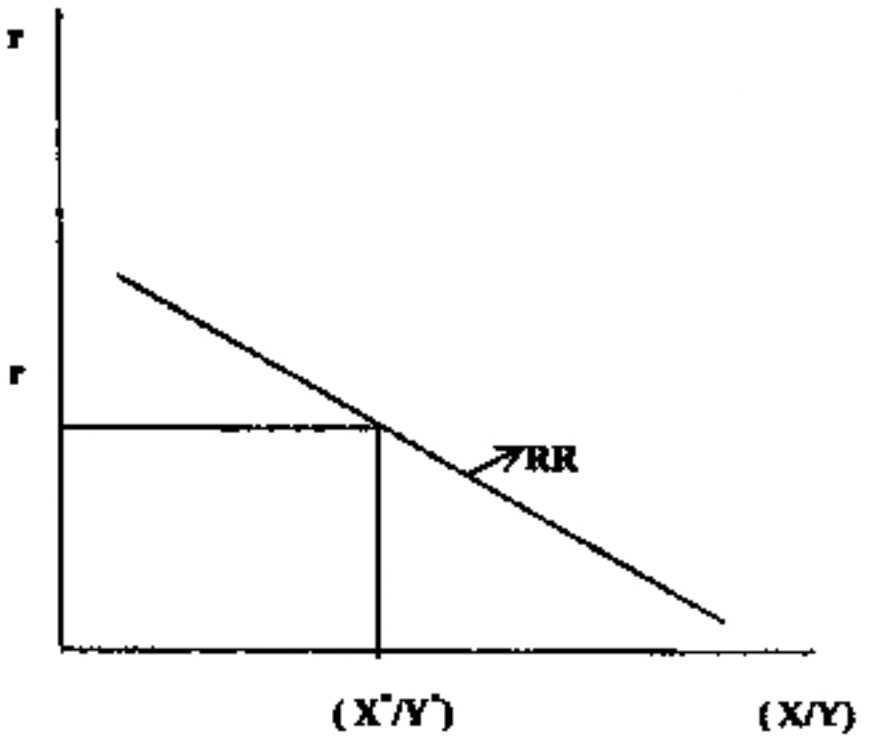

Fig 2. Determination of Equilibrium values of r

Now consider an exogenous decline in the aggregate investment brought about by an autonomous fall either in Ip or in Ig or in both. This will lead in Figure 1 to a leftward shift in $\overline{YY}$, but leave $\overline{XX}$ unchanged (vide (13) and (15)). Therefore equilibrium values of X and Y will fall, but that of (X/Y) will rise. Hence from (19) it is clear that the rate of inflation will decline. This establishes our proposition, namely, a fall in aggregate investment, all other exogenous variables remaining unchanged, reduces the rate of inflation and conversely.

The working of the model or the mechanism that brings about these changes may be described as follows. It is assumed that prices of industrial goods are fixed on a cost-plus basis, while industrial output adjusts to demand. Prices of agricultural goods, however, clear the food market at every instant and agricultural output goes up if market-clearing price of food in terms of Y is greater than the supply price of food in terms of Y. If I_g falls, there

emerges excess supply in industry and industrial output, Y, shrinks. The decline in Y reduces employment and food demand creating a situation of excess supply in the food market at the initial level of output of food, X, and food price. The excess supply in food market in turn reduces p^d and thereby lowers it below P^S at the initial X (see (12) and (13)). Therefore food output, X, falls. The fall in X reduces demand for Y even further. This process of contraction continues until the system comes to the new equilibrium with lower values of Y and X. As $\overline{XX}$ is unchanged (Figure 1), with the fall in Y, (X/Y) rises. So inflation, vide (19), falls.

Subsidy, Output and Inflation

Subsidy and Output

In the previous section we found that, if the government keeps the amount of subsidy unchanged and accommodates changes in the budget by adjusting the amount of fiscal deficit, the rate of inflation will go up with an increase in aggregate investment and conversely. Here we shall examine whether the rate of inflation can be reduced by affecting an increase in the amount of subsidy financed by an increase in fiscal deficit, given the level of aggregate investment. We shall work it out with the help of Figure 1. An increase in S will lead to a rise in workers, capitalists' and landlords' income at the initial equilibrium (X, Y), which in turn will bring about an expansion in demand for both X and Y. There will thus take place, vide (13) and (15), an upward shift in $\overline{XX}$ and a rightward shift in $\overline{YY}$ in Figure 1. Hence equilibrium values of X and Y will rise. We have derived the exact magnitudes of the increases in Y and X in Appendix in section A.2. They are given by (a.8) or (a.9) and (a. 10) respectively. This leads to the following proposition:

Proposition 1: An increase in subsidy financed by an expansion in fiscal deficit, aggregate investment and other exogenous variables remaining unchanged, leads to an increase in levels of output in both industry and agriculture.

Subsidy and Inflation

What happens to the rate of inflation following a rise in subsidy financed by all increase in fiscal deficit depends upon how (X/Y) changes from one equilibrium to the other (see (19)). We now derive the conditions under which the rate of inflation rises following an increase in S financed by a rise in fiscal deficit, given the level of aggregate investment. We find from (19) that the rate of inflation is an increasing function of (Y/X). An increase in (Y/X) implies a decline in wage rate in units of food and therefore a rise in the rate of inflation. Thus the effect on inflation of a rise in S can be traced through its impact on (Y/X). We rewrite agricultural equilibrium condition (13) as

$$\left(\frac{1}{1+\alpha}\right)(Y + S) = P^s(X)\, X \qquad (20)$$

Taking total differential of (20), with α treated as a constant, we get

$$P^s\ XdX + P^s\ dX = \left(\frac{1}{1+\alpha}\right)[dY + dS] = \left(\frac{1}{1+\alpha}\right)\ [1+\{1/dY\ /\ dS)\}]\ dY \tag{21}$$

Following a ceteris paribus increase in S equilibrium values of Y and X change. In fact, other exogenous variables remaining unchanged, we can derive the change in the equilibrium value of Y as a function of dS from the industry and agriculture equilibrium conditions. This is given in appendix in section A.2 by (a.8) or (a.9). Thus

$$dY = \bar{\theta}\,(C\ ,\ C_2)dS \tag{22}$$

From (22) we get

$$\frac{dY}{dS} = \bar{\theta}(C_1\ ,\ C_2) \tag{23}$$

If we substitute (23) in (21), we get the relationship between changes in equilibrium values of Y and X following a ceteris paribus increase in S. After making this substitution we get

$$\left(\frac{1}{1+\alpha}\right)\ [1\ +\frac{1}{\bar{\theta}\ (.)}\ ]\ dY = [P^s\ \ X\ +\ P^s]dY \tag{24}$$

Dividing the LHS of (24) by $[1/(1+\alpha)][(Y + S)]$ and the RHS by $P^S X$ (as $\frac{1}{1+\alpha}$)| $[(Y + S)] = P^S X$ in the initial equilibrium - see (13)), we get

$$[1 + \frac{1}{\bar{\theta}}\ ]\left(\frac{dY}{Y}\right)\ \left(\frac{Y}{Y+S}\right)\ = [\mathrm{Ps}'\ \left(\frac{X}{P^s}\right)\ \ + 1]\ \ \left(\frac{dX}{X}\right)\ \Rightarrow$$

$$[\ 1 +\frac{1}{\bar{\theta}}\ \ ]\ (1\text{-}s)\ \hat{Y} = (1 +\frac{1}{\eta}\ )\ \hat{X};\ (\because\ \frac{S}{Y}\ \ =\ \frac{s}{1\text{-}s}\ ;\ see\ (6)) \tag{25}$$

where $\hat{Y} = dY\ /\ Y$, $\hat{X} = dX/X$ and η = price elasticity of supply of X. Therefore, following a ceteris paribus increase in S

$$\left(\frac{\hat{X}}{\hat{Y}}\right)\ \ > 1\ ;\ \text{if and only if}$$

$$[\ 1 +\frac{1}{\bar{\theta}\ (.)}\ ]\ (1\text{-}s) > (1 +\frac{1}{\eta}) \tag{26}$$

As both X and Y rise following an increase in S, the rate of inflation will fall following such a change in S if (26) is satisfied. Now we explain the meaning of the terms on the LHS and RHS of (26). First note that, here the economy moves from one equilibrium to another because of a ceteris paribus increase in S financed by an increase in D. The LHS of (26) gives the percentage increase in the equilibrium value of industrial workers' expenditure on food in units of Y per one per cent increase in the equilibrium value of Y. The RHS gives the percentage increase in the equilibrium value of food supply to industry in units of Y per one per cent increase in the equilibrium amount of $\hat{X}$. As $\hat{Y}$ and X denote proportional changes in the equilibrium values of Y and X respectively, LHS of (26). $\hat{Y} = \hat{X}$ RHS of (26). Accordingly, if LHS (26) > RHS (26). Then $\hat{Y} < \hat{X}$ following a ceteris paribus increase in S. From (26) and (23) it follows that, if C_1, C_2 and s are sufficiently small and price elasticity of food supply to industry sufficiently large, the inflation rate falls following an increase in S. The result may be explained as follows.

