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FOOD SUBSIDIES AND INFLATION IN DEVELOPING COUNTRIES: A BRIDGE BETWEEN STRUCTURALISM AND MONETARISM

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ABSTRACT

Food Subsidies and Inflation in Developing Countries: A Bridge Between Structuralism and Monetarism*

This paper examines the efficacy of food consumption subsidies as anti-inflation policy in developing countries characterized by rigidities of food supply. First a standard structuralist model is utilized to show that though a policy of food consumption subsidies brings down inflation in the very short run, eventually it is self-defeating: a lower relative price of food encourages demand for scarce food and exacerbates inflationary pressures. Next, a monetarist feature – the asset creation effects of subsidy payments feeding through the government budget constraint – is added to the structuralist model. One might expect that this would reinforce the results of the structuralist model, but it is shown that the ensuing inflation is not unambiguously higher than the inflation in the pure structuralist version. In fact, either a contractionary real balance effect or a sizeable response of tax revenues from the expanding industrial sector can lower the inflationary effects or even reverse them. Subsequently, alternative versions of the model are presented, incorporating instantaneous real wage adjustment and a reorientation of the model to study the same issue in the context of an open economy.

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Keywords: developing countries, inflation, subsidies

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NON-TECHNICAL SUMMARY

This paper studies the use of subsidies to food consumption using a new approach which features two predominant schools of thought – structuralism and monetarism. We construct a two-sector model of a developing country consisting of food producing and non-food producing sectors. Key features of the model are that the supply of food is rigid; consumption decisions are influenced by wealth in addition to income; industrial workers bargain successfully for higher wages whenever the prevailing real wage is short of their desired target, and this propels the inflation in the economy; food prices adjust to clear the market for food, but industrial prices are based on the cost of production; and the government has an explicit budget constraint. A novelty of the model is that while it emphasizes structuralist features (rigid food supply, mark-up rule for industrial prices and real wage resistance), it recognizes also the link between the government's budget deficit and money creation.

It might be expected that such an approach would clearly reveal a greater potential for inflation, following higher subsidies to consumption of food, when compared to a pure structuralist approach. This paper demonstrates that this is not necessarily the case; the potential for inflation may be diminished in the longer run when asset effects come into operation. Longer-run inflation can be moderated either because of erosion of the real value of assets (a real balance effect) or because of higher tax revenues realized from an expanding industrial sector, which in turn cuts the budget deficit. The effects on inflation of a fiscal expansion and greater production of food are also analysed in the paper.

Section 1 of the paper outlines a simple structuralist model, without bringing in wealth effects or the government's budget constraint. The results presented here should be viewed as short-run results. In this model, subsidies to food consumption, although they cut down inflation on impact by reducing the cost of food to workers, will in due course create extra demand for food that is already scarce; the latter effect dominates, and the end result is higher inflation. It is shown also that a fiscal expansion or a cut in food production will also fuel inflation.

Section 2 builds the central model of the paper in which a monetarist feature is added on to the structuralist model of the previous section. We have already referred to the ambiguous results that an increase in food subsidies produces in this model. An increase in food production also results in an ambiguous outcome; if in the initial situation the food sector was a net recipient of subsidies (subsidies exceeding payment of taxes), then the short-run impact, one of deflation, would tend to be reversed in the longer term. A fiscal expansion, however, produces the unambiguous result of higher inflation.

Some observers regard the assumption of slow adjustment of nominal wages to the desired levels, used in Section 2, as ad hoc. Therefore, in Section 3 we discuss a variant of the central model in which industrial workers are able to maintain their real wage at the desired target level all the time. Here we get unambiguous results. An increase in food consumption subsidy or a fiscal expansion results in faster inflation. An increase in food output moderates inflation. The response of industrial output to a change in either food output or subsidy is different from that observed in the structuralist model of Section 1: higher output of food results in higher industrial output because at a constant relative price of food the purchasing power of the agricultural sector becomes larger; an increase in subsidy leaves industrial output unchanged because the induced income and wealth effects cancel out exactly.

Section 4 shows how the central ideas of our model carry over to the context of an open economy. Without substantial changes the variables can be conveniently relabelled for an open economy version when the economy in question exports a primary product and imports all food. All the analytical results obtained for the central model earlier in Section 2 hold good, especially when it is assumed that movements of the real exchange rate must balance the trade account all the time.

The main conclusion reached in this paper is that while studying developing economies characterized by structural rigidities, the addition of a monetarist perspective can, but does not unambiguously, indicate larger inflationary effects of an increase in subsidies to food consumption.

FOOD SUBSIDIES AND INFLATION IN DEVELOPING COUNTRIES: A BRIDGE BETWEEN STRUCTURALISM AND MONETARISM

Structuralism seeks explanations for inflation in rigid structures of production, trade and distribution that tend to be especially prevalent in developing countries.[1] Downward inflexibility of key relative prices and immobility of productive resources means that the price system cannot fulfil the role of ensuring that sectoral imbalances in demand and supply lead to relative price adjustments without causing unemployment of factors of production. Rather, bottle-necks in the supply of such goods as intermediate inputs into production or food can result in continuous inflationary pressures even in the presence of overall excess supply. This is the essense of a structural inflation and it is this that distinguishes it from 'demand-pull' inflation. The recurrent and endogenous nature of the inflationary pressure also sets structural inflation apart from the 'cost-push' variety.

During the 1970s and early 1980s a body of literature emerged devoted both to formalising and to extending the

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1 The structuralist approach to inflation has its strongest roots in Latin America where it grew up in response to the chronic inflations that characterised many economies of the region in the Post World War II period. Some of the important articles available in English include Sunkel (1958), Seers (1962) and Olivera (1964).

basic tenets of the structuralist approach to inflation.[2] A common objective of many of the contributions is to examine - using simple qualitative models - the dynamics of a continuous inflation sparked off by the impact of supply shocks on an economy with an inelastic food supply. These are shown to set in motion a cost-push spiral, as upward pressure on relative food prices brings about a lower real wage and thereby calls forth compensatory increases in nominal wages and prices. A generalised inflation results.

Usually a crucial assumption in these models is that money is passive and accomodating in the face of a rising price level. The aim of the present paper is to build upon this literature by developing a formal model that, while remaining true to the structuralist tradition, also explicitly includes stocks and flows of financial assets. By so doing, we are able to take account of some of the elements of the inflationary process that are central to monetarist explanations for inflation in LDCs. In order to provide a specific focus for the analysis, we concentrate upon the interactions between food consumption

2 See Taylor (1979, 1983), Chichilnisky and Taylor (1980), Cardoso (1981) for some important examples. Williamson (1985) provides a useful framework for studying cost push and monetary factors in explaining inflation in a two-sector framework similar to ours.

subsidies and inflation. These, and subsidies to basic consumer goods in general, have often been employed as anti-inflationary devices in developing countries.

In Section 1, a model is developed that shows how subsidies can have a short term anti-inflationary impact by holding down the cost of food to consumers and thereby forestalling the unleashing of cost-push pressures that might otherwise result from the impact of a food supply shortage upon the relative price of food.[3] However, the model also demonstrates that the process is unlikely to end there. The subsidy may lead to a rise in the demand for food which, if supply is inelastic, will bring about a rise in the food price. In our model, the demand effect dominates the inflation dampening cost-push effect.

A rudimentary mechanism of asset accumulation is added to the model in Section 2. By embedding the structuralist model within a framework that includes stocks and flows of financial assets, we seek to overcome a common limitation of much of the work in the structuralist tradition. Using the example of a food consumption subsidy, it becomes possible to address the issue of the inflationary consequences of deficit financing - an issue central to monetarist explanations of inflation in

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3 In a study that shares certain characteristics with our own, Taylor (1979), Ch. 5 also analyses food subsidies and inflation.

developing countries. The result is to create a bridge between explanations for inflation centred upon the interaction of prices and wages with the real economy and predominantly monetary explanations for this same phenomenon.

Using this extended model it is shown that the asset creation effects of a subsidy may enhance its inflationary stimulus beyond the simple demand effects analysed in the first section. Importantly, however, inflation need not be stimulated further: the inflation generated by the simple demand effects might set in motion a contractionary real balance effect which is powerful enough to dampen the asset creation effects. Which outcome ultimately prevails becomes an empirical question.

In the third section of the paper all of the institutional rigidities in wage determination are removed, making wages and prices instantly flexible in order to ensure a level of aggregate output in conformity with the constrained food supply. In these circumstances we confirm what would be expected: a subsidy to food consumption necessarily and immediately triggers increased inflation.

In the fourth and final section of the paper we indicate how the analytics presented in the second section can be useful also for understanding implications of food subsidies on inflation in an open economy. For this purpose we relabel some of the variables but use essentially an identical model to arrive at the same conclusions.

