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I

In a recent article[1] Professor Raj offered an explanatory hypothesis concerning price behaviour in India and tested it against data for the period 1949-66. This note is intended to draw out the logical implications of this hypothesis and subject it to critical examination. Since it was claimed that the explanation "follows up to a point the lines of the Keynesian multiplier analysis",[2] I shall first set out the main features of the Keynesian analysis and compare this with the approach of Professor Raj. Having examined the logic of his approach I then go on to carry out an alternative econometric test of the hypothesis using his data.

II

Let

C = Private consumption
G = Government consumption
I = Investment
K = Stock of capital
M = Imports
N = Employment of labour
P = Index of current prices
S = Savings
T = Direct taxes
w = Index of current money wages
X = Exports
Y = National income
a_1, a_2, a_3 = constants

1. K. N. Raj, "Price Behaviour in India, 1949-66: An Explanatory Hypothesis," *Indian Economic Review*, I (New Series), No. 2, October 1966, 56-78.
2. *Op. cit.*, p. 57.

With the preceding notation we can set up the following simple Keynesian model:

MODEL I

$$Y = C + I^* + G^* + X^* - M \tag{1.1}$$

$$S + T = Y - C \tag{1.2}$$

$$C = a_1 + c(Y-T) \tag{1.3}$$

$$T = a_2 + tY \tag{1.4}$$

$$M = a_3 + mY \tag{1.5}$$

$$Y = Y(N, K^*) \tag{1.6}$$

$$P = P(w^*, Y_N) \qquad Y_N = dY/dN. \tag{1.7}$$

All variables, with the exception of the index numbers w and P, are measured in terms of a composite commodity at the prices of some base period. Asterisks denote exogenous variables; the remaining variables are to be determined by the model. The features of this process of determination are well known. Labour and capital inputs are assumed to be in excess supply and output is variable up to the point of full employment. Given the level of autonomous expenditures I^*, G^* and X^* and the consumption, import demand and tax functions, income is determined by means of the multiplier so as to satisfy

$$Y = \frac{1}{1-c-ct+m}(a_1-ca_2-a_3+I^*+G^*+X^*),$$

from which we derive the multiplier as

$$k_1 = \frac{1}{1-c-ct+m}.$$

The production function (1.6) then gives the level of employment and the price level is determined, in accordance with (1.7), as a function of the money wage rate and the marginal product of labour.

Let us now try to develop Raj's model and contrast it with the foregoing. Since the model is not explicitly formulated in the cited work we must rely on the author's description of his approach to the empirical analysis of price behaviour.[3] On this basis the following set of relations can be constructed:

MODEL II

$$Y_d' = C' + I' + G' + X' \tag{2.1}$$

$$S' + T' = PY - C' \tag{2.2}$$

$$C' = f(PY, T') = P \cdot f(Y, T'/P), \tag{2.3}$$

$$T'/P = a_2 + tY \tag{2.4}$$

$$M = M^* \tag{2.5}$$

$$Y = Y^* \tag{2.6}$$

$$Y_s = Y + M \tag{2.7}$$

$$Y_d' = PY_s \tag{2.8}$$

where the new variables are

Y_d = Aggregate demand,

Y_s = Aggregate supply.

The symbol $'$ indicates variables measured in current prices. The consumption function (2.3) can be written in either of the two forms because of the standard neo-classical assumption that money expenditure on consumption is homogeneous of degree one in money income and prices (thereby implying absence of "money illusion")[4]. Adopting a linear specification we get

$$C'/P = a_1 + c(Y - T'/P). \tag{2.3a}$$

National product and imports in real terms, hence aggregate supply, are determined exogenously. So also are real autonomous expenditures, that is I'/P, G'/P and X'/P. With national income given by (2.6) and

3. Any misrepresentation involved in my formulation is of course unintentional.

4. Cf. Raj, *Op. cit.*, p. 63 : " . . . the price elasticity of total consumption expenditure is unity and . . . therefore changes in the price level from year to year do not make any difference to the assumed marginal propensity to consume. . . ."

taxes by (2.4), real consumption is determined from (2.3*a*). Aggregate demand is thus fully determined. As a condition of equilibrium of the system it is required, *vide* (2.8), that aggregate demand equal aggregate supply. How does this come about?

