ESSAYS ON GROWTH AND INCOME DISTRIBUTION

IN AN UNDERDEVELOPED ECONOMY

by

AMITAVA KRISHNA DUTT

B.A., University of Calcutta
(1975)

M.A., University of Calcutta
(1977)

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Signature redacted

Signature of Author _____
Department of Economics
August 19, 1982

Signature redacted

Certified by _____
Lance Taylor
Thesis Supervisor

Signature redacted

Accepted by _____
Richard S. Eckaus
Chairman, Department of Economics Committee

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ABSTRACT

The essays contained in this thesis are concerned with some aspects of the problems of growth and income distribution in an underdeveloped economy. They develop models in the structuralist tradition to analyze some problems which are relevant for the Indian economy, although the models may be applicable to other underdeveloped economies with characteristics similar to those of the Indian economy.

The first essay develops a model to examine whether it is possible to explain stagnation in an economy with an oligopolistic market structure and an excess capacity of capital by the argument that the inequality in the distribution of income narrows markets and dampens incentives for investment. The model suggests that there exists a positive relation between growth and income distribution for such an economy and discusses the nature of fiscal and other types of policies which can help to end stagnation.

While the first essay completely ignores the agricultural sector, the second essay develops formal models of agriculture-industry interaction to examine the macroeconomic implications of the empirically important phenomenon of food speculation in an economy such as the Indian one. It shows that the failure to incorporate the phenomenon in the models may imply that very important effects of changes in agricultural conditions may be incorrectly predicted, and that increased speculation in foodgrains is likely to result in adverse consequences for both the growth prospects and the distribution of income.

The third and final essay focusses on the determination of income distribution within an agrarian economy in which both rich capitalist farmers and poor subsistence farmers rent in land from landlords. A model of the agrarian economy is developed to shed light on questions such as the growth and income distributional consequences of different kinds of institutional and technological changes which may occur in the economy, the possibilities of the growth of capitalism, and the implications for the agricultural sector of an underdeveloped economy of industrial expansion.

Thesis Supervisor: Dr. Lance J. Taylor

Title: Professor of Nutritional Economics

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to my parents

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Essay 1

STAGNATION, INCOME DISTRIBUTION AND MONOPOLY POWER

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1.INTRODUCTION

The retardation of the rate of industrial growth in the Indian economy since the middle of the sixties has justifiably received a great deal of attention from economists concerned with India's economic development. What was initially looked upon by some as a temporary downward deviation from trend has now come to be generally accepted as long run stagnation. This sluggishness in industrial growth, persisting now for over fifteen years, has been subject to a great deal of more or less systematic analysis.

Several explanations of this industrial stagnation have by now been put forward. Some, like Bhagwati and Desai (1970) and Bhagwati and Srinivasan (1975) have put the blame on industrial policies pursued by the government in the form of bureaucratic systems of licensing, restrictions and controls resulting in inefficiencies and a mal-allocation of resources, which have obstructed growth. These arguments, however, have been stated in essentially static terms. Other analysts, including Chakravarty (1974), Raj (1976) and Vaidyanathan (1977) have focussed on the sluggishness in agricultural growth, which is alleged to have held back industrial growth by limiting the supply of wage goods and raw materials, and the market for industrial output. Given that the growth rate of Indian agriculture, after the first honeymoon with the Green Revolution, has been very low (except for a few lucky years), there is probably much truth in these arguments. A

third approach has been to put the blame on a slackening of investment demand due to lower public investment. Such a view, reflected, for example, in Srinivasan and Narayana (1977), seems to be somewhat simplistic in so far as it does not explain why public investment fell, or why its fall restrained industrial growth. Finally, there has been the view put forward in Bagchi (1970, 1975, 1982), in parts of Mitra (1977) and in Nayyar (1978) that has stressed the importance of income distribution and the demand factor: inequality in income distribution is seen as resulting in a limited demand for industrial goods,reducing incentives for investment and therefore reducing growth. This view seems to suggest a positive relation between growth and economic equality which is opposed to the generally accepted idea, coming from the Cambridge growth models, that higher growth requires greater inequality.

Our purpose in this paper is to examine the last explanation by considering the interaction between growth and income distribution in an underdeveloped economy with the help of a simple macroeconomic model. The model used will be a stylization of the Indian economy, so that we will be able to use the model to assess the argument that the stagnation in the Indian economy could have been caused by an unequal distribution of income. We ought to point out that we are not arguing in this paper that the income distributional constraint is the binding constraint on Indian industrial growth. We are trying to examine the internal consistency of the argument that a bad income distribution could explain stagnation, and to show that

in the Indian context, and in other similar contexts, the argument can be put forward in explaining stagnation.

Our argument is first presented with a highly simplified schematization of the Indian economy, which we shall call the basic model. Since the model is an oversimplified formalization of Indian reality, it is best to be clear at the outset what aspects of the Indian economy we have incorporated in the model, and what significant elements we have chosen to exclude. The economy we describe first, in the basic model, produces only one good, a manufactured industrial good, in an oligopolisitic market environment characterized by an excess capacity of capital. The economy is characterized by a deeply dual, class-ridden socio-economic structure, which makes it meaningful to divide the economic agents in the economy into two groups - workers and capitalists - with different behaviour patterns and economic roles. This basic model abstracts from any consideration of government activity, or from any relations the economy may be having with the rest of the world. We later modify our basic model to consider these complications one by one to see how our arguments must be modified to take them into account. The model also abstracts entirely from any consideration of an agricultural sector, which may seem somewhat of an embarassment, given the overwhelming importance of that sector in the Indian economy. Actually we are ignoring that sector not because we believe that the sector is unimportant, but because we are interested in the possibility that the income distributional constraint could be a constraint on growth in India, even if

the agricultural constraint, if it exists, could be miraculously removed. Thus we assume away the agricultural constraint by assuming away the very existence of the agricultural sector. (In any case the second essay explores some of the issues raised by the existence of this sector.)

The rest of this paper proceeds as follows. In section 2 we examine the equational structure of the basic model, justifying, where necessary, the nature of our assumptions. In section 3 we examine how equilibrium is determined in the model at a point in time. In section 4, some comparative statics properties of the model are examined, and in section 5, the most important of the comparative statics properties of the model from our perspective - the relation between growth and income distribution, is taken up for further scrutiny. In section 6 we examine how the economy portrayed in the basic model moves through time, examine some facts about the Indian economy to see how its behaviour resembles the behaviour of the economy modelled, and address some policy questions. In section 7 we explicitly consider some government fiscal activity in the basic model, to examine the implications of redistributive fiscal policies. In section 8 we introduce some open economy considerations into the basic model to see how our arguments have to be modified when we allow the economy to trade with the rest of the world. Our conclusions are presented in section 9.

2.THE EQUATIONAL STRUCTURE OF THE BASIC MODEL

In this section we set out the equational structure of the basic model of a closed economy producing one good. We shall assume throughout that we can ignore the money and other asset markets, the interest rate being pegged by the monetary authorities.[1]

2.1 PRODUCTION CONDITIONS

As already mentioned above, only one commodity is produced in the economy, with two factors of production, homogeneous labour and homogeneous capital, the latter being physically identical with the produced commodity. We assume a simple Leontief production function exhibiting constant returns to scale and fixed coefficients of production. This is essentially a simplifying assumption, and our results would not be fundamentally altered if we allowed for some substitution.[2] Moreover, the assumption could be looked upon as a rough approximation to the observed technological rigidities in

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[1] This is a simplifying assumption which can be relaxed without much change in our conclusions.

[2] See Taylor (1982a).

factor substitution, or reflecting that for some reason techniques are chosen at least in underdeveloped countries independently of factor prices.[3] We may therefore write the production function as

$$(1) \qquad Q = \min (K/a_K, L/a_1)$$

where Q denotes the level of output, K the stock of capital, L the amount of labour, and a_K and a_1 are constant technological parameters, denoting, respectively, the capital-output, and labour-output ratios.

2.2 FACTOR SUPPLIES

2.21 LABOUR

It is assumed that there exists a reservoir of labour, either in the form of a reserve army of the unemployed, or as employed in a subsistence sector having no other interaction with the industrial sector we are describing.

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[3] See Eckaus (1955). Hawrylyshyn (1978) has a comprehensive survey of reasons which could result in biased technological choices in less developed economies.

Labour is available from this reservoir in perfectly elastic supply at any real wage higher than some subsistence level a la Lewis (1954). We assume that the money wage is fixed, either through wage bargains, as a minimum wage imposed by the government, or by some other means, and that it is set above the level ensuring a subsistence consumption at all price levels subsequently considered in this paper, since otherwise labour would not be available to the industrial sector. The assumption that the money wage is fixed is a simplifying assumption, and is not crucial to our analysis. What is crucial is the assumption that the money wage reacts only with a lag to changes in the cost of living. We can easily relax the assumption regarding the fixity of the money wage and let it adjust slowly to changes in the price level, but this would add nothing to our analysis except a story of inflation, as we shall see below.

The assumption that the money wage lags behind changes in the cost of living in India has some basis in facts. Bagchi (1975), among others, has produced evidence to show that the real wage has not increased, but probably fallen, in India, in recent years. Ahluwalia's (1979) regressions show that the money wage does react to cost of living changes as measured by the price of foodgrains, but that this adjustment is slow and incomplete.

The implication of all this is that the employment of labour in our model will be determined only by the demand for it. From the production function, we therefore get

(2) $L = a_1 Q$

2.22 CAPITAL

Capital is the result of past investment, so that at a given point in time, we can take the available stock of capital to be given. Since we shall later assume that excess capacity exists in the economy, we cannot write that $K = a_K Q$. Instead, the production function implies that

(3) $K \geq a_K Q$

The level of Q at which the equality holds can be called the full capacity level of output.

2.3 MARKUP PRICING

We shall assume that in the economy being considered, oligopolistic producers set the price level, p, by applying a markup on unit prime costs.

Since in this model labour is the only factor entering into prime costs, unit prime costs are given by $w\,a_1$ so that

$$p = (1 + \tau)\, wa_1 \tag{4}$$

where w is the fixed level of the money wage and τ is the markup rate which firms apply. This kind of pricing equation has been quite extensively used in the economic development literature.[4] τ is assumed to be a given constant at a point in time, and reflects, along the lines suggested by Kalecki (1971), the degree of monopoly power.[5]

This pricing equation allows us to define the rate of profit in a simple way. Multipliying through equation (4) by Q we get, upon using equation (2),

$$p\,Q = w\,L + \tau\, w\, a_1 Q$$

---

[4] Since it was first used by Hall and Hitch (1939), the markup pricing rule has had a distinguished career in economics. It was analyzed by both Bain and Sylos-Labini in the fifties. Its relation to the degree of monopoly power has been studied by Kalecki in an early paper reprinted in Kalecki (1971). Recent use of the markup pricing rule in the development literature has been made in Lara-Resende (1979), Taylor (1979), and in Taylor (1982a), among others.

[5] See also below, in section 6. We are assuming that markup rates are given at a point in time, but can change through time, albeit sluggishly. In section 6 we shall analyze the determinants of changes in the markup rate.

which shows clearly that the value of output is equal to the sum of the earnings of labour, w L, and the earnings of capitalists or owners of capital, τ w b Q. The rate of profit, or profits per unit of capital, can then be defined as

$$r = (\tau w a_1 Q)/(p K) \tag{5}$$

This markup pricing equation has two underlying assumptions behind it. First, there is the assumption of an oligopolistic market structure, for, without such imperfections in competition, we could not have assumed that producers set prices in the above way. Second, there is the assumption of excess capacity in manufacturing industry. As argued in Kalecki (1971) such conditions makes it likely that producers will wish to set prices as a markup over prime costs, ignoring capital costs. Given the importance of these two assumptions in the model, we examine whether these assumptions are fulfilled in India.