The model used draws upon a formalisation of the structuralist approach to inflation presented in Cardoso (1981). A crucial feature of this model is the assumption of lagged adjustment of nominal wages to changes in the price level. This ensures that a change in the rate of inflation will cause some adjustment to occur in the level of the real wage. We maintain this assumption in Sections 1 and 2 but not in Section 3. Apart from our study of subsidies, the novel feature of the paper is the grafting onto Cardoso's model of the government budget constraint and of asset accumulation in the tradition of important strands of modern monetary economics.[4]

In our analysis we have made many simplifications and two important ones are:

i) Demand sensitivity to changes in interest rates is ignored. It has often proved difficult to identify

4 Blinder and Solow (1973)

significant such effects in developing economies.[5] In this context, credit availability, rather than cost, may be a more important determinant of durable consumption and investment expenditure.

ii) Any addition to budget deficits are financed by money creation. This is common in less developed countries with underdeveloped financial markets.[6]

1. A Model Without Asset Effects

We consider an economy with two sectors: agriculture (sometimes called "food") and industry. Output of agricultural goods is exogenous, the agricultural market clears by means of the "classical" mechanism of changes in the relative price of agricultural goods. Output of

5 See Parkin (1987) or (1989) Ch. 3 (III.v) and Ch. 8 (II.ii).

6 The alternative of bond finance raises interest rates which could dampen de*mand and inflation in principle though in the context of LDCs such effects of interest rates on demand may not be significant as noted above. Higher interest rates may however add to costs and prices of themselves (See Cavallo (1977) for the seminal work on the subject and Parkin (1989) Ch. 3 (VI) for some recent evidence from Brazil). Higher interest payments also add to private sector income and thus to aggregate demand.

industrial goods is endogenous, and the market for industrial goods clears by the "Keynesian" mechanism of changes in the quantity produced.

The agricultural market is represented as follows. If we let

$\overline{Q}_A$ fixed agricultural supply

Q_I output of industry

$\theta = P_A/P_I$ the relative price of agriculture to industry

then

$(\theta\overline{Q}_A + Q_I)$

is total income in the economy expressed in terms of industrial goods. If we define

c = propensity to consume, $0 < c < 1$

$(1-\alpha)$ = proportion of consumption spent on agricultural goods, $0 < \alpha < 1$

s = subsidy on consumption of agricultural goods, $0 < s < 1$

then we may write the condition that the agricultural market clears as follows:

$$(1-s)\theta\overline{Q}_A = (1-\alpha)c(\theta\overline{Q}_A + Q_I) \tag{1}$$

The right hand side of equation (1) is the value of demand for agricultural goods expressed in units of industrial goods. The left hand side is the post-subsidy value of supply of agricultural goods again expressed in terms of industrial goods.[7]

We can rewrite equation (1) to show the market-clearing relative price of food:

$$\theta = \frac{(1-\alpha)cQ_I}{[1-s-(1-\alpha)c]\overline{Q}_A} \qquad (2)$$

Equation (2) shows that an increase in industrial output Q_I raises the demand for food and thus its market clearing price providing that

$$(1-\alpha)c < (1-s)$$

This condition ensures that, for a given Q_I, a rise in the relative price of the agricultural good reduces the gap between the demand for it, $(1-\alpha)c\theta Q_A$ and its cost $(1-s)\theta Q_A$. A large enough food subsidy could in fact prevent this, but from now on we assume that the rate of subsidy is never large enough for that to happen. Equation (2) is plotted as line AA in figure 1. We assume below that the relative food price adjusts slowly, so that the economy is not always on the AA line.

(Figure 1. Equilibrium Relative Price without Asset Effects near here.)

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7 A more general supply function for agricultural goods does not add new insights to our results.

In contrast to agriculture, the industrial market clears through quantity adjustment rather than through prices. We may write the market clearing level of output as

$$Q_I = \alpha c(\theta \overline{Q}_A + Q_I) + \overline{g} \tag{3}$$

where

$\overline{g}$ = real government expenditure on industrial goods (exogenous) and where α and c are as defined above. This industrial market equilibrium condition above can be rewritten to solve explicitly for market-clearing output:

$$Q_I = \frac{\alpha c \overline{Q}_A \theta}{(1-\alpha c)} + \frac{\overline{g}}{(1-\alpha c)} \tag{4}$$

Equation (4) shows that equilibrium industrial output depends positively on government real expenditure g and agricultural real incomes $\overline{Q}_A\theta$: $1/(1-\alpha c)$ is a Keynesian type multiplier, and is positive providing that the propensity to spend on industrial goods, αc is less than unity (which we assume). Equation (4) is plotted as line II in Figure 1. In what follows, we assume that this multiplier process is <u>instantaneous,</u> so that the economy is always on the II line.

Next consider inflation. Industrial Prices P_I are determined as a mark up μ over the nominal wage rate per unit output.

$$P_I = (1+\mu)\beta W \tag{5}$$

where β = unit labor requirement for industrial output

W = nominal wage rate.

The desired nominal wage rate, W*, is given by

$$W^* = wP_c \qquad (6)$$

where w is the target real wage rate, and where the consumer price index P_C is equal to

$$P_c = [(1-s)P_A]^{(1-a)}P_I^a \qquad (7)$$

The inflation mechanism which we require for the model comes from an assumption that nominal wages adjust slowly to the gap between the target wage W* and the actual wage W. First of all, there is a non-inflationary relative price, θ^* which shows that relative price at which there would be no inflation. It is obtained by setting W equal to W* and substituting equations (7) and (6), into equation (5) and solving for θ.

$$\theta^* = \frac{[(1+\mu)\beta w]^{-1/(1-a)}}{(1-s)} \qquad (8)$$

Equation (8) shows that the non-inflationary relative price θ^*, is positively related to the real wage target, the labour-output ratio, the mark-up factor and the subsidy on food consumption. This is plotted as a horizontal line NRP in figure 1. Next, although nominal wages in industry adjust slowly to the gap between the target and the actual wage, by simple substitution, we can represent wage inflation as responding to θ/θ^*

$$\frac{\dot{W}}{W} = h\left(\frac{\theta}{\theta^*} - 1\right) \qquad (9)$$

Note that in equation (9) and in other equations that follow, a dot over a variable indicates its time derivative. In addition since industrial prices P_I are determined by a constant markup on wages (equation 5) we can write

$$\frac{\dot{P}_I}{P_I} = \frac{\dot{W}}{W} \qquad (10)$$

Equations (10), (9) and (8) fully represent the inflation process.

Finally, to complete the model, an adjustment process for relative food prices, θ is required. (Recall that industrial output Q_I adjusts instantaneously to clear the market for industrial goods.) We postulate that relative food prices adjust gradually in response to excess demand:

$$\frac{\dot{\theta}}{\theta} = \lambda\left\{\frac{(1-\alpha)(Q_I\theta^{-1}+\overline{Q}_A)-\overline{Q}_A(1-s)}{(1-s)}\right\} \qquad (11)$$

where the expression in chain brackets denotes excess demand for agricultural goods. It can be seen from equation (2) that $\dot{\theta} = 0$ when the economy is on the AA line in Figure 1, and that when θ is above the AA line, θ is falling, and vice versa, providing only that the condition beneath equation (2) holds.

Stability

Since the market for industrial goods always clears, we may substitute for Q_I (from equation (4)) into equation (11) and rearrange to get a first order differential equation in θ:

$$\dot{\theta} = \frac{\bar{g}\lambda(1-\alpha)c}{(1-s)(1-\alpha c)} - \frac{\lambda[1-c-s(1-\alpha c)]}{(1-s)(1-\alpha c)}\bar{Q}_A\theta \qquad (12)$$

Stability requires that

$$(1-\alpha)\frac{c}{(1-\alpha c)} < (1-s) \qquad (13)$$

simple substitution shows that this is equivalent to a requirement that II line is steeper than the AA line. This stability condition is stronger than the condition given beneath equation (2), for the following reason. There we showed that, for a given Q_I, a rise in θ reduces the excess demand for food providing only that $(1-\alpha)c<(1-s)$. But such a rise in θ will, through the multiplier $1/(1-\alpha c)$, raise Q_I and that channel will increase the demand for food again: we require that this latter effect be not too strong. Graphically, in Figure 1 the phase arrows point towards the AA line providing only that $(1-\alpha)c<(1-s)$. But since the economy is always on II (ex-hypothesis) there will still be instability unless AA is also flatter than II. We assume from now on that the rate of food subsidy is never large enough for such instability to arise.