Following an increase in S the expenditure on X rises for two reasons: an increase in Y and a rise in workers' share in Y. The smaller the values of C_1 and C_2, the less is the expansion in Y following a given increase in S. Again, the smaller the s and the rise in Y, the larger is the proportional increase in the workers' share following a given increase in S. Therefore the smaller are C_1, C_2 and s, the greater is the percentage increase in the workers' share relative to that in Y following a given increase in subsidy. Hence the LHS of (26), which measures the percentage increase in workers' expenditure on food per one per cent increase in Y, is larger. On the other hand, the value of supply of X also increases for two reasons: an increase in P and a rise in X. The greater the price elasticity of X, the less is the percentage increase in price per one per cent increase in X. Therefore the larger the value of η, the less is the percentage increase in the value of X per one percent increase in X and hence the less is the RHS of (26). This explains the result. Thus we get the following proposition.

Proposition 2: If consumption propensities and the initial rate of subsidy are sufficiently small, and the price elasticity of food supply sufficiently large, then, with aggregate investment remaining unchanged, an increase (a cut) in subsidy financed by an increase (a reduction) in fiscal deficit will lower (raise) inflation instead of raising (lowering) it.

Profitability and Private Investment

Here we seek to find out whether there exists an optimum mix of Ig, S and D, which minimizes the rate of inflation corresponding to any given level of aggregate investment, when I_p is sensitive to profit rate as well as to I_g. We continue to treat Ig as a policy parameter, but

$$I_p = I_p\left(\frac{\alpha}{1+\alpha}(Y+S),\ II_x(X)I_g\right) \tag{27}$$

where

$\frac{\alpha}{1+\alpha}(Y+S)$ $(\equiv \frac{\alpha}{1+\alpha}(1+\frac{s}{1-s})Y) \equiv \Pi_Y \equiv$ profit in industry in terms of Y (see (5) and (6)) and $\Pi_X(X)(\equiv p^x(X)X - M_X(X) \equiv$ profit in agriculture in terms of Y).

$$I \equiv I_p + I_g \equiv I_p\left(\frac{\alpha}{1+\alpha}(Y+S),\ \Pi_X(X), I_g\right) + I_g \tag{28}$$

Our extended model, with aggregate investment treated as an endogenous variable, is now given by the following key equations: (13), (15), (16), (19) and (28). The key equations of this new model are the same as those of the previous model except for the fact that it contains now one additional equation, (28). The endogenous variables of the model are X, Y, D, r and I. The exogenous variables of the model are C_1, C_2, α and the production functions, while I_g and S are policy parameters. The equations may be solved as follows. As before, we can solve (13) and (15) for the industry agriculture equilibrium values of X and Y in terms of I, given S and other exogenous variables. Putting these values of X and Y in (28), we can rewrite it as

$$I = I_p + I_g = I_p\left(\frac{\alpha}{1+\alpha}(Y(I,S) + S),\ \Pi_X(X(I, S)),\ I_g\right) + I_g \tag{29}$$

where $Y(.)$ and X give respectively the industry-agriculture equilibrium values of Y and X as functions of I and S, given other exogenous variables, as yielded by (13) and (15).

We can solve (29) for the equilibrium value of I, given S and other exogenous variables. The solution is shown in Figure 3 where I I gives corresponding to any I the value of I as yielded by the RHS of (29), given Ig, S and other exogenous variables. Obviously, the equilibrium value of I corresponds to the point of intersection of the 45° line and the I I schedule. I I is upward sloping because an increase in I brings about an expansion in both X and Y, which in turn raises profit rates in both industry and agriculture giving a boost to I_p and therefore to I (see (29)). We have examined the stability of equilibrium given by equations (13), (15), (16), (19) and (28) in the appendix in section A.3. We have found that the equilibrium is stable if XX is flatter than YY in (Y,X) plane (as in Figure 1) and the slope of I I is less than unity (as in Figure 3). Denoting the equilibrium value of I by I*, we get

$$I^* = I^*(I_g, S);\ I^*_{I_g},\ I^*_s > 0 \tag{30}$$

Signs of partial derivatives of (30) may also be derived diagrammatically as follows. One can easily check that, an increase in Ig or S, given I, raises the planned value of I as yielded by the RHS of (29). Therefore I I in Figure 3 shifts upward and the equilibrium value of I rises.

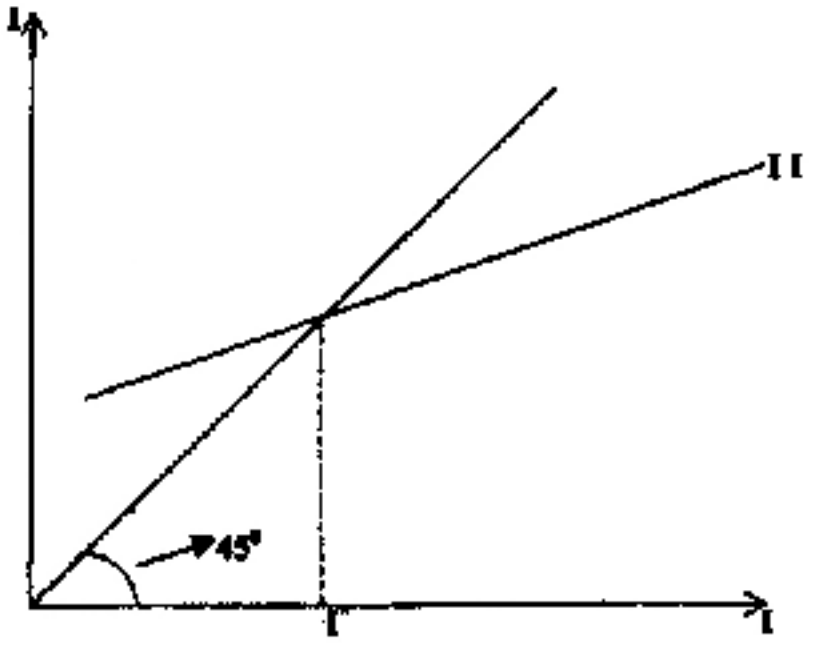

Fig 3. Determination of the Equilibrium Value of I

3. DERIVATION OF THE INFLATION-MINIMIZING PAIR (*Ig*, *S*) CORRESPONDING TO A GIVEN *I**

Here we derive the inflation minimizing pair (*Ig*, *S*) corresponding to a given *I**. First, note that we can solve the key equations of our model, (13), (15), (16), (19) and (28) to obtain

$$r^* = r^*(I_g\ ,\ S) \tag{31}$$

where r^* = the equilibrium rate of inflation. The pair (*Ig*, *S*), which minimize r^* corresponding to a given I^* is derived by carrying out the following exercise

$$\underset{I_g\ ,\ S}{Min}\ r^*\ (I_g\ ,\ S)$$

subject to

$$I^*\ (I_g\ ,\ S) = \overline{I} \tag{32}$$

The exercise has been carried out diagrammatically in Figure 4. In both Figures 4a and 4b, the line Ig Ig in the fourth quadrant gives all the combinations of Ig and S, which keep the equilibrium level of aggregate investment, I*, at a given level, $\overline{I}$, i.e., which satisfy (32). Let us now explain its slope, which is given by (34) below. Since, as follows from (30), I* goes up following an increase in either Ig or S, one has to be lowered following an increase in the other if I* is to be kept at a given level. We shall explain the exact magnitude of the slope later.

In the first quadrant rr($\overline{I}$) gives the value of r* corresponding to different combinations of *Ig* and *S* lying on *Ig Ig*. The shape of rr($\overline{I}$) may be explained as follows. With I* = $\overline{I}$, as S goes up and Ig falls commensurately along *Ig Ig*, both *X* and *Y* expand- see

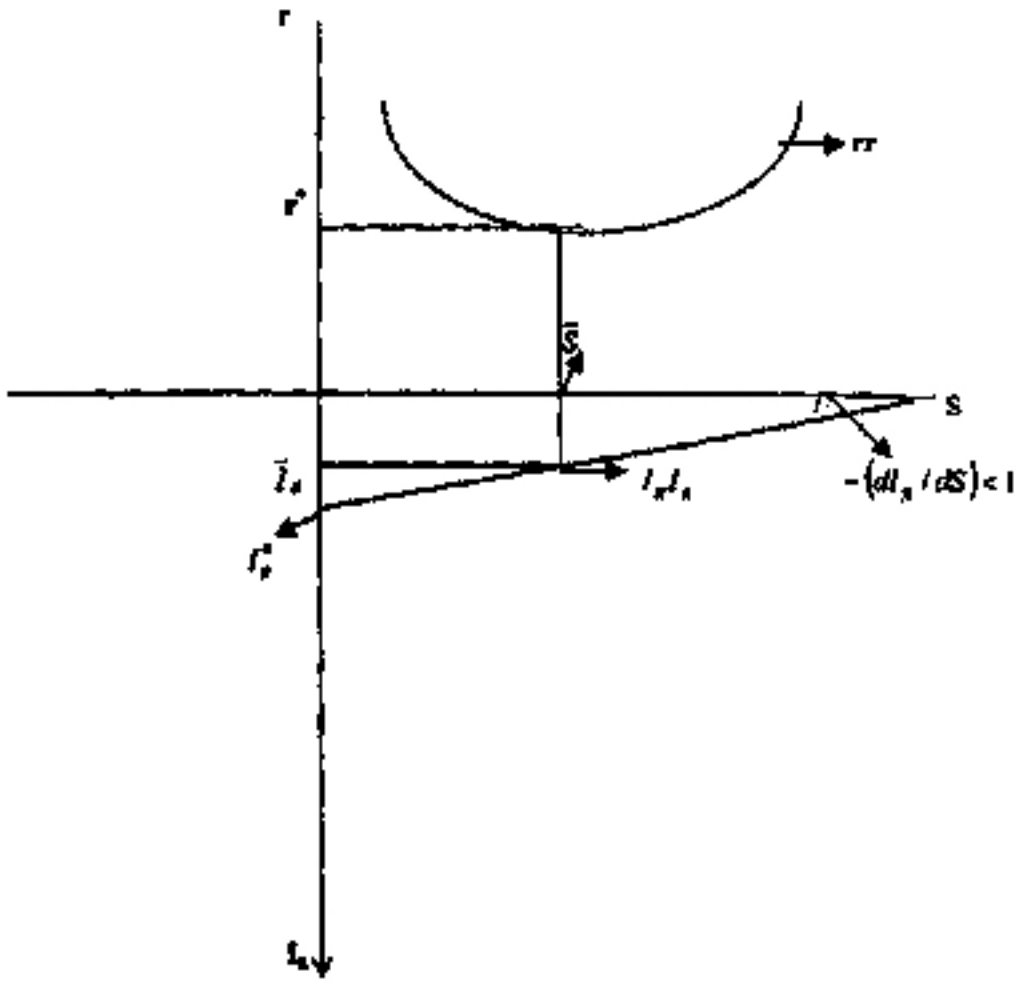

Fig 4*a*. Determination of the Equilibrium Value of the Inflation-Minimizing Pair (S, I_g) when $-(dI_g/dS) < 1$