Consider first the evidence on the market structure of Indian manufacturing industries. The evidence is available at both the industry level and at the aggregative level from the reports of the various enquiry commissions set up to study the problem of economic concentration in India, including the works of Hazari (1966), Monopolies Enquiry Commission (1965) (henceforth MEC) and the Industrial Licensing Policy Inquiry Committee (1969)

(henceforth ILPIC). As regards the extent of market concentration in particular industries, the MEC found that "in a large number of industries a single undertaking is the only supplier or at least has to its credit a very large proportion of the market compared to its competitors". Of the 1298 products covered by it, 437 had only one firm in each case. There were duopolies in 229. It was also found that in almost 90 per cent of the products, there were ten or less firms in each product. Except for the industrial groups covering food products and cotton and jute textiles, the textbook categories of monopoly and oligopoly were in evidence throughout Indian industry. Evidence reported by the ILPIC, and reproduced in Table 1 also confirm this conclusion. The table shows the high incidence of oligopolistic market structure in a large number of markets, which contributed to a large percent of total manufactured industrial production for India. We have been warned, by Chaudhuri (1975), for example, that one should not take the figures presented at face value, since in some cases single products have been unnecessarily broken up into many, and since the evidence relates only to large scale industry. Despite this warning, the preponderence of oligopoly in Indian industry seems to be an established fact. This high degree of concentration in particular markets has resulted in a very large degree of aggregate concentration in Indian industry, which, given the fact that big business houses have interests in various product groups, in some of which market concentration data would not suggest high concentration, would imply significant imperfections in the many more industries than shows up in the data presented above. The MEC reported that in 1964, 75 business groups and houses accounted for 47 per

cent of the total assets and 44 per cent of the total paid-up capital of all non-government, non-banking companies. The ILPIC also confirmed this high degree of aggregate concentration. As Hazari (1967) has pointed out, by ignoring the role of intercorporate investment, the above estimates give a downward bias to the extent of aggregate concentration.

Turning now to the question of excess capacity, the estimates of the extent of excess capacity in Indian industry vary a great deal, and given that the conceptual and statistical bases of the estimates are not precise enough, it is not clear how much reliance can be placed on them. Yet it is worth the while to take a look at some of the estimates.

The United States Agency for International Development (USAID) made some estimates for the year 1965 and concluded that the net output of large scale enterprises could be increased with already installed capacity (as of 1964) by over 75 per cent in the case of engineering industries and by about 15 per cent in the chemical industries, if an additional shift was introduced in operation and necessary imports provided for.[6] The National Council of Applied Economic Research (1966) has published its estimates for the period 1961-64, and it concluded that the increase in output that could be realized under what was described as 'desirable working conditions' was a little over 30 per cent in engineering industries and over 50 per cent in chemical industries. Using these estimates Raj (1976)

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[6] See Pfoutz and Spangler (1965).

Table 1. Market Concentration in Selected Industries, 1969

Name of Group	Total Number of Products	Number of Products where Top Four Firms Control 100% of output	Number of Products where Top Four Firms Control over 75%
Automobile and allied industries	102	96 (94)	101 (99)
Drugs and pharmaceuticals	97	90 (93)	96 (99)
Insecticides, plastics and plastic chemicals	114	105 (92)	113 (99)
Alkalis and allied chemicals	20	18 (90)	18 (90)
Acids, fertilizers and other chemicals	132	116 (88)	130 (98)
Cellulose and timber	17	14 (82)	15 (88)
Tools	66	54 (82)	65 (98)
Light mechanical engineering	93	74 (80)	89 (96)
Instruments	19	15 (79)	19(100)
Industrial machinery	71	54 (76)	70 (99)
Dyes, explosives, coke byproducts and distillation products	42	31 (74)	42(100)
Alcohol and organic chemicals	27	20 (74)	25 (93)
Metallurgical industries	71	50 (70)	67 (94)
Rubber manufacturers	75	50 (67)	74 (99)
Oil, soaps, paint and feed	95	61 (64)	88 (93)
Mineral industries	52	29 (56)	43 (83)
Heavy chemical engineering	15	7 (47)	13 (87)
Electrical engineering	39	17 (44)	33 (85)
Leather manufacture	9	4 (44)	8 (87)
Paper industries	14	5 (36)	11 (78)

Source: Mundle (1981). Figures in parenthesis give percentages of corresponding totals of number of products.

estimated that the possible increase in net output of large scale manufacturing industries as a whole under 'desirable working conditions' was about 30 per cent. Finally, the Reserve Bank of India has published its estimates of 'potential-utilization ratios', some of which are produced in Table 2. The figures show that the extent of underutilization of capacity was around 12 per cent in all manufacturing industries taken together in the first half of the sixties, but around 20 per cent in the second half of the sixties and the early seventies. However, 'potential production' for

Table 2. Potential-Utilization Ratios for Manufacturing Industries

Year	Machinery and Equipment Manufacturing Industries (10.51)	Basic Intermediate Goods Industries (10.02)	Other Intermediate Goods Industries (25.42)	Consumer Goods Industries (36.05)	All Manufacturing Industries (100.00)
1960	76.8	84.6	89.9	90.3	87.7
1961	80.4	89.7	88.7	91.4	88.9
1962	83.7	85.9	89.8	89.7	88.5
1963	80.5	90.5	89.3	85.7	86.7
1964	84.8	88.0	88.8	87.4	87.6
1965	84.9	86.8	89.4	88.1	87.9
1966	69.4	85.2	83.3	86.6	83.2
1967	63.5	80.8	83.2	81.9	79.8
1968	62.9	83.2	84.3	81.6	80.2
1969	61.3	87.8	79.1	85.0	80.5
1970	59.2	80.5	79.5	86.2	80.0
1971	56.9	81.0	77.0	82.6	77.4
1972	57.0	86.2	81.4	83.0	79.6
1973	61.6	82.0	80.3	79.8	

Notes: 1.The weights attached to the four major categories of manufacturing industry are given in brackets.
2.The definition of potential-utilization ratios is given in the text.
Source: Reserve Bank of India Bulletin,April 1970,March 1972,October 1973 and September 1975.

any industry is defined by the Bank to be nothing more than the maximum level attained by it either at the point of measurement or prior to it, and hence, the method of measuring excess capacity is questionable. To comment on these estimates as a whole, let us note that given that the estimation of true capacity in manufacturing industry and the unutilized part of it is beset with several conceptual and statistical problems, it is not surprising that there are such wide differences in the estimates offered. However, the estimates make it clear that there can be no doubt about the fact that Indian manufacturing industry has had substantial excess capacity.[7]

2.4 CONSUMPTION DEMAND

In line with our dualistic conception of the economy, we divide the economic agents of our economy into two groups, namely, workers earning their income from wages, and capitalists earning their income from profit. Following the traditions of Kaldor (1956) and Pasinetti (1962) we assume that the two groups have different consumption propensities. We shall make the assumption that workers spend their entire incomes on the purchase of consumption goods and do not save, while capitalists save a constant fraction, s, of their income. The assumption that workers do not save could easily be generalized to allow for some saving by workers, but that would make our analysis a trifle more complicated without adding much to our economic insight, and furthermore, have us to grapple with the kinds of problems Pasinetti (1962) pointed out in Kaldor (1956), that is, of having wage earners who save without getting any return from doing so. Given our assumptions,total consumption demand can be written as

$$(6) \qquad p\,C = w\,L + (1 - s)\,r\,p\,K$$

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[7] We shall argue in this paper that this excess capacity exists due to the insufficiency of excess demand. There have been other views on this: the USAID (1965) study suggests that the problem existed due to the non-availability of imported intermediate imports. However, see Ramaswami and Pfoutz (1965), who emphasize the role of demand. See also Ahluwalia's (1979) regression of a capacity utilization variable on intermediate input and demand variables, the former having a coefficient not significantly different from zero, and the latter - measured by the share of government investment in G.D.P. - having a positive, statistically significant coefficient.

It has been argued that the Pasinetti formulation with workers having a lower propensity to save than capitalists may be unrealistic in developed countries given various institutional devices which raise worker savings to high levels. Given that such criticisms have been made, we ought to try and justify our assumption for the Indian case by looking at saving propensities for different classes. While we want to examine the differences in saving propensities of different functional income groups for workers and capitalists, there is no unique way of dividing the population of a given economy into such groups, so that data on the saving propensities of these groups is not available. However, data is available on the saving propensities of different income groups, and we reproduce in Table 3 data gathered through a recent sample survey conducted by the National Council of Applied Economic Research (1980) for the agricultural year July 1975-June 1976. The table shows that the range of saving propensities varies from near zero at the lowest income group with an average income of Rs. 920 a year to almost half for the highest income group with an average income of Rs.94,290 a year. Any division of the total population ranked according to income into two groups - workers and capitalists - is bound to be arbitrary. We have taken three reasonable cut off levels of income to give the dividing line between the two classes. If we choose as the dividing line an annual income of Rs. 7,500, then capitalists, comprising 13 per cent of the population, have a saving-income ratio of .28 while workers

have their ratio at .07. If Rs. 10,000 is chosen as the cut off income, then capitalists, comprising 8 per cent of the population, are seen to have a saving propensity of .33, while workers have theirs at .08. Finally, if Rs. 15,000 were chosen, 3 per cent of the population would be capitalists with a saving-income ratio of .39, while workers would have their's at .09.[8]

2.5 INVESTMENT DEMAND

Although firms are managed by capitalists, we assume that the investment decisions of the firms producing the output are independent of the consumption decisions of capitalists as consumers. We assume that the investment decisions by the managers of firms are made with regard to both rates of profit and the rate of utilization of capacity. For simplicity we write the investment function in a form in which investment as a ratio of the existing stock of capital is a linear and increasing function of both the rate of profit and the capacity utilization rate, so that

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[8] Since capitalists will hold more wealth, and since wealth increases with income, the group with income higher than the cut off point have been called capitalists, and the others, workers. The ratios mentioned in the text have been computed as weighted averages from the data contained in Table 3.

Table 3. Income Distribution, Wealth Distribution, and Saving Propensities by Income Groups, 1975-76

Income Range	per cent share in households	income	wealth	Average per year, Rs. Income	Wealth	Saving	Saving/Income
upto 1200	6.8	1.4	1.1	920	2670	1	neg.
1201- 2400	25.9	10.2	8.1	1810	5266	47	0.03
2401- 3600	22.9	14.7	14.2	2946	10456	198	0.07
3601- 4800	15.0	13.4	12.2	4112	13694	383	0.09
4801- 6000	10.2	11.9	11.5	5339	18904	744	0.14
6001- 7500	6.1	8.9	9.8	6705	27009	1223	0.18
7501-10000	5.5	10.3	11.1	8597	34060	1876	0.22
10001-15000	4.2	11.0	13.3	12077	53242	3311	0.27
15001-20000	1.7	6.4	7.7	17077	75288	6235	0.37
20001-25000	0.8	4.0	3.9	22258	78168	9028	0.41
25001-30000	0.4	2.7	3.1	27298	112308	9858	0.36
30001-40000	0.3	2.1	1.8	34106	106650	16164	0.47
40001-60000	0.1	1.4	1.3	47927	199135	22573	0.47
over 60000	0.1	1.5	0.9	94290	211996	45832	0.49
all	100.0	100.0	100.0	4759	16783	842	0.18

Source: National Council of Applied Economic Research (1980)

(7) $$I/K = a + b\,r + c\,a_k\,Q/K$$

with a, b, and c positive. The function has been expressed in a ratio form to take account of the fact that the same amount of investment will have a different importance according to whether the existing stock of capital is large or small.

The reason for the rate of profit entering as an argument in the investment function is by now too well known, with the development of the so-called

---

* See Sen (1963) and Marglin (1976) for a description of neo-Keynesian theories, and for a comparison with alternative theories.

neo-Keynesian theories of growth and income distribution.[9] The higher the expected rate of profit, the greater the amount of investment firms will be willing to undertake. For simplicity, expected and actual (current) rates of profit are assumed equal.

The last term in the equation contains the expression a_k Q / K, which is nothing but the ratio of actual output to potential full capacity output, that is, the rate of utilization of capital. Thus, a positive relation between the utilization rate and the investment rate is assumed.[10] It ought to be emphasized that this effect, by which an increase in output, by raising utilization rates will bolster investment, is additional to the effect output will have on investment through its effect on the rate of profit, which has already been captured by the second term of the investment function. In other words, our formulation implies that any rise in the rate of utilization of capacity, even with the rate of profit unchanged, will lead to a rise in investment.