Equilibrium

We now obtain equilibrium solutions for the model, denoted by ˜. Equilibrium obtains when both the industrial and the agricultural markets clear. To obtain the equilibrium for relative prices, we set $\dot{\theta} = 0$ in equation (12) and solve for θ. This gives

$$\theta = \frac{(1-\alpha)c\bar{g}}{[1-c-s(1-\alpha c)]\bar{Q}_A} \tag{14}$$

Substituting the equilibrium relative price θ into equation (4) yields the equilibrium industrial output:

$$Q_I = \frac{[1-s-(1-\alpha)c]\bar{g}}{[1-c-s(1-\alpha)c]} \tag{15}$$

This expression is certainly positive if condition (13) holds. In equilibrium, when relative prices have stopped adjusting, overall inflation π equals the rate of change of both agricultural and industrial prices. Therefore, using (10) and (9), we can write:

$$\hat{\pi} = h\left\{\frac{(1-\alpha)c\bar{g}}{[1-c-s(1-\alpha c)]\bar{Q}_A\theta^*} - 1\right\} \tag{16}$$

<u>Comparative Statics</u>

We obtain the following comparative statics from equations (12), (13) and (16). (See Appendix for full derivation of results.) These are equilibrium results which apply after relative prices θ have fully adjusted following a change.

Table 1

Comparative Statics for the Model without Asset Effects

Increase in ----------- -- Effect on	Q_A	g	s
Q_I	0	+	+
θ	-	+	+
π	-	+	+

The effects of changes in government expenditure g and agricultural output Q_A are obvious. A rise in g raises aggregate demand - (it shifts the II line to the right) - and so industrial output Q_I and the market clearing relative price θ both rise. The gap between θ and $\theta*$ widens (i.e. real wages fall further below target) and so inflation increases. The opposite happens to θ and inflation π when agricultural output Q_A rises . Diagramatically the AA line rotates down, and the II line shifts to the right. The fact that Q_I is unchanged is due to the fact that real income of agriculture remains the same (the Cobb Douglas demand system ensures that the fall in θ is equiproportional to the rise in Q_A).

The effect of a rise in subsidy is to stimulate consumer real incomes and increase demand and so Q_I and θ both rise as when g rises. But the non-inflationary relative price of agricultural goods, $\theta*$, now rises because of the subsidy to industrial real wages. In the present model the effect of the market clearing relative price necessarily dominates the effect of $\theta*$ and so inflation <u>increases.</u> (See Appendix 1). The effect of the increasing subsidy to food consumption is illustrated in Figure 2. When the subsidy is raised the AA line rotates up, the II line is unaffected and $\theta*$ line shifts up. The economy moves from equilibrium E_o to E_1 which causes an increase in both relative prices (θ_o to θ_1) and industrial output (Q_{Io} to Q_{I1}). But as shown in the appendix the gap between θ_1 and θ^*_1 is greater than that between θ_o and θ^*_o and so we conclude that inflation also accelerates.

(Figure 2. Effects of an Increase in Subsidy in a Model Without Asset Effects near here.)

Inflation in Transition

There is an interesting process of transition to equilibrium following an increase in the subsidy to food consumption. Since θ adjusts to excess demand only with a lag, initially $(\theta^* - \theta)$ falls, and so inflation initially falls because of the cost push dampening effects. (This effect of subsidies is widely documented in developing countries, see OECD (1964)). But gradually the effect of the widening gap between θ and θ^* comes into play. So initially the subsidy dampens inflation, but eventually this effect is reversed. We have deliberately modelled lags in the adjustment of food prices in this Section so as to highlight how the cost-reducing and demand-increasing effect of food subsidies may operate over different time periods. Our message is that although the first effect may appear attractive to policy-makers, it may be dominated in due course by the second.

2. A Model including Asset Effects on Consumption

We first outline the features of a simple process of intereactions between the creation of financial assets and government's budget constraint.

Nominal financial wealth A, insists of money M and bonds B

$$A = M + B \tag{17}$$

and its accumulation

Let us define real wealth as nominal financial wealth deflated by industrial prices

$$\alpha = \frac{A}{P_I} \tag{19}$$

It follows that real asset accumulation is given by

$$\dot{\alpha} = \frac{\dot{A}}{P_I} - \frac{A}{P_I} \cdot \frac{\dot{P}_I}{P_I} \tag{20}$$

Let us now turn to the government's budget. The only revenue that government earns is through income tax at rate t levied on both agricultural and industrial nominal incomes. Government's expenditures consist of demand for industrial goods, subsidy payments to consumers of agricultural goods and interest obligations on the stock of bonds. Government covers the difference between its expenditure and revenues by issuing bonds or money. Therefore we can write

$$\dot{A} = \dot{M} + \dot{B}$$

$$= P_I g - t(P_I Q_I + P_A \overline{Q}_A) + s P_A \overline{Q}_A + \rho(1-\delta) A \tag{21}$$

where ρ is the interest rate net of income tax,

δ is the proportion of non-interest-bearing asset-money in total assets,

t is the tax rate

Substituting equation (21) into equation (20) we get an expression for rate of change of real wealth:

$$\dot{a} = g - t(Q_I + \overline{Q}_A\theta) + s\overline{Q}_A\theta + \rho(1-\delta)a - a\pi \qquad (22)$$

where π represents inflation in industrial prices. Using a linear approximation for the inflation tax where subscript '0' denotes initial values,

$$a\pi = a_0\pi_0 + a_0\pi + \pi_0 a$$

and restricting ourselves to the case of $\delta = 1$, i.e. all financial wealth is non-interest bearing money, we can write the rate of change of real assets as follows, beginning for simplicity from zero initial inflation.

$$\dot{a} = g - tQ_I + (s-t)\overline{Q}_A\theta - a_0\pi \qquad (23)$$

Equation (23) shows that when real government spending on industrial goods exceeds real tax revenues from the same sector, or when real subsidy payments exceed real taxes upon agricultural income, then, <u>ceteris paribus,</u> real assets will rise.

We now incorporate positive effect of real asset holdings on consumption. The agricultural market clears when

$$(1-s)\overline{Q}_A\theta = (1-\alpha)c(1-t)(\overline{Q}_A\theta + Q_I) + (1-\alpha)\gamma a \qquad (24)$$

where γ is the propensity to consume out of real assets and where c is now the propensity to consume out of disposable income. We can rewrite equation (24) to give

$$\theta = \frac{(1-\alpha)\gamma a}{[1-s-(1-\alpha)c(1-t)]\overline{Q}_A} + \frac{(1-\alpha)c(1-t)Q_I}{[1-s-(1-\alpha)c(1-t)]\overline{Q}_A} \quad (25)$$

Equation (25) shows that real assets and industrial output have a positive impact on market-clearing relative food prices; an increase in agricultural output decreases relative prices providing that

$$(1-\alpha)c(1-t) < (1-s)$$

This condition is identical to that given beneath equation 2 except that now income taxes are also allowed for.

The industrial market clears when

$$Q_I = \alpha c(1-t)(\overline{Q}_A\theta + Q_I) + \alpha\gamma a + g \quad (26)$$

which can be rewritten as

$$Q_I = \frac{\alpha\gamma a}{[1-\alpha c(1-t)]} + \frac{\alpha c(1-t)\overline{Q}_A}{[1-\alpha c(1-t)]}\theta + \frac{g}{[1-\alpha c(1-t)]} \quad (27)$$

We note that government expenditure real assets and real agricultural incomes have a positive effect on market clearing industrial output. $1/1-\alpha c(1-t)$ is again a Keynesian-type multiplier.

"Short Run" Equilibrium

Unlike in the previous section we now postulate, for simplicity, that both the agricultural and the industrial markets clear instantaneoulsy. Substituting equation (25) into (27) and simplifying we get the short run equilibrium when both markets clear simultaneously, at any point in time when real assets are momentarily constant.

$$Q_I = \frac{(1-s)\alpha\gamma}{\eta}a + \frac{[1-s-(1-\alpha)c(1-t)]}{\eta}g \qquad (28)$$

where

$$\eta = \{1-c(1-t)-s[1-\alpha c(1-t)]\}$$

We assume that $\eta > 0$. This assumption corresponds exactly to the stability condition (13) of the previous section. The positive impact of government expenditure on industrial output follows from $\eta > 0$ and from our earlier condition on subsidies specified beneath equation (25). If real assets increase industrial output goes up. But as in Section 1 a change in $\overline{Q}_A$ has no effect.

Substituting equation (27) into (25) and rearranging we obtain a relation describing short-run determination of the relative price of agricultural goods. Equation (29) shows that increases in government expenditure and real assets drive relative prices up and an agricultural output increase reduces relative prices.

$$\theta = \frac{(1-\alpha)\gamma}{\eta\overline{Q}_A}a + \frac{(1-\alpha)c(1-t)}{\eta\overline{Q}_A}g \qquad (29)$$

Equations (28) and (29) are equivalent to the equilibrium solutions given for relative price and industrial output in the first section, except that we now explicitly account for the influence of assets and income taxation.