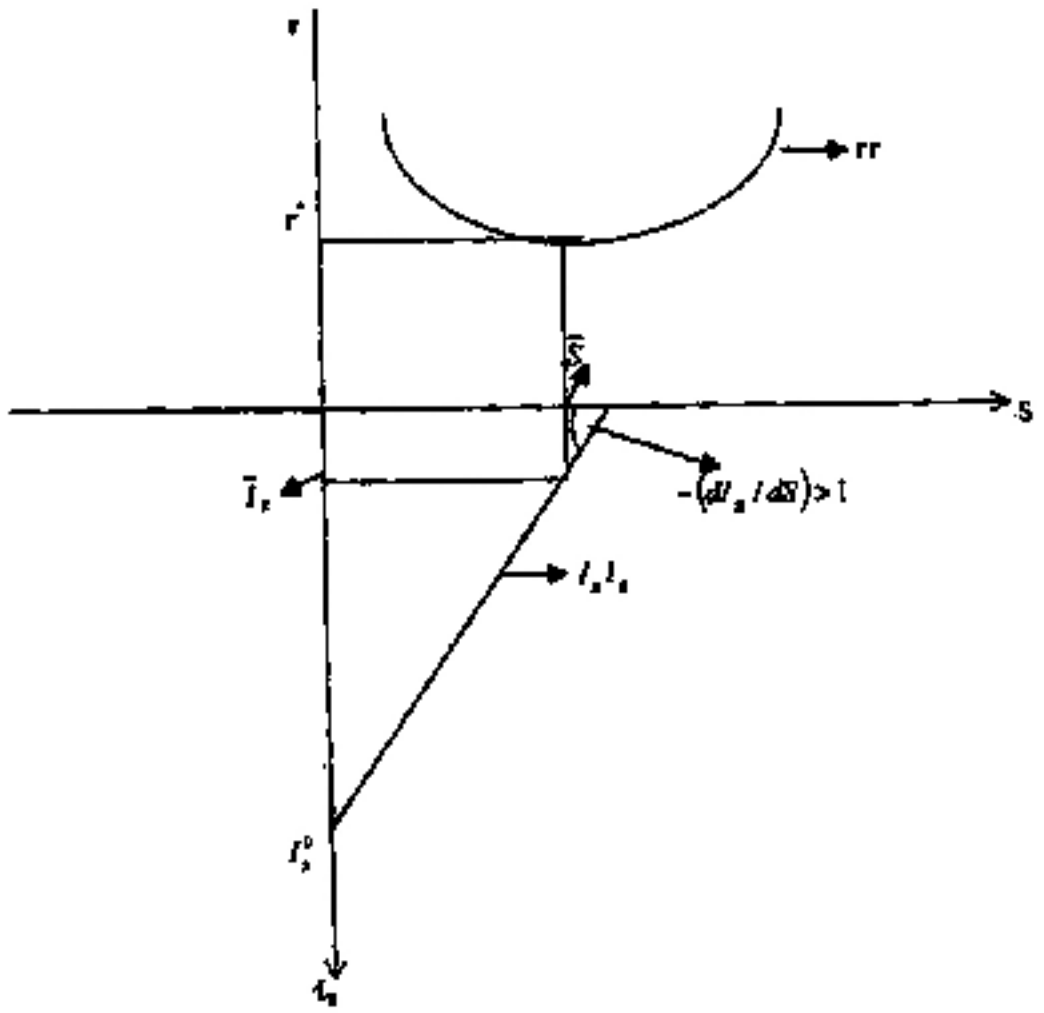

Fig 4*b*. Determination of the Equilibrium Value of the Inflation-Minimizing Pair (S, I_g) when $-(dI_g/dS) > 1$

Proposition 1. Hence, when $S = 0$ and $I_g = I_g^\circ$ (see Figs. 4*a* and 4*b*), Y and X are at their minimum possible levels, with $I = \overline{I}$. Therefore price elasticity of supply of X,η, is likely to be at the highest possible level and s at the minimum possible level. Proposition 2 states that, with I remaining at a given level. an increase is S lowers inflation, if C_1, C_2 and s are sufficiently small and η sufficiently large. Thus, with $I = \overline{I}$, r* has the highest chance of falling following an increase in S (and a commensurate decline in I_g from I_g°) along *Ig Ig*) when the initial value of S is zero. Let us first consider the case where r^* does fall. As S rises and Ig falls along IgIg so that $I = \overline{I}$, both X and Y expand. Hence η is likely to fall and s is likely to rise. (s may of course fall if Y rises more than proportionately following the increase in S. But we ignore this case for the time being). Thus, as S rises, with $I = \overline{I}$, the chance of r^* falling following a further increase in S diminishes. Therefore, as S increases, we are likely to eventually get a value of S, say $\overline{S}$, such that, if S is raised from $\overline{S}$, r^* will rise instead of falling. Thus π *(I)* may be U-shaped as shown in Figures 4*a* and 4*b*. In that case the inflation-minimizing value of S, with $I = \overline{I}$, will correspond to the minimum point of $\pi(I)$. The value of *Ig*, which corresponds to the inflation minimizing $\overline{S}$ on *Ig Ig* is the inflation-minimizing value of *Ig*. These values of *Ig* and S are shown as $\overline{I}$, *and* $\overline{S}$ in Figures 4*a* and 4*b*. Of course $\pi(\overline{I})$ can slope downward or upward all through. In these cases we have corner solutions to our constrained minimization problem. From the above and Proposition 2 we get the following proposition:

Proposition 3: If S is reduced and Ig is raised to keep I unchanged, then the rate of inflation will rise if C_1, C_2 and s are sufficiently small and η sufficiently large.

Now we shall examine how fiscal deficit, D, behaves when S is lowered and Ig is raised along IgIg. We first derive the result mathematically. Substituting $\overline{I}$ for I in (29), we get

$$\overline{I} = I_p + I_g = I_p \left(\frac{\alpha}{1+\alpha}\ (Y(\overline{I}, S) + S),\ \Pi_X\ (X\ (\overline{I}, S)),\ I_g\right) + I_g \qquad (33)$$

Substituting (13) into the expression of Πx as given by (27), we get

$$\Pi_X = p^S\ X - M_X = \frac{1}{1+\alpha}\ (Y + S) - M_X\ (X)$$

Substituting the above equation in (33), we rewrite it as

$$\overline{I} = I_p\ \left(\frac{\alpha}{1+\alpha}\ (Y(\tilde{I},S)+S), \left[\ \frac{1}{1+\alpha}\ (Y(\overline{I},S)+S),\ M_x\ (X(\overline{I},\ S))\ \right],\ I_g\right) + I_g$$

Taking total differential of the above equation treating $\overline{I}$ and α as a constants and using (a.9) and (a. 10) of the Appendix, we get

$$0 = \frac{\partial \Pi_p}{\partial \Pi_Y}\left(\frac{\alpha}{1+\alpha}\right)\left(\frac{dY}{dS}+1\right)dS + \frac{\partial \Pi_p}{\partial \Pi_X}\left(\left(\frac{1}{1+\alpha}\right)\left(\frac{dY}{dS}+1\right) - M_x'\frac{dX}{dS}\right)dS +$$

$$\left(\frac{\partial \Pi_p}{\partial \Pi_g}+1\right)dI_g = \left[\left[\frac{\partial \Pi_p}{\partial \Pi_Y}\right]\left(\frac{\alpha}{1+\alpha}\right) + \frac{\partial \Pi_p}{\partial \Pi_X}\left(\left(\frac{1}{1+\alpha}\right) - M_x' \quad \frac{1}{(1+\alpha)p^S\left(\frac{1}{\eta}+1\right)}\right)\right]$$

$$(1+\bar{\theta}(C_1, C_2))\,dS + \left(\frac{\partial \Pi_p}{\partial \Pi_g}+1\right)\,dI_g \Rightarrow$$

$$\frac{dI_g}{dS} = -\frac{\left[\left[\frac{\partial \Pi_p}{\partial \Pi_Y}\right]\left(\frac{\alpha}{1+\alpha}\right) + \frac{\partial \Pi_p}{\partial \Pi_X}\left(\left(\frac{1}{1+\alpha}\right) - M_x'\frac{1}{(1+\alpha)p^S\left(\frac{1}{\eta}+1\right)}\right)\right](1+\bar{\theta}(C_1,C_2))}{\left(\frac{\partial I_p}{\partial I_g}+1\right)}$$