The question can be posed with the aid of Figure 1 which also serves to illustrate the solution provided by the previous model. Expenditures

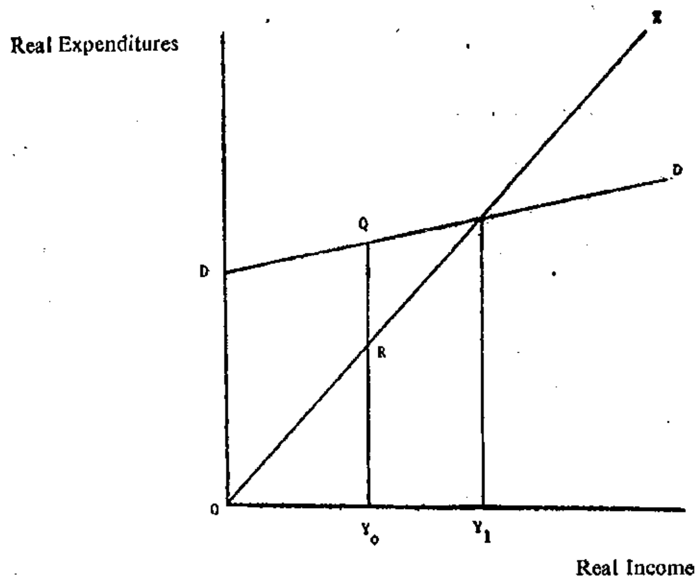

Fig. 1.

(or demand) in real terms are measured on the vertical axis and real income (or supply) on the horizontal. Both are equal on the 45° line OX. Both models assume an aggregate demand schedule such as DD. In Model I, with income initially at Y_0, there is excess demand to the extent of QR corresponding to current dissaving and/or a budget deficit. As a result income rises through the multiplier process which continues until savings plus taxes are sufficient to cover autonomous expenditures. This situation occurs at the income level Y_1 which is therefore the equilibrium level.

Now, let Y_0 correspond to an exogenously determined level of aggregate supply as in Model II. Aggregate demand is then given by Q and excess demand of QR exists. What is the behavioural mechanism by which, in this case, demand and supply are brought into equilibrium?

Raj's solution rests on the basic proposition that "the general price level adjusts itself to the extent required to clear the market each year."[5] I shall try to indicate below what this might mean.

Before going further into the implications of this solution, however, it is necessary to clear up one point concerning the role of the multiplier in Model II. Substituting into the equilibrium condition (2.8) we get the national income identity

$$Y = \frac{C'}{P} + \frac{I'}{P} + \frac{G'}{P} + \frac{X'}{P} - M,$$

which is equivalent to (1.1) of the previous model. Further manipulation yields

$$Y = \frac{1}{1-c-ct}\left(a_1 - ca_2 + \frac{I'}{P} + \frac{G'}{P} + \frac{X'}{P} - M\right)$$

and the multiplier is then

$$k_2 = \frac{1}{1-c-ct}.$$

It can be easily checked that $k_2 > k_1$ if $m > 0$. The role of the multiplier in this case is, however, quite different from that in Model I. What we obtain with the aid of k_2 is the level of autonomous expenditures consistent, *in equilibrium*, with a predetermined level of real national income and imports. In other words, the multiplier determines what autonomous expenditures must be for equilibrium to exist between aggregate demand and supply.[6] What determines aggregate demand *ex ante* is then a separate matter. If the model accurately characterizes Professor Raj's analytical framework, it follows that the multiplier cannot be used, as he uses it, to determine aggregate demand.[7]

5. *Op. cit.*, p. 57.
6. This result has obvious implications for formulations of policy in this setting of a planned economy. Knowing supply in any given year and the *ex ante* demand functions, the planners can predict excess demand and accordingly determine policy as to taxation, money supply, etc.
7. Solving model II for the level of aggregate demand we get

$$\frac{Y'_d}{P} = a_1 - ca_2 + (c-ct)Y^* + \frac{I'}{P} + \frac{G'}{P} + \frac{X'}{P}$$

Thus, aggregate demand is uniquely determined by the level of autonomous expenditures, the exogenously determined level of national income and the parameters of the consumption and tax functions.