Local Stability

Noting that $\pi = h(\theta/\theta^* - 1)$ we can rewrite the rate of change of real assets, by eliminating π as

$$\dot{a} = g - tQ_I + [(s-t)\overline{Q}_A - a_0 h/\theta^*]\theta + a_0 h \tag{30}$$

After linearizing the equations with respect to the endogenous variables ($\theta, Q_I, \wedge a$)and the exogenous variables (g, Q_A and s) around the initial equilibrium values we may write the system of relationships after dropping constants as

$$Q_I = k_{11}a + k_{12}g + k_{14}s \tag{31}$$

$$\theta = k_{21}a + k_{22}g + k_{23}Q_A + k_{24}s \tag{32}$$

$$\dot{a} = g - tQ_I + k_{30}\theta + k_{33}Q_A + k_{34}s \tag{33}$$

where variables are measured as small deviations around initial values and

$$k_{11} = \frac{(1-s_0)\alpha\gamma}{\eta_0} > 0$$

$$k_{12} = \left[\frac{1 - s_0 - (1-\alpha)c(1-t)}{\eta_0}\right] > 0$$

$$k_{14} = \left[a_0\frac{\partial k_{11}}{\partial s_0} + g_0\frac{\partial k_{12}}{\partial s_0}\right] > 0$$

$$k_{21} = \frac{(1-\alpha)\gamma}{\eta_0 Q_{A0}} > 0$$

$$k_{22} = \frac{(1-\alpha)c(1-t)}{\eta_0 Q_{A0}} > 0$$

$$k_{23} = a_0\frac{\partial k_{21}}{\partial Q_{A0}} + g_0\frac{\partial k_{22}}{\partial Q_{A0}} < 0$$

$$k_{24} = \alpha_0 \frac{\partial k_{21}}{\partial} s_0 + g_0 \frac{\partial k_{22}}{\partial s_0} > 0$$

$$k_{30} = (s_0 - t) Q_{A0} - \alpha_0 h / \theta_0^* > 0$$

$$k_{33} = (s_0 - t) > 0$$

$$k_{34} = Q_{A0} + \alpha_0 h / (1 - s_0) > 0$$

The local stability condition for asset accumulation is $d\dot{\alpha}/d\alpha < Q$ From equations (31) and (33) a <u>sufficient</u> condition may be written as

$$\frac{d\dot{\alpha}}{d\alpha} = -t \frac{dQ_I}{d\alpha} + (s_0 - t)\overline{Q}_{A0} \frac{d\theta}{d\alpha} < 0$$

That is

$$-t k_{11} + (s_0 - t)\overline{Q}_{A0} k_{21} < 0$$

which can be further simplified using the definitions of k_{11} and k_{21} to give

$$s < \frac{t}{[1 - \alpha(1 - t)]} \tag{34}$$

If there were no subsidies then a rise in assets α would raise both industrial output Q_I and agricultural incomes $\overline{\theta} Q_A$ so raising tax revenues and reducing asset creation. (Blinder and Solow, 1973). But in the presence of subsidy payments to consumers of agricultural goods, a rise in assets raises subsidy payments, and raises asset creation, leading to potential instability. Stability remains possible even if s > t because subsidies are only paid in agriculture but taxes are collected in industry as well; the very simple condition (34) puts an upper bound on the rate of subsidy for which the system is stable. In fact, since we have ignored the stabilising real-balance-effect term $\alpha_0 h/\theta^*$ in the coefficient k_s, stability is possible for even larger values of s.

By substituting for Q_I in equation (33) we reduce the system to two equations in two endogenous variables θ and a, and so give a graphic interpretation of the model. Substituting for Q_I in equation (33) from equation (31), gives

$$\dot{\alpha} = k_{40}\theta + k_{41}\alpha + k_{42}g + k_{43}Q_A + k_{44}s \qquad (35)$$

where

$k_{40} = k_{30} \gtreqless 0$

$k_{41} = -k_{11}t < 0$

$k_{42} = (1 - k_{12}t) > 0$

$k_{43} = k_{33} \gtreqless 0$

$k_{44} = k_{34} - tk_{14} \gtreqless 0$

when equilibrium prevails in the asset market, $\dot{\alpha} = 0$ and so we can write

$$\theta = -\frac{k_{41}}{k_{40}}\alpha - \frac{k_{42}}{k_{40}}g - \frac{k_{43}}{k_{40}}Q_A - \frac{k_{44}}{k_{40}}s \qquad (36)$$

Equations (32) and (35) appear as straight lines in θ. a plane in Figure 3 and help us to understand the nature of equilibrium and derive comparative static results.

Equation (32) traces out a locus AA in Figure 3 along which points represent short-run equilibria. This line slopes upwards because ceteris paribus higher asset levels are compatible with, and imply, a higher relative price of food. The economy always stays on this line by assumption. Equation (35) traces out a locus ZZ in Figure 3 along which points represent asset market equilibria. This line is downward (upward) sloping if k_{30} is negative (positive). Our local stability condition amounts to saying that either the locus ZZ is downward sloping or if upward sloping steeper than AA. In drawing locus ZZ in Figure 3 it is assumed that it is downward sloping and consequently it may be said that to the north of this line real assets are decreasing and to the south-west real assets are increasing.

(Figure 3. Long Run Equilibrium with Asset Effects. Near here.)

Comparative Statics

We now discuss the comparative statics of the model. They are worked out in details in the Appendix, and a qualitative presentation is given in Table 2.

Along the ZZ line level of real assets is constant at its equilibrium value. To the south west of this line real assets increase and to the north east real assets decrease.

Table 2

Long-run Comparative Statistics for the Model with Asset Effects

Increase in / Effects on	Q_A	g	s
Q_I	+ if $s_o < t$ and $k_{30} > 0$	+ if $k_{30} > 0$	+ if $k_{44} > 0$ and $k_{30} > 0$
θ	- if $s_o < t$	+	+ if $k_{44} > 0$
π	- if $s_o < t$	+	+ if $k_{44} > 0$ and $k_{30} > 0$

Consider first an increase in government spending. In short-run equilibrium, after the increase, a budget deficit is created. The resulting asset accumulation of itself drives up spending and increases both θ and Q_I. But the higher θ in the short-run equilibrium stimulates inflation. If the initial stock of assets a_o is big enough then real asset creation will in fact be negative in the short-run even although the government budget has gone into deficit. In this case Q_I and θ will converge to lower levels in long run than in short run equilibrium. This explains the results in the second columns of the tables. In terms of Figure 3 we can understand these effects of an increase in g as follows. Suppose that the initial long-run equilibrium position was at point A in figure 3. An increase in g shifts the position of the AA locus up along with that of our short-run equilibrium point to, say, B. It also shifts the ZZ locus to the right (see equation (30) and recall that $k_{30} < 0$). In figure 3 we have shown the case where the long-run equilibrium at C is to the north east of the short-run equilibrium position at B.

When agricultural output increases the short-run impact on relative price of food is negative but industrial output remains unchanged and inflation falls, as shown earlier. The long run impact is ambiguous; if in the initial situation, the agricultural sector was receiving net subsidies ($s_o > t$), which is largely true of developing countries, then, subsidy payments on a higher base of food output results in asset creation which could reverse the decline of the relative price of food by pushing up demand, and may result in higher industrial output also.

The long run impact of an increase in subsidy on the relative price of food is ambiguous because of the sign of k_{44}. The effect of an increase in subsidy on asset creation is captured by k_{44} and is made up of three component parts:

(a) a positive effect because of subsidy payments;

(b) a positive effect because of reduction in the gap between θ and θ^*; and

(c) a negative effect because of higher tax revenues from the expanding industrial sector.

Either a small industrial base or a low tax rate can ensure that the net effect of a higher subsidy rate on asset creation is positive and hence ensure that the long run relative price of food would also be higher. Moreover, if the initial value of s is large enough that the effect, k_{30}, of relative prices on asset creation is also positive, then an increase in the rate of subsidy would necessarily result as well in higher inflation and industrial output; in such an event the long-run effects of the increased rate of subsidy are higher than the short-run effects. But, as we have seen, this conclusion is not guaranteed.

3. A Model with Assets and Instantaneous Wage Adjustment

So far we have preserved the slow adjustment of nominal wages to desired levels. Some observers regard this as an ad hoc assumption. In order to satisfy them we examine in this section what happens if there is extreme real wage resistance, an assumption which we regard as exceptionally unrealistic.