$< 0 \quad 34$

In (34) the coefficient of $(\partial I_p / \partial \Pi_X)$ is positive - see A.2 in Appendix. Hence it follows from the above equation that if, given other things, $(\partial I_p / \partial \Pi_Y)$ and $(\partial I_p / \partial \Pi_X)$ are sufficiently large and $(\partial I_p / \partial I_g)$ sufficiently small, $-(dI_g / dS) > 1$. This case is shown in Figure 4*b*. The other case where $-(dI_g / dS) < 1$ is shown in Figure 4*a*. Let us explain the result intuitively. When S is lowered, as we have already explained, *X*, *Y* and profit rates in both industry and agriculture go down. This brings about a decline in I_p. Hence to keep I unchanged, Ig has to be raised. If I_p is very highly sensitive to profit rate and not much to Ig, then the amount of required increase in I_g may be larger than the amount of decline in S - see (27) and (28). In this case D will rise - see (16). Thus we get the following proposition:

Proposition 4: If sensitivity of I_p to profit rate is sufficiently high, but to Ig Sufficiently low, then if S is reduced and Ig is raised along with it to keep I unchanged, fiscal deficit, D, will rise. From Propositions 1, 2, 3 and 4 we get the following result:

Proposition 5: If S is reduced and Ig is raised along with it to keep I unchanged, both the rate of inflation and fiscal deficit will increase if C_1, C_2 and s are sufficiently small, η sufficiently large and sensitivity of I_p to profit rate is sufficiently high, but to Ig sufficiently low. not only that, such a policy will lead to contraction in output levels in all sectors of production.

It also follows from our discussion that, if, following, a reduction in subsidy, lg is raised not just to keep aggregate investment unchanged but to raise it, then under the same set of conditions as stated above both fiscal deficit and inflation will rise even more.

4. RELEVANCE OF THE MODEL IN THE CONTEXT OF LDCS LIKE INDIA AT THE CURRENT JUNCTURE

Basic Structure

The Closed Economy Assumption

The model considered here is a closed one. This assumption is justified empirically on grounds that, despite relaxation of controls on exports and imports of all types of products, countries like India are still the least open economies in the world. Foreign trade (i.e., exports plus imports) even now constitutes a small proportion (about 20 percent) of GDP in India. Accordingly, forces operating through foreign trade are likely to be much weaker than those generated by domestic side factors, i.e., if the two sets of forces work in opposite directions, the latter will obviously dominate. In fact, Economic Survey (2001-2002, p.163) does not emphasize on external sector as a cause for current industrial slowdown in India. To quote: 'given the relatively low level of external sector for the Indian economy, domestic demand and supply side factors have played the key role for industrial slowdown". However, even if we ignore this point and assume foreign trade to be important, all our results are like to go through. We shall discuss the implications of incorporation of foreign trade in industrial and agricultural products later.

Besides foreign trade, movement of capital across national frontiers is another important feature of the external sector in LDCs at the current juncture. There has taken place in countries like India in recent years considerable relaxation of controls over international capital mobility. Such movements produce two major macroeconomic effects. First, they cushion variations in interest rates in the face of fluctuations in monetary and real variables and second, they lead to movements in the exchange rate following changes in interest rates. Thus mobility of capital across national frontiers affects real variables through its impact on interest and exchange rates. If external sector is small relative to the domestic economy, which is true in case of countries like India, these effects are likely to be weak and may be ignored. Still we shall discuss the implications of international capital mobility later.

Industry

The major assumption regarding the industrial or the non-agricultural sector is that it is oligopolistic; its prices and wages are rigid and non-market clearing. As a result, normally, its output is off the supply curve and is demand determined. Short run rigidity in wages and prices is well accepted even in mainstream macroeconomics. In LDCs like India, just as in DCs, long period contracts govern wages in the organized sector, which produces bulk of the non-agricultural output. The oligopolistic structure of the industrial sector is also quite

self-evident. Current research in new Keynesian macroeconomics has shown that in imperfectly competitive markets prices tend to be rigid on account of menu costs or oligopolistic interdependence resulting in co-ordination failure. This rigidity is captured in our model through the assumption of the fixity of the mark-up. The point here is that in both the mainstream new Keynesian macroeconomics and structuralist macro theory industrial wages and prices do not clear markets; industrial output is off the supply curve and it adjusts to demand. Assumption of market clearing industrial prices and wages in the short run flies in the face of even casual empiricism.

Agriculture

Agricultural sector is assumed to be perfectly competitive. Hence agricultural prices are taken to be market clearing. Given the very large number of buyers and sellers in the agricultural or food grains market, it is difficult to assume otherwise. At the current juncture there has taken place considerable relaxation of controls over exports and imports of agricultural goods especially food grains. We have, however, already stated our reasons for ignoring foreign trade in industrial or agricultural produce in the context of countries like India. We shall still discuss the implications of foreign trade in agricultural produce for our results later.

Inflation-Mechanism

The literature on inflation in the context of LDCs like India identifies two routes through which inflationary forces operate. One is through agricultural prices. Agricultural goods constitute an important item in the workers' consumption basket. Non-agricultural prices are set on a cost-plus basis and hence they remain rigid unless there is an exogenous cost-push. Agricultural prices on the other hand are highly flexible and whenever there occurs any excess demand for agricultural goods, their prices go up raising the cost of living indices of the workers. In LDCs like India in the organized sector wage contracts include indexation clauses, which automatically link money wage rates to cost of living indices of workers. Hence an increase in agricultural prices generates a cost-push in the organized sector, which produces the bulk of the output of the non-agricultural sector. The paper focuses on this route of inflation alone.

The other mechanism of inflation operates through the exchange rate. In developing countries like India imported intermediate inputs are used in production. An increase in exchange rate makes these inputs costlier in terms of domestic currency generating a cost-push. However, this paper does not explicitly consider this route of inflation. Principal reasons for this omission may be explained as follows. First, imports constitute only about 13 percent of GDP in Countries like India. Imported intermediate inputs constitute even less. Second, even though exchange rates in these countries are largely market-determined these days, the monetary authority intervenes whenever exchange rate tends to change substantially in the short run. Finally, even though prices of petroleum and petrolem products, which constitute by far the most important imported intermediate inputs in countries like India, have

recently been linked to international prices, fares of railways and other means of surface transport are still largely administered by the government. For all these reasons this mechanism of inflation is likely to be quite weak. We have, however, discussed the likely implications of incorporation of this mechanism and found that the direction of change in the rate of inflation following a reduction in subsidy crucially depends, given the values of other exogenous variables, again on the value of the price elasticity of agricultural production. If it is Sufficiently high, inflation is likely to go up following a reduction in subsidy. Thus our result is likely to remain qualitatively unaffected even when we incorporate this other mechanism of inflation. Its quantitative impact on our results may also be quite weak for reasons stated above.

Direct and Indirect Taxes and Public Sector Enterprises' Profit

The fiscal side of the paper is grossly understated. The purpose of this omission is to put the focus on the relationship between fiscal deficit, subsidy and inflation in the sharpest possible relief. Let us now discuss the implications of incorporating the major fiscal instruments that we ignored earlier. First consider indirect and direct taxes and public sector enterprises' profit. Now, the rate of subsidy, s (see (3)), may always be regarded as rate of subsidy net of the rate of indirect taxes and S as total amount of subsidy net of aggregate revenue from indirect taxes. Obviously, incorporation of indirect taxes makes the value of s smaller. If we bring in direct taxes and public sector enterprises' profit, marginal/average consumption propensities out of aggregate income will no longer be C_1 and C_2, but $C_1(1-\tau)(1-\overline{\alpha})$ and $C_2(1-\tau)$, where τ and $\overline{\alpha}$ denote the direct tax rate and share of public sector enterprises' profit in aggregate profit in industry respectively. In countries like India income taxes do not apply to farm income. In such cases marginal/average consumption propensities out of aggregate income of the landlords will remain C_2. Therefore incorporation of direct taxes and public sector enterprises' profit will lower in (26) the value of $\overline{\theta}$, which measures the amount of increase in Y following a unit increase in S. Again, indirect taxes, as we have already stated, make the value of s smaller. Thus, following incorporation of direct and indirect taxes and public sector enterprises' profit, the LHS of (26) rises, while the RHS remains unaffected. This implies that the chance of inflation rising following a decrease in subsidies rises in the presence of taxes and public sector enterprises' profit. In other words, other factors remaining the same, the minimum value of η for which a reduction in S brings about a rise in the rate of inflation declines. However, they also tend to cushion the recessionary impact of a reduction in S.

Let us now see how these factors affect the relationship between subsidy and fiscal deficit. In the absence -of taxes and public sector enterprises' profit in the new equilibrium that occurs following a reduction in S, values of Y, X and I_p are less, while that of I_g higher. The direction of change in fiscal deficit is, however, ambiguous. Incorporation of taxes and public sector enterprises' profit exerts two opposite effects on fiscal deficit. On the one hand, they reduce the contractionary effect of a reduction in S and thereby cushion the fall in I_p. This tends to lower the amount of increase in I_g required to keep I unchanged and thereby dampens the increase in fiscal deficit. On the other hand, however, tax revenue and

public sector enterprises' profit themselves tend to fall with the onset of recession. This puts an upward pressure on fiscal deficit. Since these two forces work in opposite directions, the chance of fiscal deficit rising following a reduction in subsidy is likely to remain unchanged.