Steindl (1952) has examined the reason why this kind of specification may be appropriate for an economy with excess capacity. He supposes that firms have a certain level of desired excess capacity, the reasons for that being connected with fluctuations in demand, or perhaps with the mere fact of expected growth in demand which, given indivisibilities in capital equipment, may make it profitable for present value maximizing producers to

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[10] The similarity with the accelerator model is obvious, although the reason why Q enters here is different.

build ahead of demand for the kinds of reasons analyzed by Manne (1967). When the utilization of capacity fall below the desired level, producers will want to increase utilization, and thereby disinvest to reduce the stock of capital, and conversely when the utilization rate rises above the desired level. If we further assume that the speed at which relative changes in capital are sought depends positively on the extent of divergence of actual utilization to the desired utilization rate, then a term like the third one in equation (7) is obtained, in which desired utilization, taken either as a constant or as a function of the rate of profit, has been absorbed in either the first term or in the second term of the function. While we do not have sufficiently good data at this stage to test whether this kind of formulation of the investment function is meaningful in the Indian context, on a priori grounds the formulation does not seem unrealistic: given that a great deal of excess capacity exists in Indian industry, it is unlikely that changes in its level per se do not have an effect on investment decisions.

The constant term, a, is that part of investment demand which is independent on r and the utilization rate, and is assumed to be positive, due to the existence of 'animal spirits'.

2.6 THE EQUILIBRIUM CONDITION

Equilibrium in the economy is achieved when the supply of the commodity is equal to the demand for it, that is,

$$Q = C + I \tag{8}$$

What drives the economy to equilibrium are changes in output. If $Q \geq C + I$, firms will want to cut down on production so that Q will fall, and Q will rise if $Q \leq C + I$.

3.EQUILIBRIUM AT A POINT IN TIME

In this section we wish to examine how the equilibrium values of the variables of the model described in the previous section are determined at a point in time, in which the level of capital stock and the markup rate are given.

To do that, we first derive a relation between the rate of profit, r, and the level of output, Q. We get that by substituting for the value of the real wage w/p obtained from equation (4) in (5), which yields

$$(9) \qquad r = \tau/(1+\tau) \quad Q/K$$

which is just the relation we are seeking. With τ and K given at a point in time, (9) says that as Q rises, r rises simply because with a higher output and a fixed markup rate, profits are higher, and with a given stock of capital, the profit rate will be higher. Equation (9) is depicted graphically in Figure 1, in the south-east quadrant as line OR.

Second, we derive expressions for saving and investment as functions only of the rate of profit. We shall find it useful to express saving and investment as ratios of the stock of capital, and call them saving and investment ratios. Thus for investment, substituting for Q from equation (9) in (7) we get

(10) $$I/K = a + (b + a_k\, c(1+\tau)/\tau)\, r$$

An increase in the rate of profit will increase investment both directly and through an implied increase in utilization rates. The function is shown as line AN in the upper quadrant of Figure 1. Given that a is positive, the line will have a positive vertical intercept, as drawn. As regards saving, since only capitalists save, it follows directly from equation (6) that

$$p\, S = s\, r\, p\, K$$

where S denotes real saving, which in turn implies that

(11) $$S/K = s\, r$$

which is shown in Figure 1 as the line OM.

Finally we notice that for equilibrium it is required that saving must equal investment. This follows from multiplying equation (8) by p, substituting for p from (4) and for pC from (6) which gives

$$(1 + \tau)\, w\, a_1\, Q = w\, L + (1 - s)\, r\, p\, K + p\, I$$

which implies, using (2) and (5)

(12) $$S/K = I/K$$

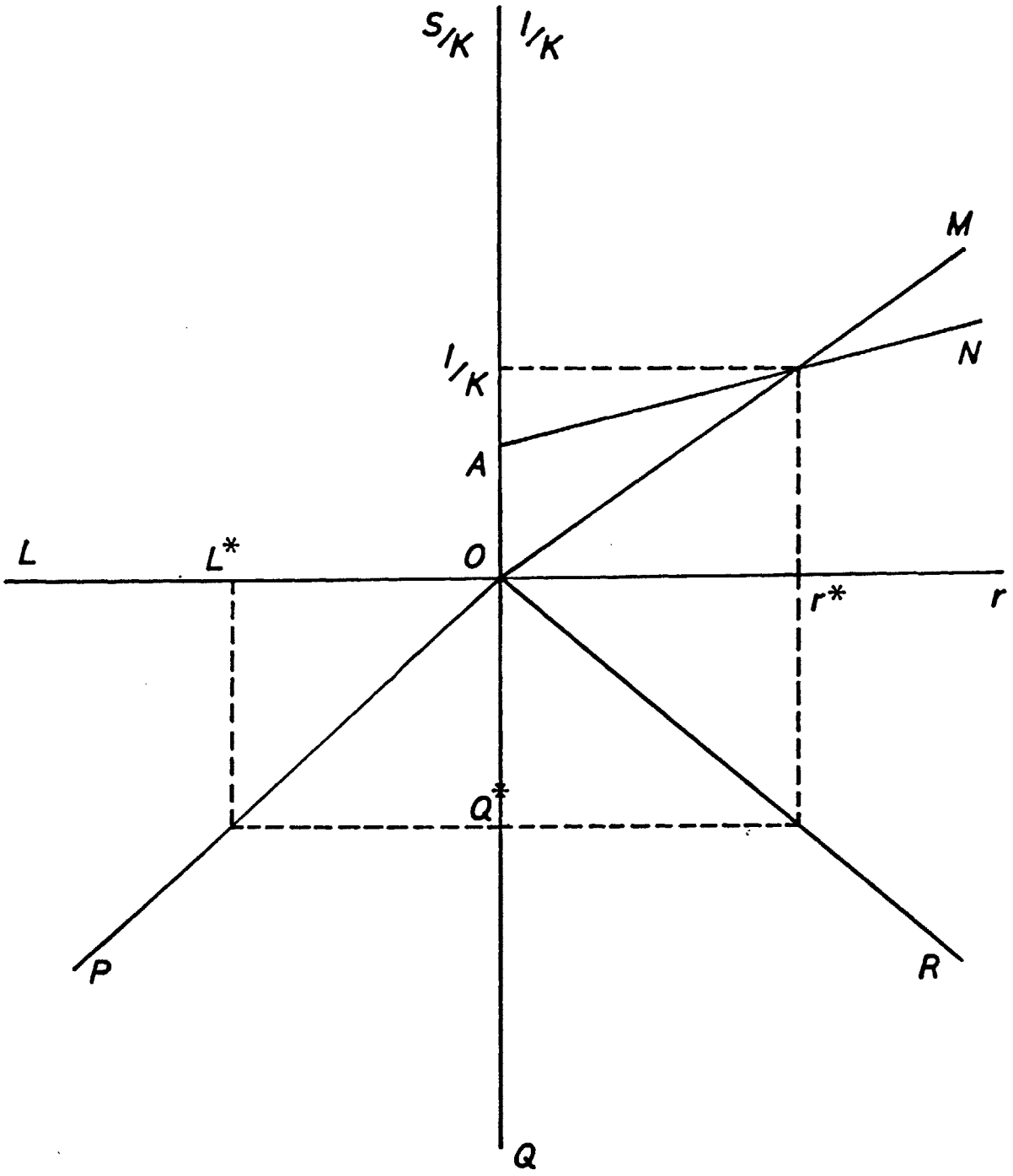


Figure 1. Determination of Equilibrium in the Basic Model

It is now a simple matter to characterize equilibrium completely. Substituting from (10) and (11) into (12) we can solve for the equilibrium value of the rate of profit,

(13) $r = a \,/\, [s-b-ca_k(1+\tau)/\tau]$

Substituting for r in (10) and (11) gives the equilibrium values of saving and investment rates, which, for future reference, are given as

(14) $S/K = I/K = a+(b+a_kc(1+\tau)/\,\tau)\,[a/(s-b-ca_k(1+\tau)/\tau)]$

Given K, I and S are solved for from this equation. Similarly, the equilibrium level of output is obtained by substituting (13) in (9) and solving for Q, which gives

(15) $Q = (1+\tau)/\tau \quad a/[s-b-ca_k(1+\tau)\tau] \quad K$

The equilibrium value of employment is consequently determined from equation (2). All this is graphically shown in Figure 1. In the upper quadrant the intersection of the saving and investment curves solves for the equilibrium value of the rate of profit,r*. The equilibrium value of the level of output is determined in the south-east quadrant at Q*. The equilibrium level of employment, L*, is consequently determined in the south-west quadrant. Note that the price level is determined, independent-

ly of all this, simply from equation (4), since w is given, and given that, the level of output, and hence the rate of profit, adjust so as to bring saving and investment to equality. This kind of adjustment process is possible in this model because we have allowed output to fall below the full capacity level, and hence not be determined by the available stock of capital.

We end this section with some comments on the existence and stability of equilibrium at a point in time. A set of sufficient conditions guaranteeing the existence of equilibrium are

(16a) $$a > 0$$

(16b) $$r/(1+r)\ (s-b) \geq a_k(c+a)$$

To prove that they are sufficient, note that, as is obvious from Figure 1, for existence to be guaranteed we require, first, that the saving and investment functions intersect at a positive rate of profit, and that the corresponding equilibrium level of output be produced with the available stock of capital. Sufficient for satisfying the first necessary condition is that $a > 0$ and that the investment function has a smaller slope than the saving function, that is,

(17) $$s > b + a_k\ c\ (1+r)/r$$

while for the second condition we require that in equilibrium,

$$K/Q \geq a_k$$

or, substituting from (15),

$$\tau/(1+\tau)\ (s - b) \geq a_k(c + a)$$

which gives condition (16b). Since (16a) and (16b) imply (17), they are sufficient conditions for the existence of equilibrium.[11]

Concerning stability, it is obvious that all that is required for it is the familiar condition that the responsiveness of saving to the decision variable (in this case either the rate of profit or the level of output) should be greater than the responsiveness of investment, that is, condition (17) should be fulfilled. Hence, conditions (16a) and (16b) are sufficient for stability as well.

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[11] We have required that a>0 for existence. This is necessary because we have not specified an autonomous level of consumption. Had we done so, the saving function would have had a negative intercept, and we would not have required a>o.

4.SOME COMPARATIVE STATICS EXERCISES

In this section we explore how the equilibrium values of the variables of the model discussed above change when the parameters are shifted.

4.1 CHANGE IN THE MARKUP RATE

Consider a change in the markup rate, τ. It is obvious from equation (4) that given w, a rise in τ implies a rise in p, and consequently, a fall in the real wage w/p. As far as the profit rate is concerned, differentiation of (13) with respect to τ gives

$$dr/d\tau = \frac{a}{(s-b-c\ a_k(1+\tau)/\tau)^2}\ c\ a_k\ /\ \tau^2$$

which, given our assumptions, must necessarily be negative, showing that as the markup rate rises, the equilibrium rate of profit must unambiguously fall. In a special case in which investment depends only on the profit rate and not on the rate of capacity utilization, we have c=0, which implies that $dr/d\tau=0$. Regarding Q, solving for Q from (9) and differentiating with respect to τ we get

$$dQ/d\tau = K\ (1+\tau)/\tau\ \ dr/d\tau - rK/\tau^2$$

Since $dr/d\tau < 0$ it follows that given our assumptions, $dQ/d\tau$ is unambiguously negative, so that output falls as the markup rate rises. Notice that even with $c = 0$, though $dr/d\tau = 0$, $dQ/d\tau < 0$. Finally, as regards investment, from equation (10) we get

$$dI/d\tau = K \{ (b+a_K c(1+\tau)/\tau)\ dr/d\tau - r a_K c/\tau^2 \}$$

Given that $dr/d\tau < 0$ it follows that $dI/d\tau < 0$ so that a rise in the markup rate, given our assumptions, unambiguously raises the rate of investment. Note, however, that with $c = 0$, $dI/d\tau = 0$.

We can confirm all these results by examining this parametric shift graphically in Figure 2. An initial equilibrium is shown at r_1, Q_1, L_1, and $(I/K)_1$, exactly in the same fashion as in Figure 1, for a given value of τ. For a higher τ, it is clear that line OR will rotate upwards, and that line AN will have a smaller slope, though the same vertical intercept. Suppose that the lines shift to OR' and AN', respectively. Then it is clear that the new equilibrium values are r_2, Q_2, L_2, and $(I/K)_2$, with a higher τ implying lower values of r, Q, L and I. Note that if $c = 0$ the equation for the investment curve becomes $I/K = a + br$, so that a change in τ will have no effect on line AN, so that r will not be affected. Only Q will be smaller as OR will rotate upwards, and L will also be smaller; I/K will not change.