Given the level of real income and the level of autonomous expenditurers *in money terms*, the multiplier can be made to determine the level of prices and money income. But this would require money illusion which is specifically excluded from the model. The multiplier comes back into its own if it is assumed that the aggregate demand schedule is less than the predetermined level of supply. The multiplier then determines an appropriate equilibrium level of income which will be less than available supply as in the Keynesian underemployment model. But the mechanism of adjustment here works through the level of income and not the level of prices. Such a situation cannot be ruled out in an underdeveloped economy and may result, for instance, from fluctuations in export earnings.

It can be seen that the approach of model II represents a complete reversal of the Kahn-Keynes multiplier which is transformed from an active determinant of the level of income to a passive factor in the adjustment process. The essence of the Keynesian approach is the proposition that demand determines income and income determines demand, the link between the two being the multiplier[8] Model II, however, suggests that demand and income can be discussed in isolation from each other and so the role of the multiplier changes.

This result is of course a logical consequence of the assumption that short-run aggregate supply is exogenously determined. This assumption in turn has to be evaluated in terms of its relevance to the particular context of the Indian economy. As to this, there is no denying the relevance of such an assumption to a particular sector like agriculture. In addition, with imports restricted by balance of payments considerations, it seems likely that shortage of raw materials and spare parts would limit output of the manufacturing sector. The assumption therefore seems a fairly reasonable one as the starting point for an analysis

8. In Kalecki's analysis this proposition became: "The workers spend what they get; the capitalists get what they spend" which gives recognition to the separate role of different classes in the functioning of the system. Cf. M. Kalecki, *Studies in the Theory of Business Cycles, 1933-1939*, Blackwell, 1966. An asymmetry in the Keynesian system should be noted in that demand and the multiplier mechanism determine the level of income up to full employment but not at full employment. As to the nature of the adjustment process when there is full employment, Keynes himself did not have much to say. It was left to Keynes' followers at Cambridge to work out a solution in terms of the behaviour of prices, wages and the distribution of income. See Joan Robinson, *The Accumulation of Capital*, Illinois: Irwin, 1956; N. Kaldor, "Alternative Theories of Distribution," *Review of Economic Studies*, 1955-56, 83-100; L. Pasinetti, "Rate of Profit and Income Distribution in Relation to the Rate of Economic Growth," *Review of Economic Studies*, October 1962, 267-79.

of income and price determination in such an economy.[9]

It was pointed out above that variations in the general price level constitute the mechanism of equilibrium adjustment in Raj's approach. If excess supply or demand exists, prices are assumed to vary until equilibrium is achieved. In order to make Model II consistent with this approach we need to specify a relation between the price level and one or more components of aggregate demand. Unfortunately Raj's analysis does not take us beyond this point. As mentioned before, money illusion is clearly ruled out so far as private consumption spending is concerned. There are, however, a number of possible ways of solving the problem.

The first is to introduce a mechanism of adjustment of money wages to prices such that changes in prices alter the distribution of income between wages and profits. With different propensities to consume out of wage and profit income, private consumption will therefore adjust.[10] Since the aggregate consumption function will then depend on the distribution of income, the notion of a stable multiplier would have to undergo a corresponding change. Introduction of wealth effects on consumption would have similar consequences. Another solution is to make investment depend on credit conditions in the money market so that, as prices and money income change, changes in the demand for transactions balances lead to a change in credit conditions, hence in investment demand. Again, export demand could be made to depend on the domestic price level relative to international prices. Finally, the possibility of government expenditure being fixed in money terms—a sort of money illusion—could be introduced.

III

Whatever may be the mechanisms of adjustment in the model, a rigorous test of the underlying hypothesis requires exact specification of the relevant functional relations through which the price level affects components of aggregate demand. In the absence of such specification we have to resort to simpler methods and so the following procedure is suggested.[11] The basic hypothesis is that real aggregate demand is in

9. I have tried to develop a disaggregated general equilibrium model starting from similar assumptions in my paper, "Income, Prices and the Balance of Payments in the Indian Economy: An Analytical Framework," Working Paper No. 46, Delhi School of Economics, July 1968.
10. Compare the post-Keynesian models mentioned in footnote 8 above.
11. Needless to say, simple procedure may also be an imperative because of data limitations.