Interest Payment and Government Consumption

Interest payment by government is fixed in the short run and hence is of no significance as far as our results are concerned. Here by hypothesis the government reduces subsidy and raises its investment and not consumption. Moreover, public consumption is not sensitive to variations in aggregate output or other endogenous variables of the model in the short run. Thus its omission does not scuttle the generality of our results in any way.

Monetary Sector

In this paper we have examined the impact of a reduction in S on inflation, fiscal deficit and aggregate output when government adjusts its investment in such a way that aggregate investment remains unchanged. Monetary factors affect real variables principally through their impact on aggregate investment via the interest rate mechanism. Empirically, consumption or saving has not been found to be interest sensitive anywhere. As this paper focuses on the relationship between S, r, X and Y for a fixed level of aggregate investment, the equilibrium values of these variables will continue to be given by (13), (15) and (19) even if we incorporate the monetary sector. Thus the relationship between subsidy, output and inflation that we have derived is likely to remain unaffected despite the incorporation of the monetary sector.

Let us now focus on the relationship between subsidy and fiscal deficit. In the absence of the monetary factors in the new equilibrium that occurs following a reduction in subsidy, Y, X and I_p are less, I_g larger and I the same as before. The amount of fiscal deficit may be greater or less. First consider the case where the amount of fiscal deficit is larger. In this case in the presence of the monetary sector the amount of money supply is the same or larger depending on how the fiscal deficit is financed. Money demand can, however, move either way. If inflation rises sufficiently, money demand will rise. It will fall otherwise. Incase there emerges excess demand for money, interest rate will rise exerting a downward pressure on I_p. This will raise the amount of increase in I_g required to keep aggregate investment unchanged. Hence fiscal deficit will increase further. If, however, there emerges excess supply of money, interest rate will fall and tend to lower fiscal deficit via its impact on I_p and thereby on I_g. Thus in the presence of the monetary sector direction of change in fiscal deficit following a cut in subsidy is determined not only by the relative magnitudes of sensitivities of private investment to profit rate and to public investment but also by its sensitivity to interest rate. The less the interest sensitivity of private investment, the weaker is the impact of the monetary factors on our results. In India at the current juncture private investment does not show much sensitivity to interest rate changes. Actually, the country is going through a recessionary phase due principally to shortages of

crucial infrastructural inputs. Obviously, in this scenario business sentiments are depressed and a fill in the cost of credit cannot give much of a boost to private investment. For these reasons in the context of countries like India at the current juncture incorporation of the monetary sector will not bring about a significant modification to the results we have derived from the real sector alone regarding the relationship between changes in subsidy and those in fiscal deficit.

External Sector

Even though the external sector, as we have already pointed out, is much less important than the domestic sector in the context of countries like India, we shall discuss here the likely implications of incorporation of foreign trade in industrial and agricultural products and mobility of capital across national frontiers for our results.

Foreign Trade in Industrial Goods without Capital Mobility

Fixed Exchange Rate

We first consider the implications of foreign trade in industrial products only. Imports and exports of industrial goods in a regime of fixed exchange rate imply that there will be a net export term in the industrial equilibrium condition, (15). The modifications that the net export term will bring to our results are the following. It will reduce marginal propensity to consume domestic industrial products lowering the value of $\overline{\theta}$. This will raise the value of the LHS of (26), but leave the RHS unaffected. This means that the minimum value of η for which rate of inflation rises following a reduction in S declines. This strengthens our result.

As foreign trade in industrial goods reduces $\overline{\theta}$, it cushions the contractionary effect of a reduction in subsidy. This dampens the fall in I_ρ and thereby lowers the amount of increase in I_g required to keep aggregate investment unchanged. This weakens the possibility of an increase in fiscal deficit following a reduction in subsidy.

From the above it follows that foreign trade in non-agricultural goods does not affect our results qualitatively. However, quantitatively it strengthens one result and weakens another.

Flexible Exchange Rate

If the exchange rate is flexible, the net export term will not be there in the industry equilibrium condition. Hence all the results that we derived in the closed economy case remain unaffected. However, in case imported inputs are used in production, certain additional forces are generated. Following a reduction in S and the contraction in aggregate output it brings about net exports will rise. Exchange rate will therefore fall to remove the trade surplus. This will tend to lower the inflation rate by making imported inputs cheaper.

Thus the chance of inflation rising following a reduction in S becomes less than what we have predicted in the paper.

The cheapening of imports will also dampen the profit squeeze and thereby arrest the decline in I_p somewhat. Hence the required increase in I_g will decline too. Hence, for D to rise following a cut in subsidy I_p has to be more sensitive to profit rate than what is needed in the closed economy case relative to I_g.

Thus in the present case both our results become weaker quantitatively. However, to what extent our results will be weaker depends on the importance of imported intermediate inputs in aggregate cost of production. We have already discussed about this earlier.

Foreign Trade in Agricultural Goods

In recent years governments in countries like India have deregulated foreign trade in agricultural goods. In the absence of barriers to trade, domestic and international prices of agricultural goods must be the same, given their homogeneity. If India is a small country in the world market, prices of agricultural produce in the domestic market will be given in terms of foreign currency. In a fixed exchange rate regime agricultural prices will be given in terms of domestic currency too. A reduction in S will first directly raise industrial prices (see (3)). Agricultural prices and industrial wage rate in nominal terms will, however, remain unaffected. The increase in industrial prices, with unchanged agricultural prices, will induce farmers to cut down production.

Moreover, as before, the reduction in S will reduce disposable income and thereby bring about contraction in industrial output. Thus in the present case in a fixed exchange rate regime a cut in S will necessarily raise prices and reduce both agricultural and non-agricultural outputs.

Subsidy Cut and Fiscal Deficit

Since a reduction in S leads to a contraction in both Y and X, it squeezes profit in both the sectors lowering I_p. Hence D will rise if I_p is sufficiently highly sensitive to profit rates relative to I_g. Thus our result regarding the direction of change in D following a cut in subsidy remains qualitatively unaffected.

Subsidy Cut and BOP

A reduction in S directly lowers aggregate disposable income by the amount of the decline in S, which in turn reduces demand for both X and Y. Y therefore contracts bringing about a further reduction in demand for X. These contractions in demand for X are independent of η. The decline in S also raises prices of industrial inputs that enter into agricultural production and thereby induces farmers to cut down X. The greater the price elasticity of agricultural production, the larger is the fall in X. This implies that, if η is sufficiently large, fall in X is more than that in its demand. (Of course, a decline in X can also lower demand for X via its impact on Y. But in the net supply of agricultural goods from

domestic sources must decline for stability). Thus import of X rises or export of X falls worsening BOP deficit.

This pushes up the exchange rate and raises import prices in domestic currency. Hence food prices go up. Non-agricultural prices go up too if intermediate inputs are used in production. Real wage rate therefore falls raising the rate of inflation. In this scenario both contraction in aggregate output and the cost-push brought about by a reduction in subsidy are likely to be stronger because of the additional impacts of the subsidy-cut and the decline in the exchange rate on food production and food prices respectively. Hence the decline in private investment and therefore the increase in public investment required to keep aggregate investment unchanged are likely to be larger too. Thus, if price elasticity of agricultural supply is sufficiently high, then following a cut in subsidy both inflation and fiscal deficit are likely to rise by a larger quantity than what we have derived in our paper when we allow for foreign trade in agricultural produce.

If the country is a large player in the world food market and if price elasticity of production of agricultural goods is sufficiently high, then in addition to the events noted above there will also take place an increase in agricultural prices in the world market. This will lead to a further increase in food prices in the domestic market. This happens because, for sufficiently high price elasticity of food production, as we have already pointed out, the fall in food demand due to the reduction in Y is less than that in food output following a cut in subsidy. Hence at the initial food price export of food falls or import of food rises. This tends to raise world food prices. Thus, if countries like India are large players in the world food market, which India in fact is in case of many agricultural products, then for sufficiently high values of price elasticity of food production inflationary impact of a cut in subsidy is even stronger.

Capital Mobility

In recent years in countries like India there has taken place considerable relaxation of controls over mobility of capital across national frontiers. However, they are still far from achieving perfect capital mobility. Hence interest rates in these countries still diverge from the world interest rates. Let us now discuss the implications of imperfect capital mobility for our results. Capital mobility is a feature of the monetary sector of the economy and it affects real variables through its effects on interest and exchange rates. We have already pointed out that, if, following a cut in subsidy, the rise in the rate of inflation is not sufficiently large, excess supply of money tends to drive down interest rates. Imperfect capital mobility on the one hand dampens the fall in the interest rate and thereby raises the amount of decline in lp. On the other hand the flight of capital that occurs raises exchange rate and thereby net exports. These two forces act on changes in lp in opposite directions and therefore tend to neutralize one another. Thus capital mobility is unlikely to have any significant impact on the relation between subsidy and fiscal deficit. However, the increase in exchange rate may contribute to inflation. Just the opposite will happen when the rise in the rate of inflation is sufficiently high.

From the above it follows that imperfect capital mobility is unlikely to affect our result regarding the relationship between subsidy and fiscal deficit. There is, however, a possibility that it will dampen somewhat the variations in the rate of inflation.

Summing up the Likely Implications of the Incorporation of the External Sector

Let us now sum up the likely implications of the incorporation of the external sector. India is a large player in many world agricultural markets. Exchange rate is also flexible although monetary authority intervenes whenever variations in the exchange rate tend to be substantial in the short run. There is also imperfect mobility of capital. Under these conditions, as we have pointed out above, if price elasticity of production of agricultural goods is sufficiently large and sensitivity of private investment to profit rate is sufficiently high, but that to public investment sufficiently low, a reduction in subsidy followed by a rise in public investment to keep unchanged or raise aggregate investment will lead to an increase in both inflation and fiscal deficit. Thus our closed economy results remain unchanged qualitatively. However, the quantitative modifications to our results are also likely to be quite weak for reasons we have already stated.