To explain the mechanism underlying these changes, it is convenient to assume, to start with, that investors react only to changes in the rate of

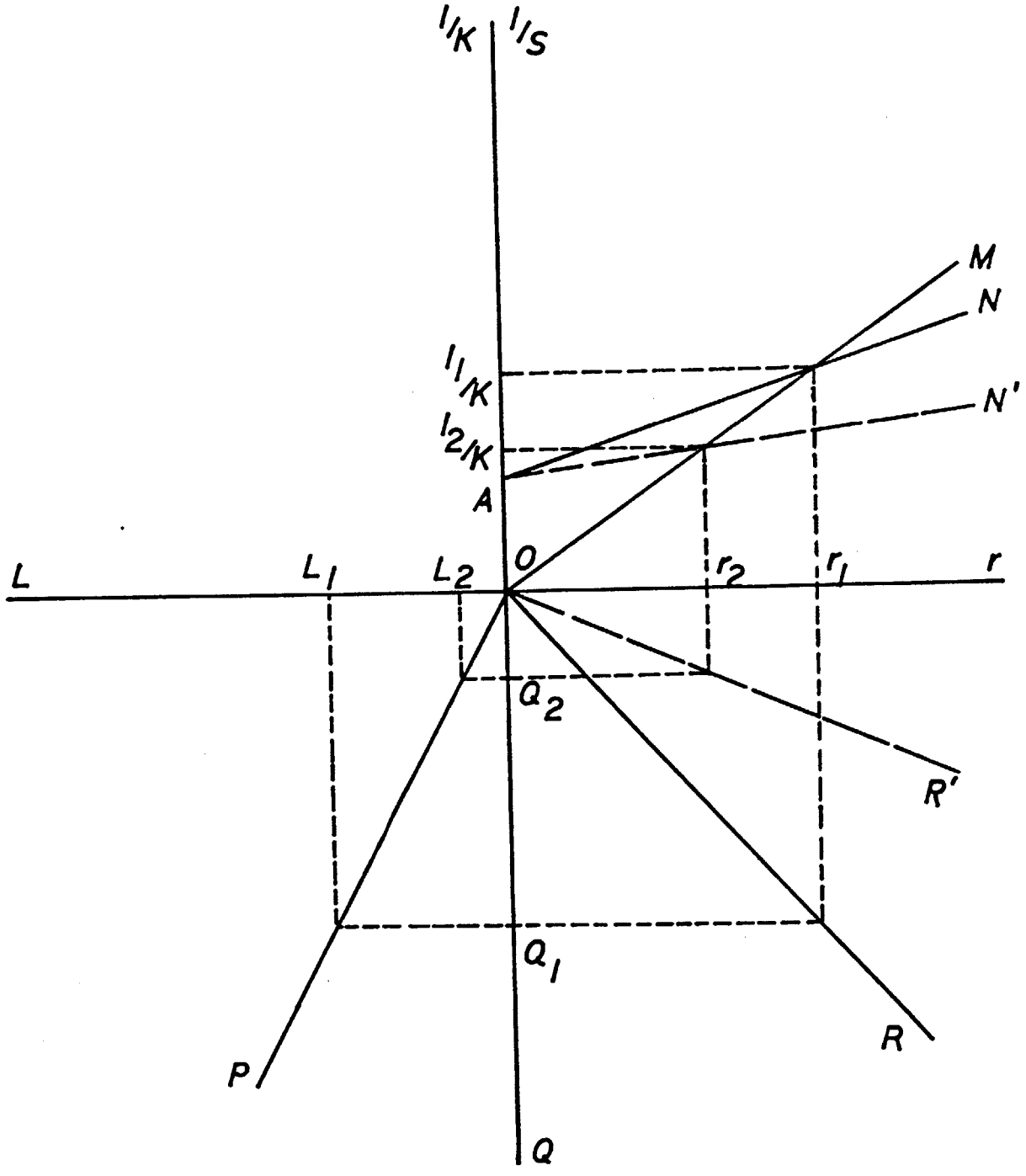


Figure 2. Effects of a rise in the Markup Rate

profit and not to changes in the rate of utilization of capacity per se. In this case, a rise in τ implies that given w, capitalists have to charge a higher price to sustain the higher markup rate, which implies a lower real wage. At the initial level of output and employment, the level of total real wage income will fall, implying a shift in the distribution of income away from workers and towards capitalists. Given the stock of capital, this must imply a rise in the rate of profit. The shift in income distribution from workers to capitalists will imply reduced aggregate consumption and higher saving, given the higher propensity to consume by workers. This increase in saving will exceed the increase in investment resulting from the higher profit rate given, as we have assumed for stability, that the responsiveness of investment to the profit rate is not too large. Hence, at the initial level of output, there will be excess supply, so that equilibrium output has to fall. To restore equilibrium, the rate of profit must return to its initial level, for otherwise, saving and investment will not be equal. With the rate of profit unaffected by the change in τ, obviously, investment will also be unaffected.

Now let us introduce the dependence of investment on the rate of capacity utilization. The lower level of output implied by the higher τ will imply a lower rate of capacity utilization, given K, and that will serve to reduce investment. This will imply that excess supply would still prevail, which will lead to further reductions in Q, r and I. Thus in the new equilibrium, Q, r and I must be lower than they were before the change in

r. This argument makes the importance of the assumption that investment depends on the rate of capacity utilization per se quite clear.

4.2 CHANGE IN THE SAVING PROPENSITY OF CAPITALISTS

It is obvious from Figure 1 that a rise in s will merely make the line OM rotate upwards, implying a fall in the equilibrium values of r, Q, L and I. The result, reminiscent of that from the Keynesian diagonal cross model, arises exactly for the same reason as in that model: a reduction in aggregate demand. The price level and the level of the real wage will not be affected.

4.3 CHANGES IN THE PARAMETERS OF THE INVESTMENT FUNCTION

By a mere examination of Figure 1 it is obvious that a rise in a, b, or c will shift line AN upwards, implying a higher I/K at each positive r. Clearly, by raising aggregate demand, such changes will increase Q, I, r, and L, while leaving p and w/p unchanged.

4.4 CHANGES IN TECHNICAL PARAMETERS

It is clear from equation (4) that given w, a fall in a_1, implying a rise in the productivity of labour, will reduce p, and hence, raise the real wage. However, it is clear from Figure 1 that Q, r and I will be unaffected: only line OP will shift to the right, implying a fall in employment, and hence a rise in the number in the reserve army. The higher real wage is just offset by a lower level of employment, so that total consumption demand is unaffected.

A rise in a_K, implying greater capital requirements per unit of output (as long as the existence conditions are not violated) will shift AN in Figure 1 upwards, but leave all the other curves unchanged. Consequently, r, Q, I and L will rise, with p and w/p left unchanged. We have here a rather surprising result, but it is explained by the fact that a higher capital intensity increases the investment responsiveness of output changes, and has no effect on the price, which is determined merely as a markup on prime costs, not taking capital costs into account.

4.5 CHANGE IN THE MONEY WAGE

A rise in w, as equation (4) shows, is immediately passed along by producers into higher prices so that the real wage remains unchanged, and hence, nothing else in the 'real' model changes.

4.6 CHANGE IN THE STOCK OF CAPITAL

It is obvious from Figure 1 that a change in K leaves the saving and investment curves in the upper quadrant unchanged, implying that the equilibrium r will be unchanged. Investment and saving will rise proportionately with the stock of capital, since given the forms of our saving and investment functions, S/K amd I/K are fixed if r is fixed. In the lower quadrant, OR will rotate downwards, implying that the equilibrium Q will rise, and with the it, equilibrium L; p and w/p will remain unchanged.

5.THE RELATION BETWEEN GROWTH AND INCOME DISTRIBUTION

In this section we shall examine the relation between growth and income distribution implied by our model. First we shall examine the determinants of income distribution, and then the determinants of growth. We shall then consider the relationship between the two, and relate our result to some views on the issue to be found in the existing literature.

Regarding income distribution, given that there are only two types of economic agents in the economy, rich capitalists and poor workers, a natural measure of the distribution of income in the model is the share of total income going to workers,

$$y_w = (wL)/(pQ)$$

A rise in y_w will be taken to imply an improvement in the distribution in income. Using equation (2) and (4) y_w can be written as

$$y_w = 1/(1+\tau) \tag{18}$$

which shows that in the model, income distribution is determined solely by the markup rate. Obviously, the higher the markup rate, the lower is y_w, and the worse the distribution of income.

To analyze the determinants of growth, let us define the rate of growth, g, to denote the rate of increase in the stock of capital, as that is the only source of growth in the model we are considering. Assuming that no depreciation of capital occurs, this implies that

(19) $$g = I/K$$

It may be noted from equation (9) that the rate of increase of K is equal to the rate of increase of Q given τ, since we saw in the previous section that changes in K leave r unchanged. Hence g also measures the rate of change of total output, at a given τ. Since we have already proven in the previous section that $dI/d\tau < 0$, it immediately follows from (19) that

(20) $$dg/d\tau < 0$$

that is, a higher markup rate implies a lower rate of growth of the economy.

Combining the last two results tells us that an improvement in income distribution is accompanied, ceteris paribus, by a higher rate of growth. These results seem to be confirming the arguments based on verbal (as opposed to formal) analysis that have been offered by a group of Indian economists in explanation of Indian industrial stagnation, as mentioned in the introduction. Representative of this group are Bagchi (1970), Bagchi

(1975), Raj (1976), Mitra (1977) and Nayyar (1978). Nayyar, for instance, writes

> Ultimately...the pace of industrialisation can only be sustained if there is a growth in the domestic market, because the production capacities created in the investment goods sector must be absorbed by final consumer demand. But, in a market economy, where the distribution of income is unequal, the demand base might be very narrow in terms of population spread. That was and, indeed, is the case in India...Clearly, a large proportion of the demand for industrial products originates from a narrow segment of the population. However, manufactured goods sold to the relatively few rich can use up only so much, and no more of the capacity in the intermediate and capital good sector. Only a broad based demand for mass consumption goods can lead to a full utilization of capacity (and generate sustainable increases in output), but that in turn requires incomes for the poor. Thus, an unequal income distribution, operating through the demand factors, might well restrict the prospects of sustained industrial growth.

Naturally, our simple one sector model cannot take into account all the factors discussed by the above group of economists, but in our opinion, does capture the essence of their arguments.

Our model, as do the arguments of the group of economists mentioned above, also has its origins in the contributions of Marx, and in the subsequent contributions of Sweezy (1968), Kalecki (1971), Baran and Sweezy (1966) and Steindl (1952), regarding what may be called 'realization crisis' theories. The analysis of crisis in capitalist economies discussed in these contributions emphasizes the non-realization of profit, or the surplus component of value production, as a consequence of the inadequacy of aggregate demand. This tradition has the emphasis on effective demand in commnon with Keynes's (1936) analysis of underemployment equilibria, but with the difference that Keynes was interested in explaining the short run phenome-

non of unemployment and not concerned directly with growth. Also, realization theory concerned itself with imperfect competition, while Keynes's analysis was mainly concerned with competitive product markets.

The result regarding the positive relation between growth and income distribution derived from our model is in contradiction with the negative relation argued in much of growth and development theory. The usual results implying that a worsening of the distribution of income is required for higher growth are derived from models of the Cambridge variety.[12] In those models, the argument proceeds as follows: higher rates of growth require faster capital accumulation, and therefore higher investment; since higher investment requires higher saving, higher growth rates require a redistribution of income in favour of those groups in the economy who save more, and given that the rich save more, a worsening in the income distribution. Essentially this argument underlies a large number of development models, including forced saving and structuralist inflation models.[13]

It is instructive to compare our result with that derived from a model in the above tradition, that of Lara-Resende (1979). In that model, which is in many ways similar to ours, there are two kinds of income - workers' income and profit income, with different saving propensities out of them as in our model; markup pricing applies; and the economy is closed and has

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[12] Kaldor (1956) and Pasinetti (1962) are the pioneering works.