some sense a function of the price level. Accordingly we can write, instead of (2.8),

$$\hat{Y}_d(P) = Y_s \tag{2.8a}$$

where $\hat{Y}_d = Y_d'/P$. This condition determines the price level and the model is thereby closed. We now set up the following simple version of the model:

$$(i) \qquad \hat{Y}_d = A.P^b \qquad b < 0$$

$$(ii) \qquad Y_s = \bar{Y}_s$$

$$(iii) \qquad \hat{Y}_d = Y_s.$$

Aggregate demand is taken to be a linear function of the price level and aggregate supply is *ex hypothesi*, exogenously determined. Solving this system for P we get the reduced form equation

$$\log P = \frac{1}{b} (\log \bar{Y}_s - \log A)$$

which is to be statistically estimated. Note that this formulation has the advantage that it does not require direct observation of *ex ante* demand, thereby freeing us from the complicated calculations involved in Raj's approach. At the same time, we are able to obtain an indirect estimate of the slope coefficient of the demand function, a parameter which is of some interest.

The equation was estimated from Raj's data[12] using least squares regression methods.[13] The result was

$$\underset{}{\log P = \underset{(0.1185)}{0.8363} \log Y_s + 4.9410} \qquad \bar{R}^2 = 0.753$$

which gives a regression coefficient of the wrong sign despite a high (adjusted) coefficient of determination. In order to reduce the effect of

12. Observations on P are obtainable fram Table 4, column 13, of the cited paper and those on Y_s from column 7 using column 2 to reconvert the figures to 1948-49 prices.

13. The regressions reported here were run on the computer of the Delhi School of Economics using a program prepared by Dr. K. L. Krishna. I am grateful to Dr. Krishna for making the program available to me and supervising its operation as well as to the Director of the Computer Centre for allowing use of the computer.

common trends in both variables and thereby obtain a possibly better estimate of the true short-run relationship, the previous year's price level was added to the equation. This yielded

$$\log P = 0.2809 \log Y_t + 0.8189 \log P_{t-1} + 0.5915$$
$$(0.1603) \qquad (0.2020)$$
$$\overline{R}^2 = 0.878$$

The fit of the equation improves but the magnitude and statistical significance of the coefficient of the supply variable decline considerably and its sign remains positive.

As to the validity of the hypothesis we are concerned with, the preceding test has to be regarded as inconclusive. Not much should in any case be expected from a simple (possibly simplistic) representation of what must be rather complex economic relations. In order to get at the form of these relations we have to dig deeper into the structure and behaviour of the economic system. One necessary step in this direction involves disaggregation and this leads us to a consideration of Raj's sub-model of the foodgrains sector of the Indian economy.

An explicit formulation of this model is as follows :

$$D_f = g(Y_n, P_f) = B \cdot Y_n^d \cdot P_f^e \qquad \begin{matrix} d > 0 \\ e < 0 \end{matrix} \tag{3.1}$$

$$S_f = \overline{S}_f \tag{3.2}$$

$$D_f = S_f \tag{3.3}$$

where

D_f = Per capita demand for foodgrains

S_f = Per capita availability of foodgrains

Y_n = Per capita income

P_f = Relative price of foodgrains

B, d, e = constants

Solving for P_f gives

$$\log P_f = \frac{1}{e} (\log S_f - d \log Y_n - \log B)$$

Using Raj's data to estimate this equation gave the result

$$\log P_f = -\ 1.6541 \log S_f + 0.8314 \log Y_n + 12.4512$$
$$(0.4714) \qquad\qquad (0.4700)$$
$$\bar{R}^2 = 0.466$$

The fit is rather poor but the coefficients have the right sign although the coefficient of the income variable is not very significant. The demand elasticities can be readily calculated from the estimated coefficients. They are

$$d = 0.5204$$
$$e = -\ 0.6046$$

The income elasticity d is very close to Raj's assumed value of 0.45 and the price elasticity e is equal to the lower of the two values used by him.

The poor fit of this equation could be explained by a possible mis-specification of the demand and supply relations. In the Indian context one needs to distinguish between the urban demand for foodgrains and the demand of rural producers, the latter being also a determinant of the marketable surplus on the supply side. The role of government buffer stocks as well as direct controls on foodgrains prices also need to be taken into account. Finally, there is likely to be a degree of multi-collinearity since, as Raj points out, "... the official national income series (from which the per capita estimates are derived) is based on the ... official estimates of foodgrain production. ..."[14]

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14. *Op. cit.*, p. 74, footnote 20.