Nature of Subsidies

In this paper we have considered only subsidies on non-agricultural products. Examples of some of the major non-agricultural products that receive government subsidies are electricity, fertilizer, petroleum and petroleum products (prices of which in India have very recently been linked to international prices), water, education etc. Most of these products enter as inputs in agriculture and the bulk of these products originate in public sector enterprises. We have not distinguished between private and public sector enterprises in our paper. The underlying assumption is that public sector enterprises produce mainly intermediate inputs, which they sell at cost to the private sector. Hence the entire profit in the non-agricultural sector accrues to private enterprises. If public sector enterprises receive subsidies, their prices move below the average cost of production by the amount of the unit subsidy. As a result the entire subsidy passes on to the private sector enterprises. These assumptions are not far from reality in countries like India. We have, however, discussed earlier the implications of incorporation of non-zero profit of public sector enterprises.

Summing Up

At the current juncture India is going through a phase of recession. Despite significant decline in interest rates, there has not taken place any spurt in investment activities. In this scenario, as we have already pointed out, incorporation of the monetary sector is unlikely to bring about any change in our results.

Besides monetary sector, the other feature that may seem important and that we have ignored is the external sector. At present in countries like India there is imperfect capital mobility. Exchange rate is also quite flexible. To quote from Economic Survey (2001-2002,

p.157) " exchange rate of rupee against the US dollar continued to be broadly market determined (in the year 2000- 2001)." The monetary authority of course intervenes whenever fluctuations in exchange rate tend to be substantial in the short run. There are also exports and imports of both industrial and agricultural products and India is large in the world market in some of the agricultural products such as rice, sugar, tea, jute etc. (Pursell and Gulati (1995, p.277). From our above discussion it follows that, if we incorporate these features in our model, we are likely to get qualitatively the same result as before. However, as we have pointed out earlier, given the relatively less importance of the external sector, additional forces emanating from it are unlikely to be significant. We have also shown that the inflationary mechanism that originates in the external sector is also likely to be quite weak. Hence the critical value of the price elasticity of production of agricultural products that we have derived on the basis of our closed economy assumption is unlikely to be substantially modified in the current context of countries like India even if the external sector is incorporated.

Incorporation of taxes and public sector enterprises' profit strengthens our results. Interest payment by government is fixed in the short run and hence is of no significance as far as our results are concerned. Here by hypothesis the government reduces subsidy and raises its investment and not consumption. Moreover, public consumption is not sensitive to variations in aggregate output or other endogenous variables of the model in the short run. Thus its omission does not scuttle the generality of our results in any way.

Rough Estimate of the Critical Value of the Elasticity of the Supply of Agricultural Goods to Industry

Here we shall give a very rough and ready estimate of the critical value of the price elasticity of supply of agricultural goods to industry on the basis of (26). In (26) 's' represents the amount of subsidy on non-agricultural products net of indirect tax revenue as a proportion of non-agricultural output. We do not have any data regarding the magnitude of s. Economic Survey (2001-2002) puts down the magnitude of total subsidy as a proportion of GDP at 1.3 percent for the year 2000-2001. This in one sense overestimates the amount of subsidy on non-agricultural products as a proportion of non-agricultural output and underestimates it in another. Quite a large part of the aggregate subsidy is on food and this part must be excluded to estimate the amount of subsidy on nonagricultural products. In this sense there is overestimation. Again, GDP is much larger than nonagricultural output and hence there is underestimation. As data regarding the composition of subsidy are not readily available, we assume that the upward and downward biases noted above cancel out one another and take the figure of 1.3 percent as a rough estimate of the amount of subsidy on nonagricultural products as a proportion of non-agricultural output. The bulk of the indirect taxes are on non-agricultural products. Economic Survey (2001-2002) puts the figure of indirect taxes as a proportion of GDP at 6 percent for the year 2000-2001. As non-agricultural output constitutes about 75 per cent of GDP, indirect taxes (IR) as a proportion of non-agricultural production (Y) is given by (IR/GDP)(GDP/Y) .06)(4/3) = .08. Thus

s = [.013 - .08] = - .067 = - .07 (approx.)

Now, to estimate $\overline{\theta}$ as follows from (a.8) in Appendix A.2, we need data regarding marginal propensity to use non-agricultural output for non-investment purposes for the economy as a whole, which is the numerator and also the second term in the denominator on the RHS in (a.8). We do not have any ready data regarding this. All we have is information regarding the aggregate saving ratio, which Economic Survey (2001-2002) puts at around 25 percent for recent years. One way of getting some rough idea about the average propensity to use non-agricultural goods for non-investment purposes may be to find out the proportion of non-agricultural goods that is used for non-investment purposes in the aggregate output. Since bulk of aggregate investment constitutes demand for nonagricultural goods, we may regard agricultural goods only as consumption goods. (Of course there is one minor caveat here, as agricultural goods may be added to stocks). Investment, as we have already pointed out, constitutes (1/4) of GDP and non-agricultural output (Y) constitutes (3/4) of GDP. Hence (1/3) of non-agricultural output is used for purposes of investment ((I/Y) = (I/GDP)(GDP/Y) = (1/4)(4/3) = (1/3)). Therefore (2/3) of non-agricultural output is used for non-investment purposes. This part of non-agricultural output constitutes (1/2) of GDP ([(2/3)Y/Y](Y/GDP) = (2/3)(3/4) = (1/2)). Hence average propensity to use non-agricultural goods for non-investment purposes may be taken to be (1/2). Even though it overestimates the marginal propensity to use non-agricultural output for non-investment purposes, we have to use it as a proxy for the latter. (The overestimation is due to, among others, exports and government consumption, which are independent of domestic GDP in a demand-constrained set-up. This overestimation incorporates an upward bias in our estimate of the critical value of the price elasticity of agricultural production). On the basis of this figure we find that $\overline{\theta}$ = (1/2)/[1-(1/2)] = 1.

Now, LHS of (26) is given by

$[1 + (1 / \overline{\theta})](1-s) = (1+1)(1.07) = 2.14 = 1 + (1.14)$

Now, as follows from (26), for a reduction in S to lead to an increase in the rate of inflation the following condition must be satisfied.

$1 + (1.14) > 1 + (1/\eta) \Rightarrow 1.14 > (1/\eta) \Rightarrow \eta > (1/1.14) = .86$

Price Elasticity of Agricultural Production in Indian Economy

Several studies have been made to measure price elasticity of aggregated crop output in Indian agriculture. Studies carried out by Krishna (1982), Rao (1989), Storm (1993) and Bharadwaj (1994) show that price elasticity of agricultural output is extremely low even in the long run. It is of the order of only .2 to .5 percent. However, proponents of NEP put great stress on price incentives to promote agricultural growth. To quote Rao and Storm (1998, p.198) " the heavy incentives that accompanied NAS (New Agricultural Strategy) was founded on the assumption that the supply response of private producers would be high.

Price enthusiasts such as Schultz and his followers went further in asserting that higher prices would induce higher public investment in land augmentation (Schultz (1978))" However, in Indian context supporters of NEP admit that price elasticity of agricultural production is low at least in the short run. To quote Gulati (1998, p.141) studies on Indian agriculture indicate that the aggregate supply response is quite low at least in the short run. It increases to over double in the long run, which in supply response equation is just 2 to 3 years." They attribute this inadequate supply response to severe shortages of crucial infrastructural inputs that enter into agricultural production. To quote Gulati (1998, p. 141): " to get full mileage from reform it is important to address the supply bottlenecks in agriculture specially water and credit." Economists on both sides of the fence agree that the acute scarcity of water, electricity and other infrastructural services that have emerged at the current juncture in India is due to drastic decline in public investment in these areas in the 80s and 90s.

Economists who oppose NEP or NAS do not recognize the importance of price incentives for agricultural growth in countries like India. Patnaik (I 996, pp. 24-8), for example, is of the view that terms of trade have no bearing on private sector investment in agriculture. Once the minimum profitability in agriculture is established, what happens to the terms of trade have no influence on private sector investment, and thereby on growth in agriculture.

From the above discussion it is clear that on account of either severe shortages of crucial infrastructural inputs in rural areas or some inherent features of Indian agriculture price elasticity of agricultural production is extremely low at the current juncture in India. Hence, if government reduces subsidy and raises public investment in crucial infrastructural areas to keep aggregate investment unchanged, rate of inflation will go down.

However, there is one important caveat. The variable that is really relevant for our result is not really the price elasticity of agricultural production, but price elasticity of supply of agricultural goods to actual consumers in the non-agricultural sector. η in (26) basically represents that. Despite completely inelastic production, supply of food or agricultural produce to actual consumers in the non-agricultural sector may be highly price elastic in the short run because of speculative activities of farmers and traders. To quote Krishnaji (1998, p.339): "availability (of food) is not determined by levels of production alone: the operations of the government (through imports and distribution) and of surplus holding farmers and traders at the different tiers of the market economy are equally relevant. A good part of price flexibility (in the food grains market) may be due to speculative activities of the traders."