In this case relative prices must adjust instantaneously to equal θ^* (since only then will desired real wages be achieved), agricultural market equilibrium can be established now, only by variations in real asset levels which ensure that demand for agricultural output equals supply at this fixed relative price. The mechanism by which this happens - i.e. by which the demand for agricultural goods is brought into equality with supply - is through an instantaneous "jump" in the level of prices. By contrast, the inflation of prices now emerges as the mechanism by which the evolution of nominal assets from the budget constraint is made consistent with a stock of real wealth that gives equilibrium in the agricultural market. The workings of this rather different model, which, even with real wage resistance is very monetarist, are not without interest.

The agricultural market-clearing condition can now be written as

$$\theta^* = \frac{(1-\alpha)\gamma}{\xi\overline{Q}_A}\alpha + \frac{(1-\alpha)c(1-t)}{\xi\overline{Q}_A}Q, \qquad (37)$$

where

$$\xi = [1 - s(1-\alpha)c(1-t)]$$

The industrial market-clearing condition becomes

$$Q_I = \frac{\alpha\gamma}{[1-\alpha c(1-t)]}a + \frac{\alpha c(1-t)\overline{Q}_A\theta^*}{[1-\alpha c(1-t)]} + \frac{g}{[1-\alpha c(1-t)]} \qquad (38)$$

Equations (37) and (38) simultaneously determine equilibrium values for industrial output and the stock of real wealth.

Using our equation (23) to define asset accumulation and setting $\dot{a}=0$, we may solve for the inflation rate

$$\pi = \frac{[g - tQ_I + (s-t)\overline{Q}_A\theta^*]}{a} \qquad (39)$$

Solving (37) and (38) we get equilibrium values

$$\overline{Q}_I = \frac{\alpha(1-s)\overline{Q}_A\theta^*}{(1-\alpha)} + g \qquad (40)$$

and

$$\overline{a} = \frac{\eta\overline{Q}_A\theta^*}{(1-\alpha)\gamma} - \frac{c(1-t)}{\gamma}g \qquad (41)$$

where we may recall that

$$\eta = \{1 - c(1-t) - s[1-\alpha c(1-t)]\}$$

The full solution for inflation can then be obtained by substituting equations (40) and (41) into equation (39) to yield[8]:

$$\bar{\pi} = \frac{(1-t)(1-\alpha)\gamma g - \psi\gamma\bar{Q}_A\theta^*}{\eta\bar{Q}_A\theta^* - c(1-t)(1-\alpha)g} \tag{42}$$

The results of the comparative statics of the model are summarised in Table 3 and the details are placed in the Appendix. Notice that we have assumed instantaneous adjustment of output Q_I, and that we require instantaneous changes in the price level P_I, following any change. Thus the changes in 'a' displayed in the third row of the table are brought about by instantaneous changes in the opposite direction in the level of prices P_I, revaluing nominal assets A to the new equilibrium value of a as required. At this point inflation of prices, π_I is such as to keep a constant.

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8 Positive equilibrium inflation obtains only if θ^* lies in the positive interval:

$$\frac{c(1-t)(1-\alpha)g}{\eta\bar{\bar{Q}}_A} < \theta^* < \frac{(1-t)(1-\alpha)g}{\psi\bar{Q}_A}$$

Table 3

Comparative Statics for the Model with Instantaneous Adjustment

Increase in / Effect on	Q_A	g	s
Q_I	+	+	0
π	-	+	+
a	+	-	-

An increase in government expenditure prompts a fall in real assets (through a higher level of P_I) and generates higher inflation to neutralize the asset creation effects of a bigger deficit.[9] It does however succeed in raising Q_I (note from equation (40) that in this particular model $\partial QI/\partial g = 1$).[10] The effects are easily illustrated in figure 4 where we have represented equation (37) and (38) as lines AA and II respectively in the a, Q_I plane. An increase in g shifts line II to the right, shown in I'I'.

(Figure 4. Effects of an increase in industrial output in a model with instantaneous wage adjustment. Near here.)

An increase in agricultural output Q_A, will now tend to increase industrial output because at fixed relative prices θ^* it increases agricultural purchasing power. The effect on real assets depends upon whether or not the increase in industrial output causes demand for agricultural goods to outstrip the extra supply. Given the

9 Given the equation for the budget deficit and given that dQ/dg = 1, an increase in g does enlarge the budget deficit.

10 If a were to fall enough to neutralize the effects of g on Q_I then the demand for agricultural goods would fall, contradicting the assumption of fixed θ^*. This is because g influences the demand for agricultural goods only indirectly by its effect on Q_I , but a influences demand for agricultural goods both directly and indirectly. If the effect of g on Q_I were neutralised by a fall in a, interest effects through Q_I on the demand for agricultural goods would disappear. But there would remain the negative direct effect of lower a.

structure of this particular model this does not happen and therefore an increase in real assets α is required to stimulate extra spending on agriculture and balance this market. The effect on inflation is necessarily negative because the higher Q_I and Q_A cause tax revenues to increase, nominal asset creation falls and so inflation must fall if the higher level of real assets (due to initial fall in the price level P_I) is to be maintained. In Figure 5 we see that an increase in Q_A shifts both the AA and II lines to the right so that α and Q_I increase.

(Figure 5. Effects of an increase in Q_A in the model with instantaneous wage adjustment. Near here.)

Finally and most interestingly an increase in subsidies has the following effects. It raises the non-inflationary relative price of agricultural goods θ^*. We know from Section 1 that if real assets were constant it would raise θ to a point above θ^*. With instantaneous real wage resistance this cannot happen; P_I rises depressing real assets enough to bring θ down to the new θ^*. Industrial output Q_I is subjected to conflicting pressures - upwards from higher agricultural incomes $\theta^* Q_A$, downward from a lower asset stock, a; in the present model these effects exactly cancel.[11] With no change in either Q_I or Q_A but with an increase in the budget deficit created by higher

11 In terms of Figure 4, higher subsidies shift AA line to the left and the II line to the right; they intersect vertically below the old equilibrium.

subsidies, the effect on inflation is unambiguously positive. These results are essentially monetarist outcomes: subsidies do not influence real output in the economy but merely 'distort' relative prices θ and create inflation.

4. Extension of the Model to an Open LDC

Now we show how the central ideas discussed so far, may be applied in the context of an open economy.

Let us consider the economy of a small open LDC with three goods: exports, imports and non-traded. Assuming specialisation in production let us treat all food as imported. Export production exhibits rigidities in supply but excess capacity exists in non-traded goods production. All other features of the economy are as in the model specified in Section 2.[12]

As the economy is open we now require an equilibrium condition for the balance of payments. Our relative price variable θ now denotes the real exchange rate, the ratio of the domestic currency price received for exported food to the price of non-traded goods. The relative price of exports and imports is exogenous, and we set it equal to unity. It is the adjustment of the real exchange rate which achieves equilibrium in the balance of payments. When the balance of payments is in deficit the real

12 We leave the interested reader to construct his or her own open-economy version of the flex-price model of Section 3.

exchange rate depreciates and vice versa. The real exchange rate can adjust in the wake of the balance of payments disequilibrium either instantaneously or slowly. With instantaneous adjustment of the real exchange rate all analytical results presented in Section 2 hold good.

If the speed of adjustment of the real exchange rate is slow we need to assume a sufficient initial stock of foreign reserves to allow adjustment to run its course.[13]

Slow adjustment of real exchange rate allows short-run inflation to be controlled by running down reserves. However, in this case, the adjustment of the economy to shocks may be cyclical.

As an illustration let us examine the consequences of an increase in the rate of subsidy to food consumption.

Figure 6 corresponds to the case where real exchange rate adjustment is instantaneous. As the subsidy rate is increased, the real exchange rate depreciates and we move from points A to B. Real assets may decline or increase depending upon initial conditions, as noted in Section 2. If real assets decrease in equilibrium then inflation would be higher in the short run than in the long-run, as shown here.

(Figure 6. Effect of an Increase in Subsidy with instantaneous Adjustment of Real Exchange Rate. Near here.)

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13 We rule out capital flows as well as hoarding by domestic residents of foreign currency.

Figure 7 portrays the consequences of an increase in the rate of subsidy to food consumption when the speed of adjustment of the real exchange rate is not instantaneous. The adjustment path of endogenous variables may well be cyclical. The pressure on inflation can be dissipated by running a current account deficit, facilitating importation of more food than export capacity alone permits. Eventually this temporary gain will be reversed; and it may be more than reversed.

(Figure 7. Effect of an Increase in Subsidy with slow Adjustment of Real Exchange Rate, near here.)

5. Conclusion

The present paper has outlined a model that synthesizes the structuralist approach to inflation, which emphasises supply rigidities and cost push pressures, with the monetarist approach - which emphasizes money creation. We have focussed on the effects of subsidies on inflation because their effect provides a 'critical test'. According to a naive or stylized structuralist view a food subsidy should reduce cost push inflation, while for the monetarist viewpoint it should stimulate inflation higher through the impact on the budget deficit of higher subsidies.