[13] See, for example, Taylor (1979)

just one sector. The crucial distinguishing feature of that model in contrast to ours is that full capacity utilization is assumed, so that output is determined by the existing stock of capital. We have depicted Lara-Resende's economy in Figure 3, using the notation used in this paper. Given the stock of capital K*, equilibrium output is determined at Q* and equilibrium rate of profit at r*. Given the markup rate τ, the resulting investment ratio, and hence the rate of full capacity growth, is given by g*. Suppose, now, that we want a higher rate of growth g'. To make that possible, it is clear that firms must somehow raise their markup rate to rotate OR up exactly to OR' since we need a higher profit rate with output fixed to the full capacity level. Hence the result that higher growth requires a higher markup rate, and hence a worsening in the distribution of income. In our model we allow excess capacity to exist, so that this relationship does not hold.[14] [15]

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[14] It should be pointed out that since K does not fix Q in our model, we have a degree of freedom. Hence we have an investment function to close our model, while there is no such function in the Lara-Resende model in the form depicted in Figure 3. Further, while our model takes τ to be fixed at a point in time by the existing degree of monopoly power, in the Lara-Resende model it is chosen by the firms, and hence is a variable even in the short run.

[15] The comparison of these two models could give some insight regarding the U-shaped relation between growth and income distribution discussed by Kuznets (1955) and examined by Ahluwalia (1976), among others. For example, one could assume that economies with low levels of income could be capital scarce and with full capacity utilization so that an inverse relation between growth and income distribution along Cambridge lines could be assumed; mature economies with excess capacity could have the positive relation like that of our model. India seems to be a less developed economy with excess capacity, so that at low levels of income the positive relation holds.

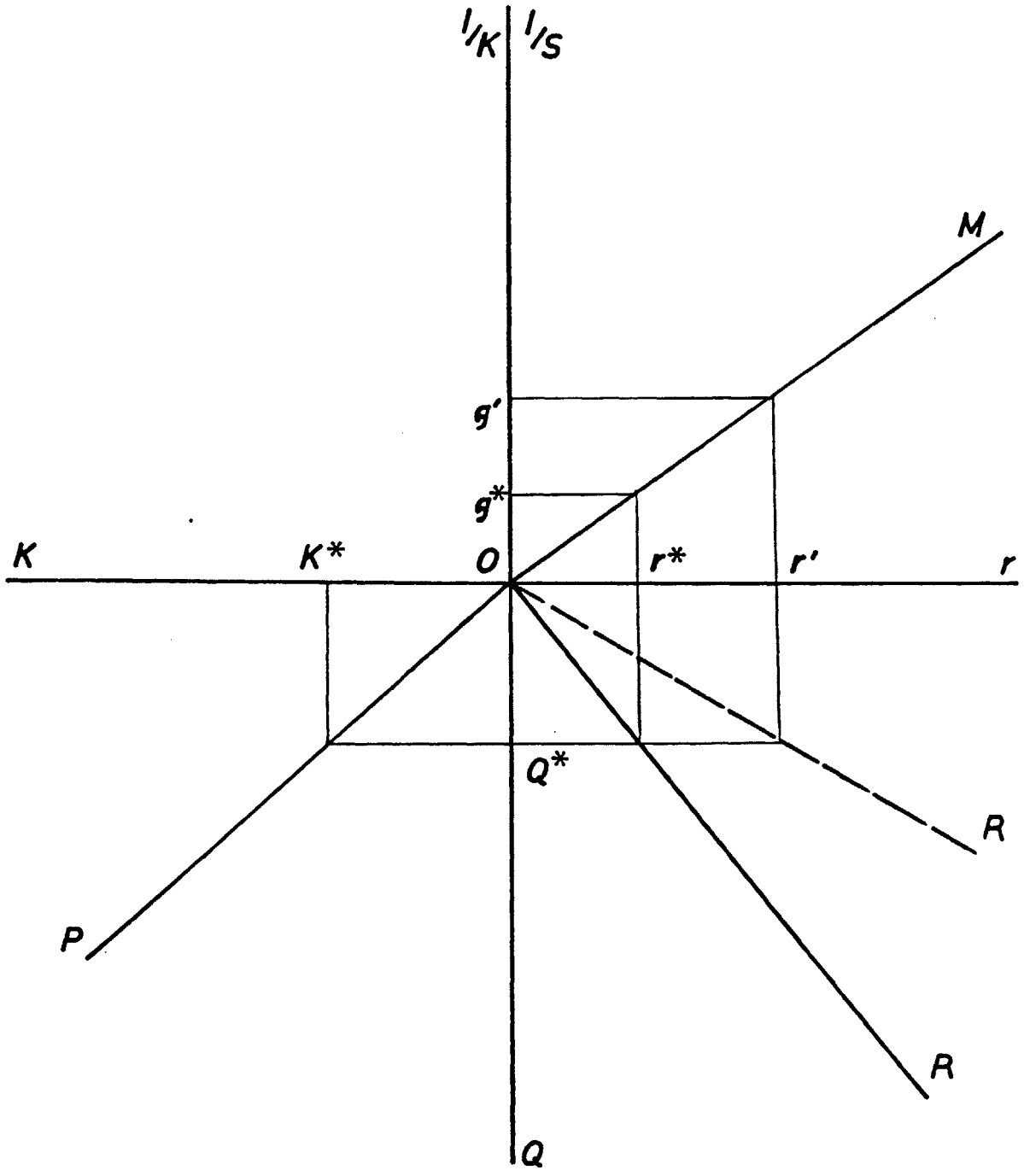


Figure 3. A Model of Full Capacity Utilization

6.GROWTH AND MONOPOLY POWER

In this section we examine how the economy described above moves through time, how well the movement of this economy represents the movement of the Indian economy, and address some policy issues.

6.1 CUMULATIVE PROCESSES

In examining how our economy moves through time, we shall carry out a dynamic analysis involving the interaction of monoply power, income distribution, and growth, using a method borrowed from Taylor, Cardoso, and Darity (1979). We shall first review the relation between g and τ, which we have already derived in previous sections, then examine what factors determine changes in the markup rate, and finally, examine how the economy can possibly move through time.

Let us therefore first recall that the relation between g and τ based on the saving-investment equality, showing equilibrium at a point in time in the economy, is given by

$$(21) \quad g = a + (b+a_k c(1+\tau)/\tau)\ \ a/(s-b-ca_k(1+\tau)/\tau)$$

which follows from equations (14) and (19). Clearly, then,

$$dg/d\tau = -\left[(b+a_k c(1+\tau)/\tau) \{a/(s-b-ca_k(1+\tau)/\tau)^2\}\{ca_k/\tau^2\} + \{a/(s-b-ca_k(1+\tau)/\tau)\}\{a_k c/\tau^2\} \right]$$

which, given the assmuptions of our model, merely tells us that $dg/d\tau < 0$, something we have already deduced above. It is also obvious that as τ increases, the value of the terms inside the square brackets falls, so that $-dg/d\tau$ falls as τ rises. All this implies that the curve showing the equilibrium rate of growth, g, for given values of τ, on a quadrant measuring g on the vertical axis and τ on the horizontal, is downward sloping and convex to the origin, as shown in Figure 4 as the IS curve. We shall assume that at each point in time the economy is in commodity market equilibrium, so that it must always be on the IS curve.[16]

We now turn to the examination of how τ will change, depending on where the economy is at a point in time, as described completely by given values of g and τ. In other words, we are interested in finding the possible form of a function

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[16] This implies the assumption of instantaneous quantity adjustments. As will be clear below, this is almost equivalent to assuming that these adjustments are much more rapid than adjustments in markup rates, although a stronger way of saying it. Since changes in the markup rate reflect changes in industrial structure, our assumption seems a valid one.

(22) $\tau' = F(g,\tau)$

where primes denote time derivatives. In doing so we shall assume a given structure of government policies, so that a shift in that structure will cause a change in the form of the function F.

Consider first the relation between τ' and g. To examine that relationship we shall examine the relationships between growth rates and changes in concentration rates (that is, measures of industrial concentration), and between changes in concentration rates and changes in markup rates.

Regarding the former, we may expect an inverse relationship following the arguments given in Baumol (1962) suggesting that with fast growth in an industry new entrants are encouraged to enter through the attraction of higher profits, and also barriers to entry may appear less formidable in an expanding market. For the case of India, Ghosh (1975) has found that changes in concentration ratios among industries during the period 1948-68 were inversely related to the growth rates of industries, and similar results have also been reported for other countries. We therefore assume that higher growth rates in the economy are associated with smaller changes in concentration ratios.[17]

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[17] This relation may not hold in all economies, of course. For example, in economies in which multinational corporations are important, and these corporations enter when high rates of growth are experienced, thereby (possibly) increasing concentration rates, a positive relation may be expected. While this may be true of some Latin American economies, it is certainly not the case for India.

Regarding the latter relationship, it may be argued, following Strickland and Weiss (1976), that higher concentration ratios are associated with higher markup rates, since collusion is more effective the greater is the share of larger firms. There is by now an abundant literature on the relation between some index of profit and the concentration ratios for developed countries, especially for the United States. After Bain's (1951) pioneering contribution, a large literature on the subject has come into being, which is surveyed in Weiss (1974), Weiss (1980) and in Scherer (1980). Not all the studies use a profit index like our markup over variable costs, but several of them do. The studies show that the markup rate increases significantly with increases in concentration rates, most of the results coming out of linear regressions putting in some other explanatory variables as well. Not much work has been done for the case of India, but Katrak's (1980) regressions show that the Indian case parallels the results of the above studies. If we assume that this relationship between the markup rate and the concentration ratio is roughly linear, then we get a similar positive association between changes in the markup rate and changes in the concentration ratio.

Combining these two relationships, we can assume that a higher growth rate is associated with lower rate of change in the markup rate, so that $\partial F/\partial g < 0$.

Regarding the relationship between τ' and τ, it seems that at least at low levels of τ, higher τ will imply greater monopoly power, and hence greater

ability to push up markup rates, implying a higher τ'. This kind of effect could operate through the increased concentration of credit, for example. But beyond a certain level of τ, it seems likely that further increases in τ will reduce τ' because high markups will induce greater entry and faster falls in concentration ratios as argued in limit pricing models of oligopoly[18] ,because existing firms may apprehend government action if they push up their markups by a large amount, and because firms cannot push markups up indefinitely in any case. Hence it seems reasonable to assume that for a given g, $\partial F/\partial \tau > 0$ at low levels of τ, but $\partial F/\partial \tau < 0$ at higher levels.

We can now find a relationship between g and τ which sets $\tau' = 0$, using equation (22). Clearly,

$$dg/d\tau\big|_{\tau'=0} = - \frac{\partial F/\partial \tau}{\partial F/\partial g}$$

so that for low values of τ, the curve representing thtis relation will have a positive slope, and for higher levels, as $\partial F/\partial \tau$ changes sign, the curve will have a negative slope. The curve showing this relation is shown in Figure 4 and is labelled $\tau' = 0$. Clearly, as $\partial F/\partial g < 0$, $\tau' < 0$ above the curve, and $\tau' > 0$ below it. This is shown by the direction of the two arrows in the Figure. Also note that the curve has been drawn for a given

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[18] See Kaldor (1939), Bain (1949) and Sylos-Labini (1962); for a dynamic analysis see Gaskins (1971).

structure of government policies. For example, if the government were to come down more heavily on non-competitive behaviour, the area below the $\tau'=0$ curve would shrink and the line would shift downwards to a position like that shown by the dotted curve, since points previously implying $\tau'=0$ would now have to imply $\tau'<0$.

We can now examine how the economy moves through time by bringing together the two relationships between g and τ we have just derived, one for commodity market equilibrium, given by the IS curve and one for $\tau' = 0$. It should be obvious from looking at Figure 4 that there are several possible configurations of the two curves, the cumulative processes resulting from them being different. In the Figure we have presented one possible configuration, which, apart from being a probable configuration (see below for a discussion of Indian data), is also interesting to examine because it admits of two possible long run equilibria (by which we mean states that can be attained by the economy which once attained, will be repeated through time). In the Figure, the economy is by assumption restricted to positions on the IS curve. The direction in which the economy will move along the IS curve will be determined by whether the economy is above or below the $\tau'=0$ curve. The direction of movement at different points on the IS curve are shown in the Figure with arrows. A and B represent the two long run equilibrium positions; A is unstable and B is stable.