In our model we have not explicitly considered traders' activities. Following Rakshit (1982) we can easily incorporate their behavior in the agricultural equilibrium condition, (13). As pointed out by Rakshit (1982, p.146): " trading and inventory investment in farm products are major economic activities in all LDCS, and (with somewhat inelastic expectations inventory investment will tend to decline (and may, in fact, turn negative) with a rise in prices of agricultural goods." We can use the same function as he used to capture the behavior of traders. The function he used is the following

$X^d \ (P)$; $X^d < 0$

In the above equation X^d gives supply of food grains from the inventory by traders. For high values of P it is positive, but for low values of P it is negative. We can explain the above function very simply in following terms. Suppose every trader has an expected future price of food, which is independent of current food price. If the current food price is below this expected price, the trader buys to add to his stock. In the opposite case he sells from his stock. Suppose expected prices of different traders are different. In such a scenario, the higher the current price, the larger is the number of traders who consider it profitable to sell in the current period. This explains the above function. In the presence of traders therefore supply of food or agricultural produce is not given by (9) but by $\tilde{X}(P) = X^S(p) + X^d(P)$; $\tilde{X}$ = planned production of X plus planned supply from inventory. Inverting this function, we will have $\tilde{P}^S = \tilde{X}^{-1}(\tilde{X}) = \tilde{P}^S(X)$; $\tilde{P}^{S\prime} > 0$; $\tilde{P}^S$ = supply price of $\tilde{X}$. Using this, we shall rewrite agricultural equilibrium condition as

$$\frac{\frac{1}{1+\alpha}(Y+S)}{\tilde{X}} = \tilde{P}^S(\tilde{X})$$

All other equations, however, will remain unaffected following the incorporation of the activity of traders in the food grains market. Hence all our results will remain unchanged except for the fact that η in (26) has to be interpreted not as price elasticity of production of food, but as weighted average of price elasticity of production of food and price elasticity of supply of food from traders' inventory. The weight of each item is given by its importance or proportion in the total supply of food to actual consumers. The value of η is therefore likely to be substantially higher than the price elasticity of production of food or agricultural produce in the short run. Hence, as follows from our paper, despite very low values of price elasticity of production of food, inflation may go up following a reduction in subsidy in countries like India. Unfortunately, in recent years debate over NEP or NAS centres on the value of price elasticity of production of agricultural output. Hence its estimates are readily available. But no efforts have currently been made to measure the value of price elasticity of supply of agricultural goods from traders' inventory. This paper shows that to predict the direction of change in the rate of inflation in the short run following a reduction in subsidy, reliable estimate of this variable is absolutely essential.

Relationship between Subsidy and Fiscal Deficit at the Current Juncture

From our analysis it follows that a reduction in subsidy will lead to an increase in the amount of fiscal deficit if private investment is highly sensitive to profit rate, but not much to public investment. At the current juncture economic recession that is evident in the fall in the growth rates of GDP and output levels in industry and agriculture is principally due to severe bottlenecks in crucial infrastructural services. The shortage is chiefly responsible

for depressed business sentiments and low levels of investment. If in this scenario public investment in these essential areas goes up, it will surely give substantial boost to private investment. This effect is more than likely to offset by a substantial margin the dampening effect of the decline in output following the reduction in subsidy. Hence at the current juncture there is a high degree of possibility that by cutting down subsidy and raising public investment in crucial sectors, the government will be able to raise aggregate investment keeping the amount of fiscal deficit unchanged.

However, underlying the New Economic Policy there is a deep scepticism about the efficiency of public investment. This is quite evident in its thrust on privatisation, minimization of the scope of government's activities etc. If this line of thought is true, i.e., if private investors think that public investment is inefficient and unproductive due to corruption, bureaucratic apathy, political interference etc., higher doses of public investment will not assure them of better future supplies of crucial infrastructural services. If this is true, then, obviously, as our paper suggests, fiscal deficit will rise following a decline in subsidy and stepping up of public investment in crucial areas in an effort to keep aggregate investment unchanged even at the current juncture.

5. CONCLUSION

The proponents of the New Economic Policy (NEP) recommend stringent restrictions on fiscal deficit to avoid macroeconomic imbalance and internal and external debt traps. They also recognize the necessity of large-scale public investment particularly in infrastructure to sustain a high rate of growth. To reconcile the apparently incompatible objectives of having public investment on a substantial scale and keeping fiscal deficit at a low level, they prescribe in Indian context a drastic reduction in subsidies. They point out that, if subsidies are reduced to finance a step-up in public investment, aggregate investment will rise without generating any upward pressure on fiscal deficit and hence there will be no threat to the macroeconomic stability of the economy.

Using a structuralist dual economy model where effective demand plays a key role in determining aggregate output, this paper draws the result that the policy prescription described above does not always work. More importantly and ironically, it shows that the policy prescription is unlikely to work under conditions, which constitute a part of the basic premise of the New Economic Policy. The proponents of NEP suggest the policy of Subsidy-cut and stepping up of public investment as a solution to the problem of low levels of aggregate investment. This paper shows that, if public investment is stepped up following a reduction in subsidy to raise or just to keep unchanged aggregate investment, then fiscal deficit will rise if private investment is not much sensitive to public investment, but highly responsive to profit rates. This condition is perhaps a basic assumption of the New Economic Policy, which relies on market forces to ensure efficiency in inter-temporal allocation of resources and to drive growth.

Price elasticity of production of agricultural goods is a bone of contention between the proponents and critics of the New Economic Policy. While the former consider it to be

fairly high, the latter regard it to be very low. Our paper shows that, if, following a reduction in subsidy, public investment is increased to raise or just to keep aggregate investment unchanged, then inflation will go up instead of falling, when, given other factors, the price elasticity of agricultural production is sufficiently high.

The paper also seeks to assess the relevance of the policy considered here in the current Indian context. India at present is going through a phase of recession, which has its roots principally in severe shortages of infrastructural services. Higher doses of public investment in crucial areas will therefore give substantial boost to private investment and is likely to more than offset the adverse impact of a subsidy-cut. Under these conditions, as our paper suggests, if the government reduces subsidy and raises public investment in crucial areas to keep aggregate investment unchanged, fiscal deficit will go down. Therefore in the current Indian context by reducing subsidy and raising public investment it will be possible for the government to step up aggregate investment without raising fiscal deficit. However, underlying the New Economic Policy there is a deep belief that public investment is highly inefficient owing to corruption, bureaucratic apathy, political interference etc. This belief is reflected in the emphasis that NEP puts on privatisation, minimization of the scope of government's activities etc. If this line of thought is true, i.e., if private investors think that public investment is inefficient and unproductive, higher doses of public investment will not assure them on the required scale of better future supplies of crucial infrastructural services. If this is the case, then, obviously, the policy considered above will lead to an increase in fiscal deficit even at the current juncture.

In India price elasticity of agricultural production is extremely low. Even the proponents of NEP who put great stress on price incentives to promote agricultural growth admit that price - responsiveness of agricultural production is inadequate in India. However, they attribute this to severe shortages of crucial infrastructural inputs such as water, electricity, credit etc. Our paper shows that, under these conditions by reducing subsidy and raising public investment it will be possible for the government to raise aggregate investment without putting any upward pressure on inflation in the short run, provided traders' activities are insignificant in the agricultural market.

Experts in this area are, however, of the view that speculative activities of traders play a crucial role in the formation of agricultural prices in the short run. If this is true, then price elasticity of supply of agricultural produce to the actual consumers may be fairly high and, as our paper shows, a cut in subsidy followed by an increase in public investment just to keep aggregate investment unchanged will lead to an increase in the rate of inflation in the short run.

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APPENDIX

A.1 *The Stability of Equilibrium: 1*

Here we shall examine the stability of the equilibrium values of X, Y, D and r, which we get by solving the eqs. (13), (15), (16) and (19). Regarding D and r we assume that their values are always given by (16) and (19). Adjustments in X and Y are, however, sluggish. We shall specify their adjusti-nent rules below. Before doing that we shall rewrite the agriculture and industry equilibrium conditions given respectively by (13) and (15) in the text as follows:

$$P^d - P^s = \frac{\frac{1}{1+\alpha}(Y+S)}{X} - P^s(X) \equiv P(Y, X; S) = 0 \qquad (a.1)$$

$$\left[C_1 \left(\frac{\alpha}{1+\alpha}\right) (Y+S) + C_2 \left(\frac{1}{1+\alpha}\right) (Y+S) + (1-C_2)\, M_x\, (X) + I_p + I_g \right] - Y \qquad \text{(a.2)}$$

$$\equiv U\,(Y, X; S) = 0$$

Equations (a.1) and (a.2) can be solved for the equilibrium values of Y and X, given I_p, I_g, S etc. Now we consider the stabilit of the equilibrium defined above. The adjustment rules of Y and X are given by

$$\frac{dY}{dt} = a_1 \,.U(.);\ a_1 > 0 \qquad \text{(a.3)}$$

$$\frac{dY}{dt} = a_2 \,.P(.);\ a_2 > 0 \qquad \text{(a.4)}$$

Given the adjustment rules stated above, the equilibrium given by eqs. (13), (15), (16) and (19) is stable if the following conditions are satisfied.

$$\frac{\partial U}{\partial Y} + \frac{\partial P}{\partial X} < 0 \qquad \text{(a.5)}$$

$$\left[- \left(\frac{\partial U}{\partial Y}\right) / \left(\frac{\partial U}{\partial X}\right)\right] - \left[- \left(\frac{\partial P}{\partial Y}\right) / \left(\frac{\partial P}{\partial X}\right)\right] > 0 \qquad \text{(a.6)}$$

Condition (a.5) is always satisfied, given the signs of the partial derivatives of (a.1) and (a.2) (also see (13) and (15)). Condition (a.6) is satisfied if and only if the slope of YY (the first term on the LHS of (a.6)) > the slope of XX (the second term on the LHS of (a.6)) (see Figure 1).