We have shown that an increase in the rate of subsidy on food can reduce inflation in the very short run (or what we called instantaneously) because it ameliorates the cost push driven wage-price spiral. However it also lowers the relative price of food and so encourages a shift in demand towards food which is assumed to be scarce and thereby stimulates inflation. In the simple structuralist model of Section 1, with our Cobb-Douglas a unit price elasticity of demand for food, the demand effect dominates the cost push effect and subsidies unambiguously increase inflation although with a lage; even without allowing for their effects on asset creation. This result might be altered if the price elasticity of demand for food were sufficiently high but we consider this eventuality to be an unlikely one.

This paper has also shown how asset creation effects emphasized by monetarists can be integrated into a simple structuralist model. Adding these might be expected to make the inflationary impact of subsidies unambiguously greater. However, the negative real balance effect caused by subsidy induced inflation works against this tendency; a comparison of the outcomes with the simple model of Section 1 is ambiguous.

In Section 3 we changed our assumptions to posit that real wages were not completely inflexible and that money wages and prices were perfectly flexible. We did this in order to examine a variant of a monetarist type of world.

It was shown that, in this case, a food subsidy would cause inflation entirely through its budgetary asset creation effects - a quintessentially monetarist view. Nonetheless, we consider that the model model of Section 3 oversimplifies, as does the simple structuralist model of Section 1. What is necessary to analyse the resulting inflationary process is a synthesis of the two models as derived in Section 2.

It is possible to study these questions empirically and to this end one of the present authors has built a macro econometric model of Brazil. The reader is referred to Parkin (1989) for a description and detailed discussion.

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APPENDIX

1. Comparative Statistics for the Model without Asset Effects

We have the folllowing equilibrium values for relative prices, industrial output and inflation.

$$\bar{\theta}=\frac{(1-\alpha)c\bar{g}}{[1-c-s(1-\alpha c)]\bar{Q}_A} \tag{14}$$

$$\bar{Q}_I=\frac{[1-s-(1-\alpha)c]\bar{g}}{[1-c-s(1-\alpha)c]} \tag{15}$$

$$\bar{\pi}=h\left\{\frac{(1-\alpha)c\bar{g}}{[1-c-s(1-\alpha c)]\bar{Q}_A\theta^*}-1\right\} \tag{16}$$

Noting that α and c are positive fractions and making use of stability condition we obtain the following results:

$$\frac{\partial\bar{\theta}}{\partial g}=\frac{(1-\alpha)c}{[1-c-s(1-\alpha c)]Q_A}>0$$

$$\frac{\partial\bar{Q}_I}{\partial g}=\frac{[1-s-(1-\alpha)c]}{[1-c-s(1-\alpha c)]}>0$$

$$\frac{\partial\pi}{\partial g}=\frac{h(1-\alpha)c}{[1-c-s(1-\alpha c)]\bar{Q}_A\theta^*}>0$$

$$\frac{\partial\bar{\theta}}{\partial\bar{Q}_A}=-\frac{\bar{\theta}}{\bar{Q}_A}<0$$

$$\frac{\partial\bar{Q}_I}{\partial\bar{Q}_A}=0$$

$$\frac{\partial\bar{\pi}}{\partial\bar{Q}_A}=-\frac{h(1-\alpha)cg}{[1-c-s(1-\alpha c)]\bar{Q}_A^2\theta^*}<0$$

$$\frac{\partial\bar{\theta}}{\partial s}=\bar{\theta}\frac{(1-\alpha c)}{[1-c-s(1-\alpha c)]}>0$$

$$\frac{\partial \overline{Q}_I}{\partial s} = \frac{\alpha c^2(1-\alpha)}{[1-c-s(1-\alpha c)]^2} > 0$$

As $$\pi = h\left(\frac{\theta}{\theta^*} - 1\right)$$

$$\frac{\partial \pi}{\partial s} = h\partial \frac{(\theta/\theta^*)}{\partial s}$$

$$\frac{\partial \pi}{\partial s} = \frac{h}{\theta^{*2}}\left\{\theta^* \frac{\partial \overline{\theta}}{\partial s} - \overline{\theta}\frac{\partial \theta^*}{\partial s}\right\}$$

Noting that $$\frac{\partial \theta^*}{\partial s} = \frac{\theta^*}{(1-s)},$$

$$\frac{\partial \pi}{\partial s} = h\frac{\theta}{\theta^*}\frac{(1-\alpha)c}{(1-s)[1-c-s(1-\alpha c)]} > 0$$

We may easily derive, from equations (3) and (9), the instantaneous effects of changes which occur before relative price θ has begun to respond. The results are:

$$\frac{\partial \overline{Q}_I}{\partial g} = \frac{1}{(1-\alpha c)} > 0$$

$$\frac{\partial \pi}{\partial g} = 0$$

$$\frac{\partial \overline{Q}_I}{\partial \overline{Q}_A} = \frac{\alpha c \theta}{(1-\alpha c)}$$

$$\frac{\partial \pi}{\partial \overline{Q}_A} = 0$$

$$\frac{\partial \overline{Q}_I}{\partial s} = 0$$

$$\frac{\partial \pi}{\partial s} = -h\frac{\theta}{\theta^*(1-s)} < 0 \text{ because } \frac{\partial \theta^*}{\partial s} > 0$$

2. Comparative Statics for the Model with Asset Effects

Using equation (32) and (35) in the text, we can derive θ and a in terms of the exogenous variables Q_A, g and s. The resulting a can be utilized in equation (31) to derive Q_I and similarly θ can be used to derive π, following equations (9) and (10). Note also that all variables are measured as deviations around initial values.

$$\theta = m_{11} Q_A + m_{12} g + m_{13} s$$

$$a = m_{21} Q_A + m_{22} g + m_{23} s$$

where

$m_{11} = (k_{23} + k_{21} k_{43}/k_{11}t)/d$

$m_{12} = (k_{22} + k_{21} k_{42}/k_{11}t)/d$

$m_{13} = (k_{24} + k_{21} k_{44}/k_{11}t)/d$

$m_{21} = (k_{43} + k_{30} k_{23})/(k_{11}t\ d)$

$m_{22} = (k_{42} + k_{30} k_{22})/(k_{11}t\ d)$

$m_{23} = (k_{44} + k_{30} k_{24})/(k_{11}t\ d)$

$d = (1 - k_{21} k_{30} k_{11} t)$

$$Q_I = k_{11} a + k_{12} g + k_{14} s$$

$$\bar{\pi} = h(\theta - \theta^*)$$

The multipliers are collected and presented in Table A2.1.

Table A2.1

Multipliers for the Model with Asset Effects

Increase in Effects on	Q_A	g	s
θ	m_{11}	m_{12}	m_{13}
a	m_{21}	m_{22}	m_{23}
Q_I	$k_{11}\ m_{21}$	$k_{12}+k_{11}m_{22}$	$k_{14}+k_{11}m_{23}$
π	$h\ m_{11}$	$h\ m_{12}$	m_{44}

where

$$m_{44} = h\{(1-\alpha)c(1-t)k_{11}t + (1-s)k_{21}k_{44} + k_{21}k_{30}\}$$

3. Comparative Statics for the Model with Instantaneous Wage Adjustment

We have the following equilibrium solutions:

$$\overline{Q}_I = \frac{\alpha(1-s)\overline{Q}_A\theta^*}{(1-\alpha)} + g$$

$$\overline{\alpha} = \frac{\eta\overline{Q}_A\theta^*}{(1-\alpha)\gamma} - \frac{c(1-t)}{\gamma}g$$

Where $\eta = \{1-c(1-t)-s[1-\alpha c(1-t)]\}$

$$\overline{\pi} = \frac{(1-t)(1-\alpha)\gamma g - \psi\gamma\overline{Q}_A\theta^*}{\eta\overline{Q}_A\theta^* - c(1-t)(1-\alpha)g}$$

Using the equations above one can derive the comparative static results as shown.