An economy starting from any $\tau>\tau^*$ (as long as $\tau^*>\tau_f$ where τ_f equates the two sides of (16b) and is therefore the markup rate corresponding to full

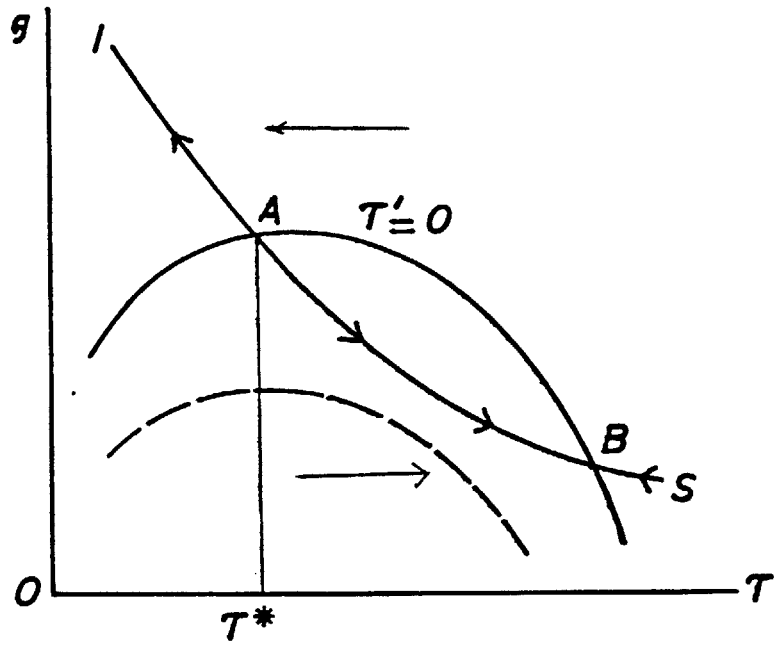


Figure 4. Movement of the Economy in the Long Run

capacity utilization) will over time tend to move towards B. If τ is initially very high, the economy may grow gradually towards B. If initially τ has an intermediate value, the economy may stagnate towards B, with g falling and τ rising, reflecting a progressively worsening income distribution and a progressively falling growth rate. However, if the economy has an initial τ such that $\tau_f<\tau<\tau^*$ then the economy will grow with g increasing and τ falling over time, the growth rate and the markup rate interacting to produce accelerating growth and improving income distribution. Of course, after a point τ would reach the value τ_f when full capacity utilization would be reached, and the economy could no longer be

described by our model. Then the economy would have to be described by a model with full capacity utilization such as the forced savings models.

6.2 THE INDIAN CASE

A stagnating economy is one which is at or very near the point B in Figure 4, with a low growth rate and a high degree of monopoly power and hence large inequality in income distribution. In terms of the model, the Indian economy could be described as being trapped near point B, perhaps moving towards it from above, with a declining rate of growth and a worsening distribution of income. In this way our model can be used to 'explain' the stagnation in Indian industry.

No doubt the model is too simple to capture all the major constraints to growth. Yet a look at Indian data on some relevant variables suggests that the Indian experience is not very different from what this model suggests. We look at some data on the rate of industrial growth, on capital accumulation in industry, on rates of profit in manufacturing, on industrial concentration, and on the wage share in industrial output.

As regards the rate of industrial growth there seems to be little doubt that industrial growth in India seems to be showing a retarding trend,

whether we look at the growth rate for each year, or averages over successive periods, or whether we look at some of the results obtained by fitting trend equations. After a high - more than 8 per cent - rate of growth during 1960-63 there has been a steady decline in the annual rate of growth to 3.3 per cent in the period 1965-70 and to 2.75 per cent in the period 1970-74, with several years of even lower rates therefater. Dey's (1975) Gompertz fit using Rudra's (1970) methodology suggests that the annual growth rate of industrial output fell from 11 per cent in 1951/52 to 6 per cent in 1961/62 and to 3 per cent in 1973/74, and Nayyar's (1978) semilog fit corroborates the hypothesis of retardation. While there have been unusual years - 10 per cent growth in 1976 and an absolute fall in industrial output in 1979/80 - which may be explained by special circumstances caused by climatic factors, the general trend is unquestionably one of retardation in the growth rate of industrial output.

Next we turn to data on capital accumulation in Indian industry, and here again we find evidence of a decline in the rate of investment. The financial statistics of joint stock companies reported by the Reserve Bank of India, for example, shows sharp drops in net fixed assets formation (at 1960-61 prices) in the private corporate sector from Rs. 12,819 million during 1961-62/1965-66 to Rs. 6,658 million in 1966-67/ 1970-71, and further to Rs. 3,844 million in 1971-72/1975-76.

Turning to data on the rate of profit in Indian manufacturing, the trend is not quite clear. There are two alternative sources of data for profit

rates. The first is the Census of Manufacturing Industries which covered all industrial units outside the defence sector employing 20 or more workers using power, and which was replaced in 1958 by the Annual Survey of Industries which covers all units with 50 or more workers with power or 100 or more workers without power. Defining gross profit rates as the excess of net value added over wages, salaries and other benefits, the rate of profit in relation to total capital is shown by this source to decline more or less continuously from 21 per cent in 1950 to 9.4 per cent in 1967, after which it recovered somewhat, but not to the level of the fifties. The second source is the Financial Statistics published by the Reserve Bank of India pertaining to joint stock companies, which seems to suggest that for medium and large public limited companies gross profit as a percentage of total capital remained more or less unchanged at 10 per cent.[19] In sum, there seems to be no clear tendency regarding the rate of profit; however, for the period from the middle sixties to the late sixties, the period for which most of the complaints of retardation were made, both series seem to suggest declines. One could argue that it was in this period that the Indian economy came down its IS curve and reached B.

Concerning industrial concentration ratios, we do not have hard time series data. However, Sau (1981) has produced data to show that the bigger companies in India have grown faster while smaller companies have not grown half as fast. Most commentators seem to believe in the growth of monopoly power

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[19] See Sau (1980).

in the Indian case, though the form in which this growth has been occuring has not been through the mechanism of mergers, but through intercorporate investment.

Finally, regarding income distribution, the data is once again sparse and it is not obvious how much credibility can be attached to the different estimates. One series, given in Shetty (1973) suggests that wages as a percentage of value added by manufacture in Indian industries fell almost continuously from 53.5 in 1949, to 39.6 in 1960, to 36.6 in 1965, and to 34.7 in 1969.

While not all of the data referred to above is of desirable quality, the available evidence does seem to suggest that the Indian manufacturing sector has been behaving over time very much like our simple model would expect it to behave.

6.3 SOME POLICY IMPLICATIONS

We have mentioned that the curve $\tau'=0$ could be moved by a change in the structure of government policies. Recent empirical work by Katrak (1980) suggests that among other things, import competition dampens price-cost margins (where costs exclude capital costs) in Indian manufacturing indus-

tries, while tariffs and other protective devices increase them. Similarly,one would expect that restrictions to entry in the form of industrial licensing would also raise markup rates. Moreover, the government's attitude towards how the credit system functions could also affect the degree of concentration in the economy, with a credit system favouring big business - as argued, for instance by Chaudhuri (1975) - to be existing in India and drawing into the hands of a few capitalists the financial resources scattered over the economy.

Hence, it would seem that it should be possible to shift the $r'=0$ curve downwards to a position shown by the dotted curve in Figure 4, by a change in the structure of government policies promoting competition through trade liberalization, through the relaxation of licensing policies which reduce competition, and through reform in the credit system. Such a system could make the economy experience increasing growth rates and improving income distributions. Of course, this growth could occur under conditions described by our model as long as $r>r_f$, that is, as long as excess capacity exists.

The foregoing analysis seems to vindicate the view of those economists who have suggested that the main reasons for India's poor growth performance can be found in the industrial policies pursued by the Indian government. These economists, Bhagwati and Desai (1970) and Bhagwati and Srinivasan (1975) among them, put the blame mainly on the industrial licensing policies and foreign trade policies involving heavy protection to Indian

industry. However, the mechanisms through which these policies had detrimental effects on growth in the opinion of these economists are quite different from the effects we have in mind. While they primarily have micro-economic efficiency effects in mind, we stress the importance of income distribution related macro-economic effects. Both interpretations, however, would lead to the policy prescription of substantial trade liberalization and the removal of the kinds of policies tending to reduce competition in industry.

7.FISCAL POLICY

In this section we extend the basic model to consider government fiscal policy. Our main purpose will be to show that in the economy of the type being considered, the government can redistribute income from the rich to the poor with different kinds of fiscal policy instruments and thereby not only improve the distribution of income, but also improve the growth performance of the economy. The basic model is extended by introducing three kinds of taxes (or subsidies) - an indirect commodity tax, a tax on capitalist income and a tax (or subsidy) on the income of workers - and government expenditure.

The pricing equation (4) must then be modified to reflect the existence of the indirect tax, which is assumed to be at the constant rate t_1, so that we now have

$$(23) \qquad p = (1+\tau)\, w\, a_1\, (1+t_1)$$

which states that the price level is determined by applying the indirect tax rate on the amount firms want to charge by applying their markup on prime costs, that is, consumers bear the entire tax burden. Consumption demand must be rewritten as

$$(24) \qquad pC = wL\,(1-t_w) + (1-s)\,(1-t_c)\,rpK$$

where money consumption is the sum of workers' income net of taxes at the proportional rate t_w on income and the fraction (1-s) of capitalist income net of taxes at rate t_c on income. We will write the investment function as

(25) $I/K = a + br(1-t_c) + ca_k\ (Q/K)$

where the rate of profit which enters the investment function is the after tax rate. It is by no means obvious that the investment ratio should depend on $r(1-t_c)$ rather than on r, since investment decisions are made by firms which are not taxed, the burden actually falling on rentier-capitalists. However, insofar as it may not be possible to distinguish perfectly between capitalists as entrepreneurs and managers of firms, and capitalists as rentiers, we have gone to the extreme of assuming that entrepreneurs look at the profit rate net of taxes in making their investment decisions. By doing so, we are actually stacking the cards against us, given our interest in showing that redistributive taxes affect growth favourably, since we are allowing taxes on capitalist income to adversely affect investment. The commodity market equilibrium condition must be rewritten as

(26) $Q = C + I + G$

to include government demand, G. We shall assume, for simplicity, that this government demand is all for consumption purposes and not for investment purposes, an assumption which can easily be relaxed.

Finally, we must include the government balance equation

$$(27) \qquad pG = t_w wL + t_c rpK + t_1(1+\tau)wa_1Q + D$$

where D denotes the government fiscal deficit in money terms. Following Kalecki (1937) and Asimakopoulos and Burbridge (1974) we shall assume, for simplicity, that the government balances its budget, that is,

$$(28) \qquad D = 0$$

This assumption is made because our interest lies primarily in examining the effects of purely redistributive fiscal policy changes. Our model can quite easily be extended to deal with cases involving unbalanced budgets. It ought to be noted that the achievement of a balanced budget depends on the government's ability to make continuous and accurate forecasts of the possible effects of changes in one of its tax rates, and to make suitable adjustments in other tax rates: we assume heroically that the government has this ability.

With the rest of the equations of the model, that is equations (1), (2), (3), and (5), we can first consider how equilibrium is attained in the

economy in the short run, given K and τ. If we specify the values of three of the four fiscal policy variables, t_i, t_w, t_c, and G, as policy parameters, then the model yields a determinate solution: we would have one additional equation, (27), and one additional variable (out of the four fiscal policy variables). For our purposes we shall take t_i, t_c, and G as policy parameters and let t_w be determined residually by the requirement that the government balances its budget. We get, from the saving-investment equality (which must still be satisfied because the government budget is in balance), using equations (23) through (28),

$$(29) \qquad a + [\, b(1-t_c) + a_k(1+\tau)/\tau \;\; (1+t_i) \,]r = s\,(1-t_c)\,r$$

which implies that

$$(30) \qquad r = a \;/\; [\, (1-t_c)(s-b) - ca_k\,(1+\tau)/\tau\;\;(1+t_i) \,]$$

For $r > 0$ it is sufficient that $a > 0$ and that the denominator is positive, which for given values of s, b, a_k, c and τ, places upper limits on t_c and t_i. We shall assume that a meaningful solution exists. Once r is solved for in equation (30), we can solve for Q from

$$(31) \qquad Q = \{r\,(1+\tau)/\tau\}\;(1+t_i)\;K$$

and the other variables can be solved for as in the basic model. Hence, given τ, K, and the fiscal policy instruments, the model solves for all the variables, including I, and hence g = I/K.