A.2 *Effect of an Increase in S on Y and X*

Taking total differential of the agricultural equilibrium condition, (13), we get

$$\left(\frac{1}{1+\alpha}\right) (dY + dS) = (P^{S'} X + P^S)\, dX = P^S \left(P^{S'} \frac{X}{P^S} + 1 \right) dX$$

$$\Rightarrow dX = \frac{1}{(1+\alpha) P^S \left(\frac{1}{\eta} + 1\right)} (dY + dS);\ \eta \equiv \text{price elasticity of supply of food} \qquad \text{(a.7)}$$

Taking total differential of the industry equilibrium condition, (15), and substituting for dX its value as given by (a.7), we get

$$dY = C_1 \left(\frac{\alpha}{1+\alpha}\right)(dY + dS) + C_2 \left[\left(\frac{\alpha}{1+\alpha}\right)(dY + dS) - M'_X\, dX \right] + M'_X\, dX$$

$$= C_1\left(\frac{\alpha}{1+\alpha}\right)(dY+dS)+C_2 \left[\left(\frac{\alpha}{1+\alpha}\right)(dY+dS)-M'_X \left\{\frac{1}{(1+\alpha)P^S\left(\frac{1}{\eta}+1\right)}\right\}(dY + dS)\right] +$$

$$M'_X \left\{\frac{1}{(1+\alpha)P^S\left(\frac{1}{\eta}+1\right)}\right\}(dY + dS)$$

From the above we get

$$\frac{dY}{dS} \equiv \bar{\theta} = \frac{C_1\left(\frac{\alpha}{1+\alpha}\right)+C_2\left[\frac{1}{1+\alpha}-M'_X\left\{\frac{1}{(1+\alpha)P^S\left(\frac{1}{\eta}+1\right)}\right\}\right]+M'_X\left\{\frac{1}{(1+\alpha)P^S\left(\frac{1}{\eta}+1\right)}\right\}}{1-\left(C_1\left(\frac{\alpha}{1+\alpha}\right)+C_2\left[\frac{1}{1+\alpha}-M'_X\left\{\frac{1}{(1+\alpha)P^S\left(\frac{1}{\eta}+1\right)}\right\}\right]+M'_X\left\{\frac{1}{(1+\alpha)P^S\left(\frac{1}{\eta}+1\right)}\right\}\right)} > 0 \qquad \text{(a.8)}$$

Let us now interpret the expression on the RHS of (a.8). The numerator gives the increase in demand for Y at the initial equilibrium Y per unit increase in S when X adjusts to the rise ill S in such a way that the food market remains in equilibrium. It should be noted that the coefficient of C_2 is positive. The term $(1/(1+\alpha))$ gives the increase in the revenue of the farmers per unit increase in S. The expression M_X' $[1/((1+\alpha)P^S\{(1/\eta)+1\})]$ $(\equiv\xi)$ on the other hand gives the increase in cost as profit-maximizing farrhers adjust their output

to meet the additional demand. Obviously, therefore, $[(1/(1+\alpha))-\xi] > 0$. The denominator gives the amount of fall in excess demand for industrial goods per unit increase in Y when X adjusts along with the rise in Y to keep the fo d market in equilibrium. It is clear that the larger the values of C_1 and C_2, the greater is $(\frac{dY}{dS})$. It also appears from (a.8) that $(\frac{dY}{dS})$ is a function of M_X, and η too. Both these variables affect tile value of (dY/dS) through their impact on ξ. The greater the value of η, the easier is it to produce more X and therefore the less is likely to be the value of M'_X. As they move in opposite directions, their effects on ξ tend to cancel out one another. Hence we neglect them as determinants of the value of (dY / dS). Thus

$$\frac{dY}{dS} = \bar{\theta} = \bar{\theta}\,(C_1, C_2) \qquad \text{(a.9)}$$

Substituting (a.9) in (a.7), we get

$$\frac{dY}{dS} = \frac{1}{(1+\alpha)P^S\left(\frac{1}{\eta}+1\right)}(1+\bar{\theta}) > 1 \qquad \text{(a10)}$$

A.3 *Stability of Equilibrium: 2*

Here we shall examine the stability of the equilibrium given by eqs.(1 3), (15), (16), (19) and (28) in 5 endogenous variables: X, Y, D, r and 1. Adjustment rules of the first four variables are assumed to be the same as those in section A. I. For simplicity, regarding I we make the assumption that it adjusts much more slowly than X and Y so much so that it adjusts only when adjustments in X and Y are complete. We have already shown in section A.1 that equilibrium values of X, Y, D and r, given 1, are stable if and only if the slope of YY > the slope of XX in the (Y,X) plane (see Figure 1). Let us now examine the stability of the equilibrium value of I when X, Y, D and r, given 1, have already adjusted to their respective equilibrium values. We assume the following adjustment rule for 1:

$$\frac{dI}{dt} = \gamma\left[\left\{I_p\left(\frac{\alpha}{1+\alpha}(Y(I,S)+S), \Pi_X(X(I,S)), I_g\right) + I_g\right\} - I\right] (\equiv \gamma\tilde{I}(I));\ 0<\gamma<1 \qquad \text{(a.11)}$$

In (a.11) on the RHS the first term within second brackets gives the planned value of aggregate investment, while the second term, I, gives the actual level of investment. Eq. (a.11) states that, if planned I exceeds actual I, I rises and the larger the difference, the greater is the increase in I per unit of time. Linearising the function $\tilde{I}(I)$ around the equilibrium value of 1, ignoring all terms other than the first and the second and denoting the deviation of I from its equilibrium value by i, we get

$$\frac{di}{dt} = \gamma \left(\frac{d\tilde{I}}{dI} \right) i \qquad \text{(a.12)}$$

where $\frac{d\tilde{I}}{dI} = \frac{\partial \Pi_P}{\partial \Pi_Y} \left(\frac{\alpha}{1+\alpha} \right) \frac{dY}{dI} + \frac{\partial \Pi_P}{\partial \Pi_X} \frac{\partial \Pi_X}{\partial X} \frac{dX}{dI} - 1$

From (a.12) we get

$$\tilde{I} = \tilde{I}_0 e^{\left(\frac{d\tilde{I}}{dI} \right) t} \qquad \text{(a.13)}$$

From (a.13) we find that the equilibrium value of I is stable if and only if $\frac{d\tilde{I}}{dI} < 0$, i.e., if and only if

$$\frac{\partial \Pi_P}{\partial \Pi_Y} \left(\frac{\alpha}{1+\alpha} \right) \frac{dY}{dI} + \frac{\partial \Pi_P}{\partial \Pi_X} \frac{\partial \Pi_X}{\partial X} \frac{dX}{dI} - 1 < 0 \Rightarrow \frac{\partial \Pi_P}{\partial \Pi_Y} \left(\frac{\alpha}{1+\alpha} \right) \frac{dY}{dI} + \frac{\partial \Pi_P}{\partial \Pi_X} \frac{\partial \Pi_X}{\partial X} \frac{dX}{dI} =$$

the slope of I I in Figure 3 is less than unity.

List of Notations

$X \equiv$ output of the agricultural sector

$Y \equiv$ output of industry

$L_Y \equiv$ quantity of labor available to industry

$K_Y \equiv$ quantity of capital available to industry

$a \equiv$ fixed quantity of labor required per unit of Y.

$b \equiv$ fixed quantity of capital required per unit of Y.

$W \equiv$ money wage rate in industry

$P_Y \equiv$ price of Y received by industrial producers

$\alpha \equiv$ fixed mark-up in industry, which is applied to the average variable cost of production, W.

$s \equiv$ rate of subsidy applied on an ad valorem basis to Y

P_Y = price of Y faced by buyers

S = aggregate subsidy in terms of Y

Π_X = aggregate profit in agriculture

$P = P_X / P_Y$, P_X = nominal price of food

M_X = the amount of manufactured intermediate inputs used in agricultural production

$M_X(X)$ = the amount of manufactured intermediate inputs used as a function of X

X^S = the planned supply of X

P^S = the supply price of X.

P^d = food market clearing value of P

C_1 = average and marginal consumption propensity of industrial producers

C_2 = average and marginal consumption propensity of landlords

I_p = private investment

Ig = public investment

$w = (W / P_y)$

t = time

h^* = desired minimum wage rate in terms of food

$$\hat{W} = \left(\frac{1}{W}\right)\left(\frac{dW}{dt}\right)$$

r = rate of inflation

r^* = the equilibrium rate of inflation

I^* = the equilibrium rate of aggregate investment

D = the amount of fiscal deficit

$\hat{Y} = dY / Y$

$\hat{X} = dX / X$

η = price elasticity of supply of X

Π_Y = profit in industry in terms of Y

$Y(.)$ = equilibrium values of Y as a function of I and S, given other erogenous variables, as yielded by (13) and (15).

$X(.)$ = equilibrium value of X as a function of I and S, given other erogenous variables, as yielded by (13) and (15).

$\tilde{I}$ ≡ deviation of the planned value of I as yielded by the RHS of (29) and the actual I

i ≡ deviation of I from its equilibrium value

$\overline{I_g}$ ≡ inflation-minimizing value of I_g

$\overline{S}$ ≡ inflation-minimizing value of S

τ ≡ direct tax rate

$\overline{\alpha}$ ≡ share of public sector enterprises' profit in aggregate profit in industry