$$\frac{\partial\overline{Q}_I}{\partial\overline{Q}_A} = \frac{\alpha(1-s)}{(1-\alpha)}\theta^* > 0$$

$$\frac{\partial\overline{Q}_I}{\partial g} = 1 \cdot > 0$$

$$\frac{\partial\overline{Q}_I}{\partial s} = \frac{\alpha\overline{Q}_A\theta^*}{(1-\alpha)} - \frac{\alpha\overline{Q}_A\theta^*}{(1-\alpha)} = 0 \cdot$$

$$\frac{\partial\overline{\alpha}}{\partial\overline{Q}_A} = \frac{\eta\theta^*}{(1-\alpha)\gamma} > 0$$

$$\frac{\partial\overline{\alpha}}{\partial g} = -\frac{c(1-t)}{\gamma} < 0$$

$$\frac{\partial\overline{\alpha}}{\partial s} = \frac{\eta\overline{Q}_A\theta^*}{(1-\alpha)(1-s)} > 0$$

$$\frac{\partial\overline{\pi}}{\partial\overline{Q}_A} = \frac{-\gamma\psi\theta^*}{\eta\overline{Q}_A\theta^* - c(1-t)(1-\alpha)g} < 0$$

$$\frac{\partial \overline{\pi}}{\partial g} = \frac{(1-t)(1-\alpha)\gamma V + U \cdot c(1-t)(1-\alpha)}{[\overline{Q}_A \theta^* - c(1-t)(1-\alpha)g]^2}$$

$$= \frac{(1-t)(1-\alpha)}{V^2}(\gamma V + cU) > 0$$

Where

$$U = (1-t)(1-\alpha)\gamma g + \gamma\{[1-\alpha(1-t)]s - t\}\overline{Q}_A \theta^*$$

$$V = [\eta \overline{Q}_A \theta^* - c(1-t)(1-\alpha)g]$$

$$\frac{\partial \overline{\pi}}{\partial s} = \frac{\{[V(1-t)(1-\alpha)/(1-s)] + \{U[(1-\alpha c) + s(1-\alpha c)(1-s)]\}\}\overline{Q}_A \theta^*}{V^2} > 0$$

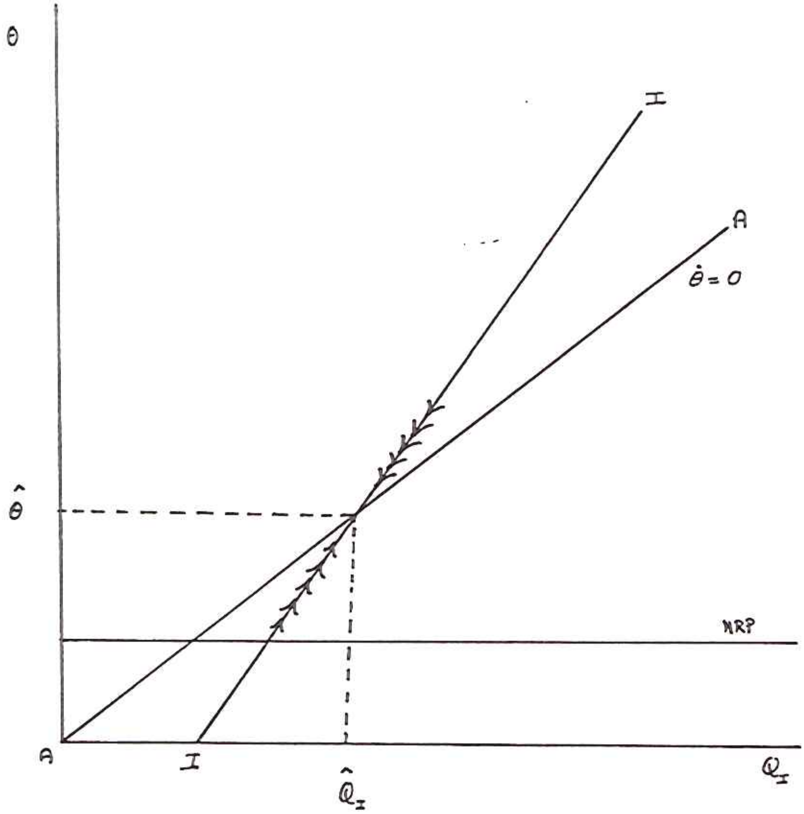

Figure 1. Equilibrium Relative Price Without Asset Effects.

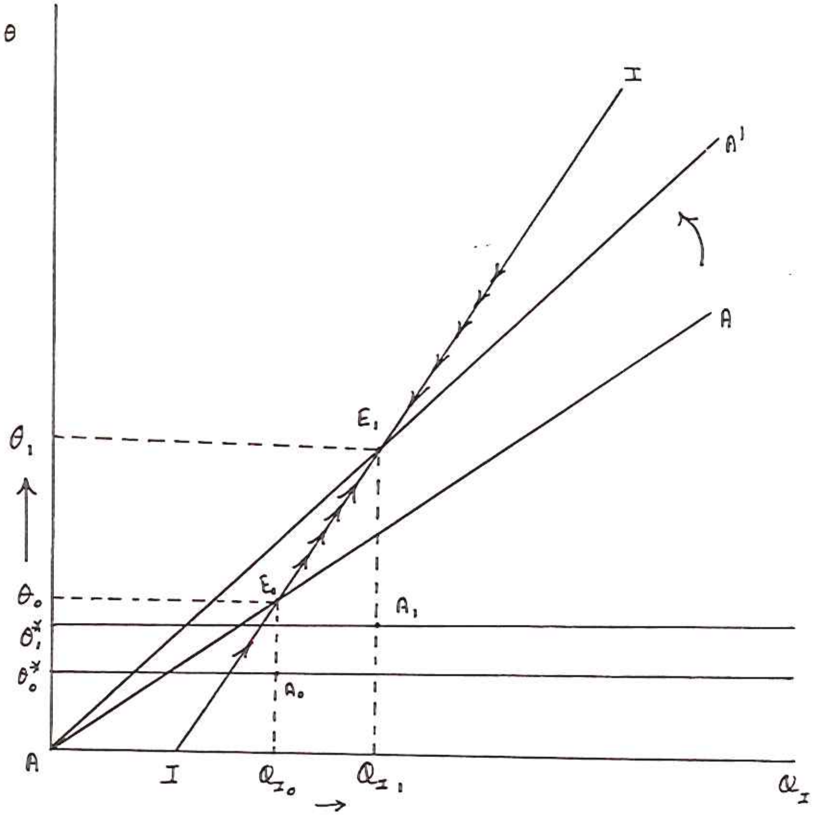

Figure 2. Effects of an Increase in Subsidy in a Model Without Asset Effects.

Note: Initial "inflation gap" A_oE_o, ultimate "inflation gap" A_1E_1.

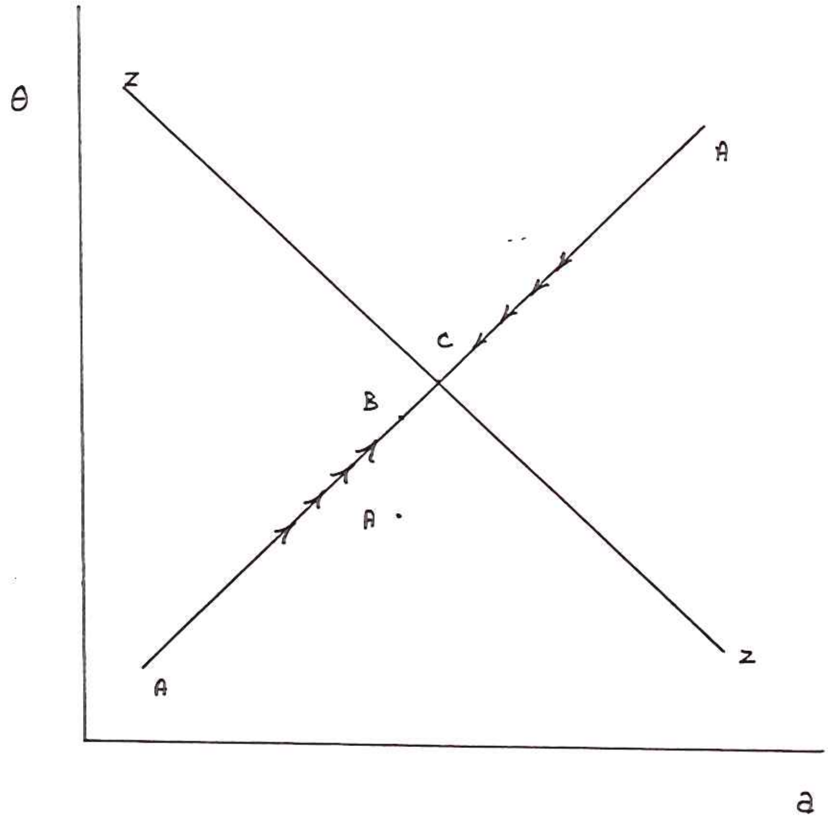

Figure 3. Long Run Equilibrium With Asset Effects.