We can then derive the relation between g and τ, which will give us the same kind of downward sloping IS curve, except that now its position will depend on G, t_c, and t_i, in addition to the other parameters considered in the basic model. The $\tau'=0$ curve can be drawn exactly in the same way as before to examine how the economy moves through time, with no other change as compared with the basic model.

With the help of this model we consider two kinds of tax policy changes which leave government expenditures and revenues unchanged in real terms. The first change is an increase in the tax rate on capitalists with an offsetting reduction in the tax rate (or increase in the subsidy rate) on workers, and the second is an increase in the rate of indirect commodity tax, with reduced direct taxes (or increased subsidies) on workers. Our analysis is initially conducted under the assumption that none of the other parameters of the model are affected by these tax changes; later we shall comment on the implications of relaxing this assumption.

First let us consider what happens to all the variables of the model, given τ and K; that is, we consider the short run impact, which is the same as considering how the IS curve shifts for a given value of τ. We shall consider long run dynamics later.

Consider first the case of the government increasing t_c and allowing t_w to change so that the budget remains balanced with t_i and G held constant. The effect of this change on r is found by differentiating equation (30) with respect to t_c to give

$$dr/dt_c = \frac{a\,(s-b)}{[\,(1-t_c)(s-b) - ca_k\,(1+\tau)/\tau\,(1+t_i)\,]\,r}$$

Since $s - b > 0$, as guaranteed by the stability and existence assumptions, the expression is positive, so that it follows that the rate of profit must rise if t_c rises. Equation (31) shows that Q must also rise in consequence. Regarding investment, we can show that

$$d(I/K)/dt_c = \frac{a\ s\ ca_k\{(1+\tau)/\tau\}\ (1+t_i)}{[\,(1-t_c)(s-b) - ca_k\{(1+\tau)/\tau\}(1+t_i)\,]^2}$$

which is clearly positive implying that a rise in t_c increases I/K.

Notice that this is true only if $c > 0$, that is, capacity utilization rates can affect investment directly. It immediately follows from $d(I/K)/dt_c > 0$ that $dg/dt_c > 0$.

To examine the income distributional consequences we can examine the effect on the real wage net of taxes, the profit income net of taxes, and the ratio of the net workers' income to the net income of capitalists. To do all that, first notice that when t_c is increased, under our assumptions, t_w must fall. For, from equations (27) and (28) we see that

(32) $pG = t_w wL + t_c rpK + t_i(1+\tau)wa_1Q$

Since a rise in t_c raises r, Q and L, but leaves p, G, w and K unchanged, t_w must fall if the equality is to be maintained. It follows immediately that the real wage net of taxes,

(33) $w/p \quad (1-t_w) = (1-t_w) \;/\; (1+\tau)a_1(1+t_i)$

must rise when t_c rises. Somewhat surprisingly, perhaps, the real profit income net of taxes also rises, for we can show that

$$d/dt_c\{rK(1-t_c)\} = \frac{K\, aca_k\, (1+\tau)/\tau \quad (1+t_i)}{[\ (1-t_c)(s-b) - ca_k\{(1+\tau)/\tau\}(1+t_i)\ ]^2}$$

which is clearly positive. Defining

(34) $y_d = wL(1-t_w) \;/\; rpK(1-t_c)$

to be the indicator of income distribution we see that

$$dy_d/dt_c = -\ [\ (1-t_c)\tau\ dt_w/dt_c + (1-t_w)\tau\ ]\ /\ [\ (1-t_c)\tau\ ]^2$$

In sum, such a redistributive fiscal policy increases output, employment, the growth rate, the after tax real wage, and also the after tax return to capital, but causes a redistribution in favour of workers. The mechanism

through which such changes occur is the redistribution of income from capitalists who have a low propensity to consume to workers who have a high propensity to consume, resulting in a rise in aggregate demand which raises output and profit rates, which in turn makes capitalist entrepreneurs want to invest more, raising the growth rate of the economy.

This kind of a redistributive fiscal policy would therefore seem to be desirable, whether one is interested in improving growth prospects or improving the income distribution. However, there may be practical problems in raising the tax rate on capitalists, since these are already high in countries like India, and further increases could result in widespread tax evasion. Whatever the merits of this kind of an argument, it would be of interest to know whether there are other kinds of fiscal policy changes which can produce effects similar to those obtained above. That brings us to the second kind of change, an increase in the indirect tax rate with a corresponding decline in taxes on workers, leaving G and t_c unchanged.[20]

It is simplest to consider the effect of such a change geometrically using Figure 5, which is a modification of Figure 1 to include government fiscal policy. The line AN represents the investment function, that is, the left hand side of equation (29), while OM represents the saving function, that is, the right hand side of the same equation. OR shows the relationship between Q and r, that is, equation (31). Clearly, a rise in t_i balanced by

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[20] An alternative would be to keep pG unchanged, but is not pursued here.

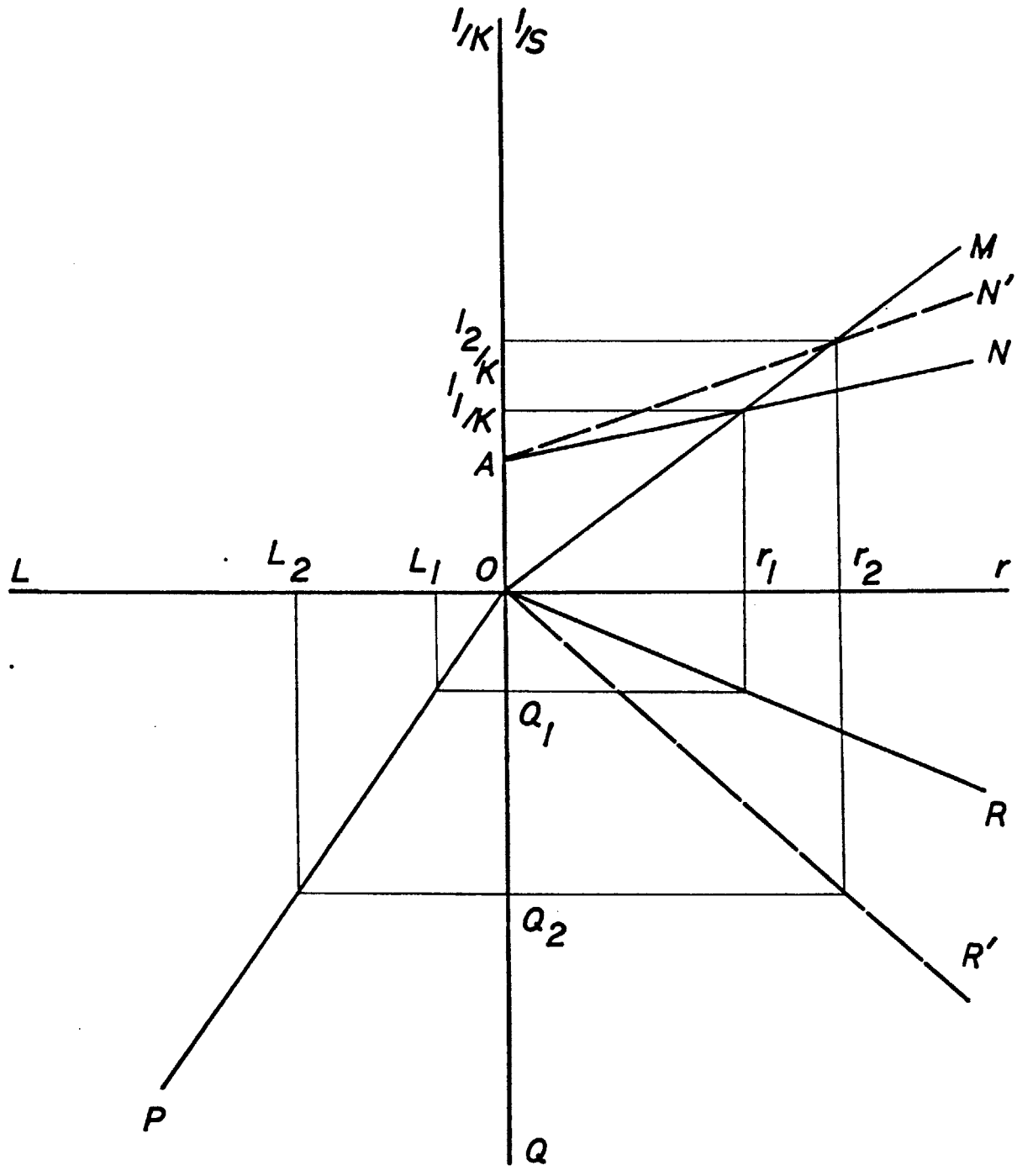


Figure 5. The Model with Fiscal Policy

a change in t_w will leave OM unaffected, but rotate AN up to a position like AN' and OR down to a position like OR', implying that at the new equilibrium, the rate of profit, output, employment, investment, and hence the rate of growth, must all be higher than at the original equilibrium, but since p rises, w/p must fall.

The effect on the income distributional variables appears to be somewhat complicated. For example, while a higher indirect tax rate lowers real wages, the revenue is returned to workers as subsidies, or reduced taxes, and it is not obvious whether the net effect is a rise or a fall in real wages net of taxes. The effect on the real profit rate is simple to see. We have

$$d/dt_c \quad rK(1-t_c) = K(1-t_c)\, dr/dt_i$$

which is positive since $dr/dt_i > 0$. As regards the real wage net of taxes as defined in (33), given that a_1 and $(1+\tau)$ are constants, we may as well confine our attention to $(1-t_w)/(1+t_i)$. Clearly,

$$d/dt_i \; (1-t_w)/(1+t_i) = -\left[(1+t_i)dt_w/dt_i + (1-t_w) \right] / (1+t_i)^2$$

which, for the case in which $t_w=t_i=0$, using the budget balance equation can be shown equal to

$$\frac{\tau(1-t_c)(s-b)-a_k c(1+\tau)(1-t_c)}{(1-t_c)(s-b) - ca_k(1+\tau)/\tau}$$

If we can show that the numerator is positive, then we will have shown that at least for this special case where the initial values of the tax rates are equal to zero, $d/dt_i \quad (1-t_w)/(1+t_i) > 0$. But since $(s-b)(1-t_c)-a_k c(1+\tau)/\tau \quad (1+t_i) > 0$ by the existence and stability assumptions, it follows that with $t_c \geq 0$ and $t_i \geq 0$, the numerator is positive, so that $d/dt_i \quad w/p \quad (1-t_w) > 0$ for this special case. If $t_i > 0$ the result is still seen to follow; but if t_w becomes negative and large in magnitude, it may not hold. Finally, as regards y_d as defined in (34) we can write

$$y_d = (1-t_w) \; / \; (1-t_c)\tau$$

Since a rise in t_i implies a fall in t_w from the government budget equation, we see that y_d rises with t_i.

In sum, we find that such a redistributive fiscal policy has effects similar to that obtained in the previous case, provided that subsidies to labour are initially not too high. These results follow since even in this case there is a redistribution of real income from capitalists to workers since additional taxes are raised from both capitalists and workers, while the receipts are given only to workers.

The entire discussion above has been carried out under the assumption that τ was fixed. We saw from that discussion that both redistributive tax policy changes imply a rise in g given τ, that is, an upward shift in the IS curve. The long run implication of such a shift is seen from looking at

Figure 6. Suppose that the economy is initially at A. The redistributive fiscal policy change shifts the IS curve up to a position like IS'. The economy moves from A to C in the short run with Q, and hence g, adjusting to bring the economy into short run equilibrium. Then the economy moves along IS' to D, the new long run equilibrium, with an even higher g and better income distribution than at C. If the fiscal policy change was large enough, though the economy still had excess capacity after the change, then IS could shift to a position like IS", so that the economy could move to F in the short run, and then move along IS" with accelerating growth and improving income distribution till full capacity were reached. Thus, the favourable short run effects carry over into the long run as well.