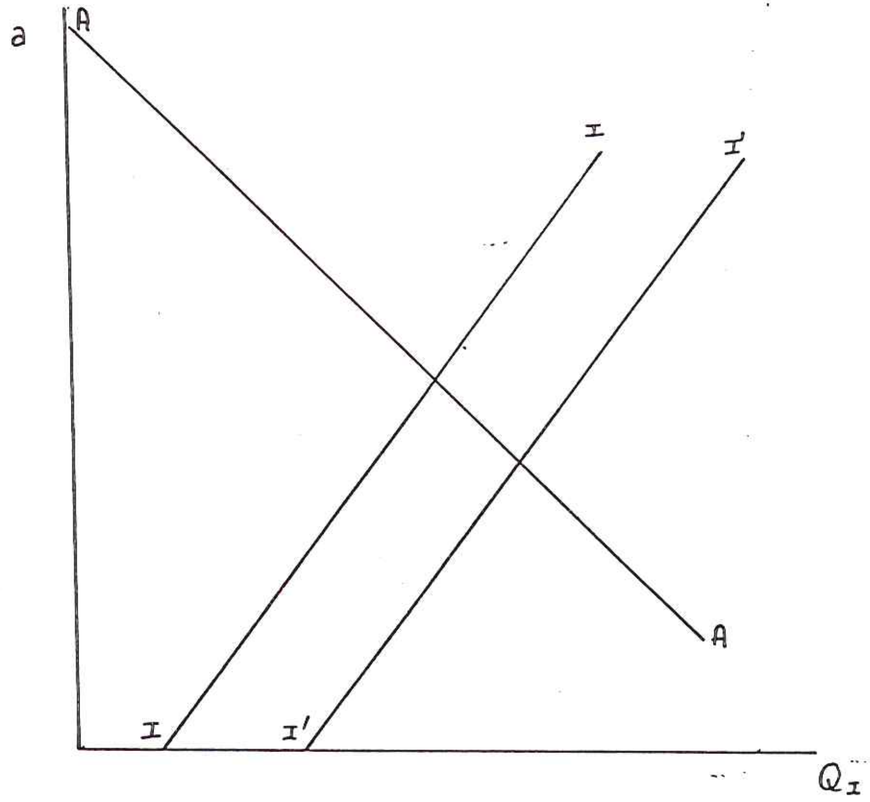

Figure 4. Effect of an Increase in Government Spending in a Model with Instantaneous Wage Adjustment.

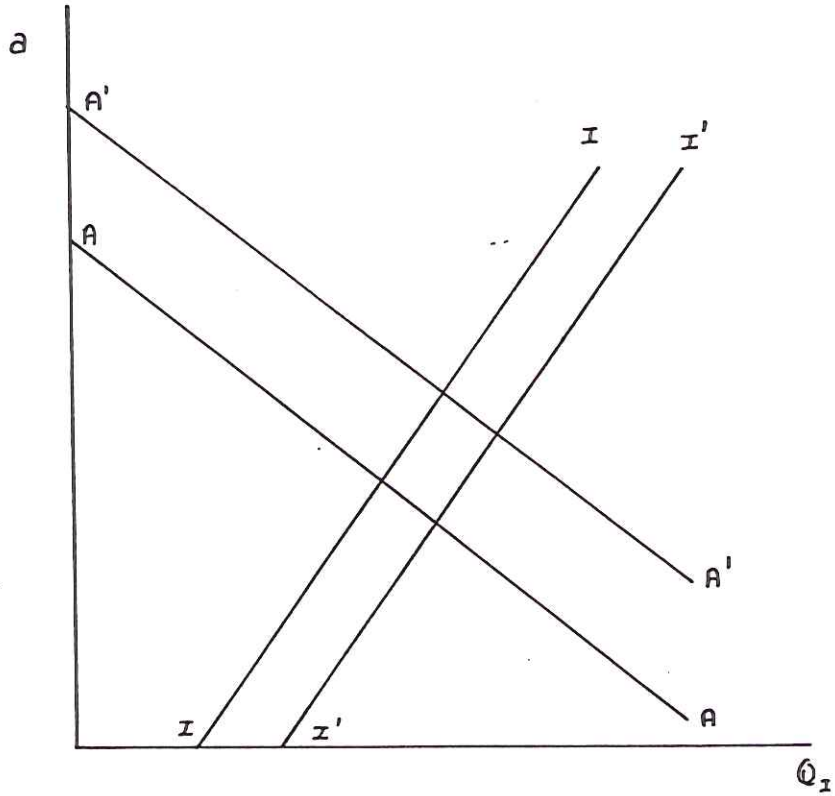

Figure 5. Effects of an Increase in Agricultural Output in a Model with Instantaneous Wage Adjustment.

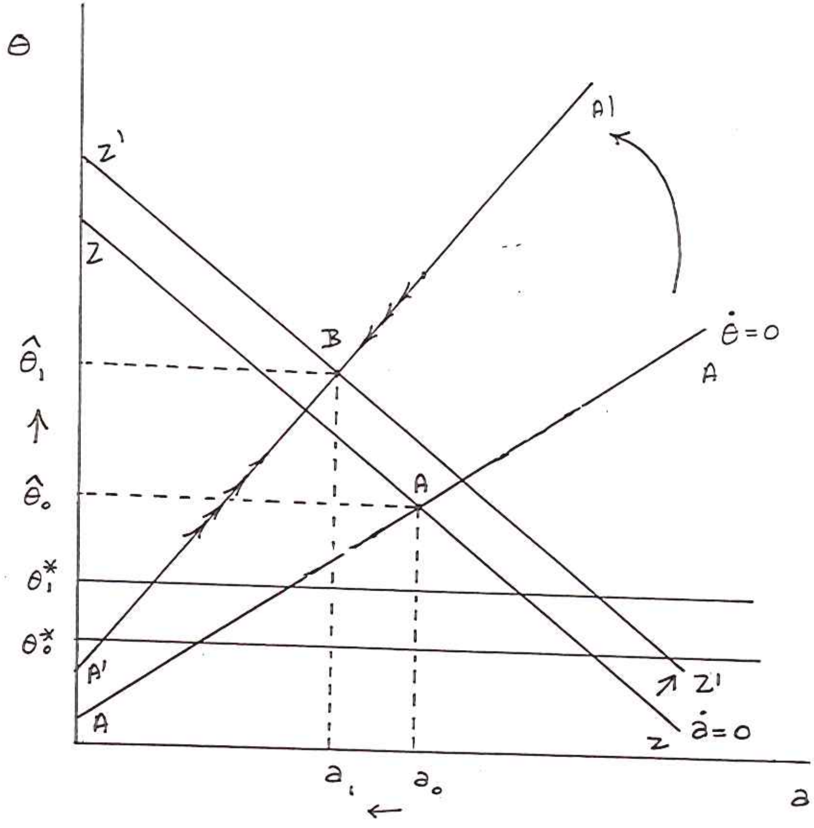

Figure 6. Effect of an Increase in Subsidy with Instantaneous Adjustment of Real Exchange Rate.

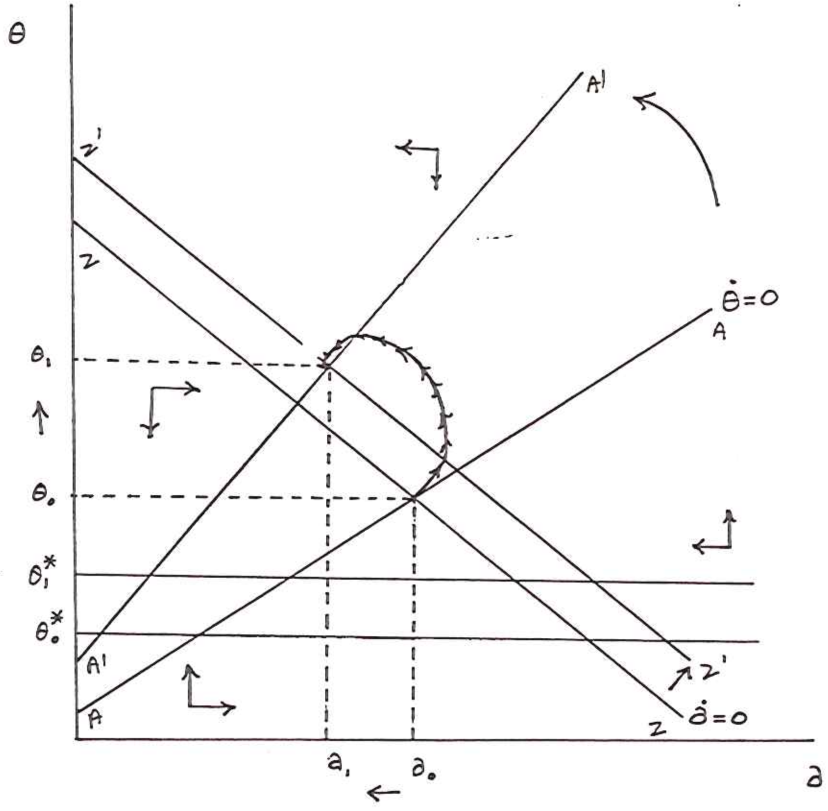

Figure 7. Effect of an Increase in Subsidy with Slow Adjustment of Real Exchange Rate.