Our analysis so far has assumed that none of the policy changes considered affected any of the parameters of the model; here we note sketchily the implications of relaxing this assumption. While our model can predict how any of its parameters will change when the tax rates are changed, it can be used to analyze the final effects of tax changes after some reasonable assumptions are made regarding the direction of change in some parameters when these changes are made. For example, suppose that there is a rise in t_c. In this case capitalists might be led to believe that their consumption might fall, and reduce s to prevent that. Since it is obvious that this reduction in s will result in a further increase in output, employment and the growth rate, our conclusions regarding the effect of a rise in t_c when we held s constant would only be strengthened. Another example would be to

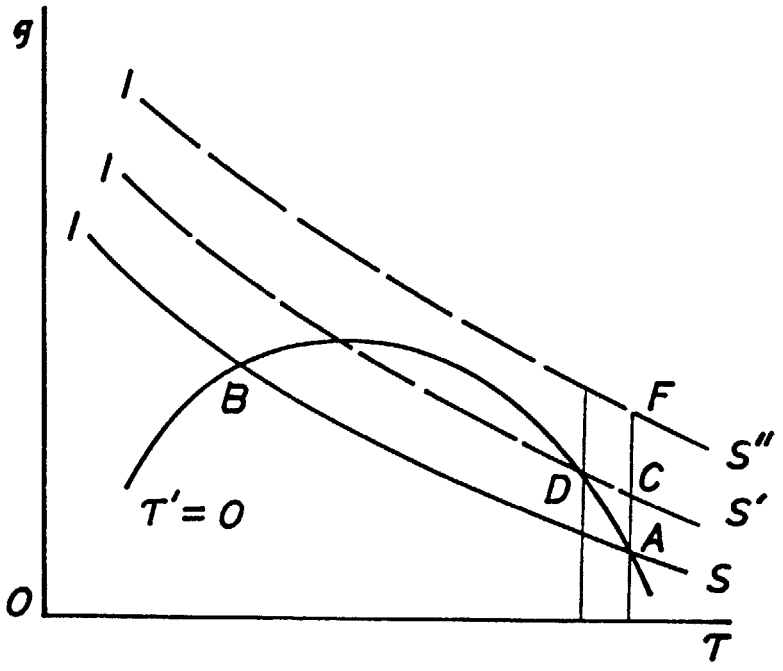


Figure 6. The Long Run Effects of Redistributive Fiscal Policy

consider the effects of a change in t_w on w. If w were fixed by wage bargains, a fall in t_w would probably result in a fall in w, due to pressure by firms. It can be shown that this fall in w would reduce p in the same proportion to leave w/p unchanged, so that there would be no additional effects on the economy over and above the effects already discussed above. As a final example, a rise in t_i may imply that firms may not be able to pass the entire burden of additional taxes onto consumers, implying a fall in r given the industrial structure, so that even in the short run there would be a movement along the IS curve, but the effects on income distribution and growth in the short run are merely going to be strengthened in

the same direction. Hence, the relaxation of this assumption is unlikely to reverse the conclusions we arrived at in this section.

In conclusion, this section has shown that we can easily make modifications in our basic model to consider government fiscal activity. Our modification shows that in an economy of the type modelled, the efforts by the government to improve the distribution of income through redistributive fiscal policy would not have adverse effects on the economy and on growth prospects. On the contrary, there would be output expansion in the short run, and a higher rate of growth in the long run. Such policies could therefore be used to lift a stagnant economy from a 'low level equilibrium trap' and put it on a path which involves accelerating growth and improving income distribution. Capitalists' profits would also be rising, so that even they need not be unduly apprehensive about the possible effects of such a policy.

8.OPEN ECONOMY CONSIDERATIONS

In this section we extend the basic model to take some open economy complications into account. Specifically, we allow the economy to engage in trade with the rest of the world; capital flows, however, will still not be considered explicitly. Our purpose is to examine whether, even allowing for such open economy complications, our conclusion that there is a positive relation between growth and income distribution still holds. The basic model is extended by allowing the economy to import intermediate goods and luxury consumption goods for capitalists, and to export its product.

The pricing equation must therefore be modified to allow for intermediate imports entering into prime costs, so that we have

$$(35) \qquad p = (1+\tau)\ (a_1 w + e p_o^* a_o)$$

where e is the exchange rate, that is the domestic price of an unit of foreign exchange, p_o^* is the foreign price of intermediate imported imports, which is taken to be fixed, and a_o is the amount of such imports needed per unit of output.[21] Since capitalists can now consume imported luxuries, their consumption expenditure is no longer spent entirely on the domestic

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[21] The production function is now written as $Q=\min(K/a_k, L/a_1, M_o/a_o)$ where M_o is the input of intermediate inputs.

good. We assume that a fraction m_c of their consumption expenditure is spent on imports and the rest on the domestic consumption good. Hence, the consumption demand for the domestic good is now given by

(36) $pC = wL + (1-m_c)\ (1-s)\ rpK$

Exports, E, are assumed to be given by

(37) $E = (\alpha + \beta\ e/p)\ K$

which shows that exports are price responsive and increase with K. A rise in e/p implies that exports become more competitive, so that the rest of the world buys more from the economy. Note also that the elasticity of E/K with respect to e/p exceeds unity for $\alpha<0$ and is less than it for $\alpha>0$. The stock of capital is used for a proxy for the complexity of the production structure: a higher K reflects a more complex production structure, implying a larger export capability. This change summarizes structural changes, which would be interpreted as product diversification in a more general model. The linear form is used for simplicity, but captures the notion that raising e/p raises exports rapidly at first, but then with diminishing strength. The commodity market equilibrium condition must now be written as

(38) $Q = C + I + E$

Finally, we must include a balance of payments equation

(39) $eF^* + pE = m_c(1-s)rpK + ep_o^*a_o\bar{Q}$

where F^* is the trade deficit in terms of foreign currency - or the capital inflow - and the right hand side shows total imports.

We can think of two possible versions of the model with these four equations in addition to the other equations of the basic model. One is to fix the exchange rate and to let F^* be determined to satisfy equation (39), and the other is to fix F^* and let e vary to clear the same equation. Since the first is relevant for a fixed exchange rate situation and the latter for one involving variable exchange rates, and since the former is the assumption relevant for India, we shall assume that e is given and let F^* be endogenously determined, to be interpreted as required capital inflows. We are therefore ignoring constraints on the balance of payments to focus on constraints entering from domestic income distributional issues and suppose that F^* can be satisfied by foreign aid, for example, or as showing the balance of payments implications of alternative strategies.[22]

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[22] Constraints on F^* could imply constraints on M_o and hence constraints on output. Treatment of this constraint would give us some sort of a two-gap theory, although the other gap would not be a saving gap, but could be described as a demand gap. This interesting analysis is not pursued here.

To consider how equilibrium is attained in this open economy, we first note that equation (38), using the other equations of the model can be written as

$$(40) \quad [\, s + m_c(1-s) + ep_o^*a_o/\tau(wa_1+ep_o^*a_o) \,]\, r = \alpha + \beta e/\{(1+\tau)(wa_1+ea_op_o^*)\} + a + (b + ca_k(1+\tau)/\tau)r$$

which shows that equilibrium requires that the sum of saving and imports must equal the sum of investment and exports (all as ratios of the stock of capital).

Equation (40) implies that

$$(41) \quad r = \frac{a + \alpha + \beta\eta_o/a_op_o^*(1+\tau)}{s + m_c(1-s) + \eta_o/\tau - b - ca_k(1+\tau)/\tau}$$

where $\eta_o = ep_o^*a_o/(wa_1+ea_op_o^*)$, is the ratio of the value of intermediate imports to total variable costs. Equation (41) solves for r, given e. Q, L, I and g, and the other variables are then determined as in the basic model. F* is solved for residually from equation (39). We assume that the existence and stability conditions for this extended model are fulfilled, which requires, for example, that the denominator of (41), for example, is positive.

Differentiating equation (41) with respect to τ we find that

$$dr/d\tau = -1/[\, s + m_c(1-s) + \eta_o/\tau - b - ca_k(1+\tau)/\tau \,]^2$$

$$\{ (a + \alpha + \beta\eta_o/a_o p_o^*(1+\tau))(1/\tau^2)(a_k c - \eta_o) +$$

$$\beta(\eta_o/a_o p_o^*)[1/(1+\tau)^2]\ [s\, m_c(1-s) + \eta_o/\tau - b - ca_k(1+\tau)/\tau\ ]\}$$

A sufficient condition for $dr/d\tau<0$ is $ca_k>\eta_o$, that is, the ratio of the value of intermediate imports to the total variable cost is smaller than the responsiveness of investment to the capacity utilization variables. However, with β at all positive, $ca_k>\eta_o$ is no longer necessary for $dr/d\tau<0$. Our presumption for an economy like India is that $\beta>0$,[23] η_o is not very large, and c is large. Given all this, we expect $dr/d\tau < 0$. It follows that Q, L, and g rise when τ falls. Note that even if r rises with a fall in τ, g could still fall.

When τ falls there are three kinds of effects which come into operation. There is a shift in income distribution from capitalists to workers which raises aggregate demand and hence output and the rate of profit. This is the effect already considered in the basic model. There is the further effect that this shift switches demand from luxury imports consumed entirely by capitalists to domestic goods. In the open economy model there are two further effects operating in opposite directions. First, a fall in τ reduces p, which makes domestic goods more competitive abroad and raises exports given some positive response of exports to prices, thereby tending

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[23] Our regressions suggest that the price elasticity of exports for India may be as high as .4 to .5, and seems to be rising as the exports are increasingly being diversified away from traditional exports.

to raise output and the rate of profit. Second, the fall in τ implies that foreign saving increases as imports amount to a larger share in redirected income flows, which reduces aggregate demand and serves to reduce output and the rate of profit. If β is large so that the first effect is strong, and if η_0 is small, so that the second effect is weak, the effect of a fall in τ is to raise r and Q.

To conclude this section we note that provided the ratio of the value of intermediate imports to total prime costs is not too large, the results for the closed economy carry over to the case of the economy, that is, we have an IS curve which shows that g falls as τ rises. The model can now be used to examine the impact of different kinds of changes - for example, devaluation, and intermediate import price shocks - but we do not go into such exercises here since that would take us far from our present concern of examining the relation between growth and income distribution.

9.CONCLUSION

In this paper we have constructed a simple one sector closed economy model of an economy producing an industrial good in an oligopolistic manufacturing sector characterized by excess capacity. The model implies a positive relation between economic growth and income distribution. Appending to the model the dynamics of changes in industrial structure, we have examined cumulative processes involving the interaction of growth, income distribution and monopoly power, which has shown us how stagnation can be explained in the economy, and what kinds of policy changes are required to make the economy grow. We have also extended this model to consider government fiscal policy and foreign trade to show that the logic of the simple model does not change when these complications are introduced.

The main theoretical implications of this paper are as follows. First, in economies with generalized excess capacity and market imperfections, a bad income distribution can be a cause of stagnation; economic growth may well go hand in hand with improving income distribution. Second, economic growth and income distribution may not be conflicting goals in such economies. Policies such as attempts at reducing monopoly power by trade liberalization or removal of other types of controls may have positive effects on both economic growth and income distribution. Redistributive fiscal policies may improve growth performance in addition to improving the distribution of income.

The model was constructed explicitly to depict the Indian economy and motivated by the desire to explain the causes of stagnation of that economy. The above conclusions can therefore be applied to the Indian economy. However, such an application should be made with caution. What we have argued is that in the Indian economy a bad income distribution due to a high degree of monopoly power could be a cause of stagnation, even in the absence of other constraints such as those arising in the agricultural sector, or from the balance of payments. If these other constraints are empirically important, and one can indeed make a strong case that the agricultural constraint is extremely important in the Indian context, then the removal of the income distributional constraint would not ipso facto generate higher growth. However, we can conclude that the removal of the other constraints could still be consistent with stagnation due to a bad distribution of income.

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Essay 2

THE MACROECONOMIC IMPLICATIONS OF FOOD SPECULATION IN A LESS DEVELOPED ECONOMY

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1. INTRODUCTION

There has been a great deal of discussion on the effects of speculative operations in foodgrains in India. In micro-oriented discussions it has been argued that speculation in foodgrains, especially on the part of large farmers and traders, has resulted in a perverse price responsiveness of the marketed surplus of foodgrains. In macro-oriented discussions, such speculative activity has been seen as reducing 'productive' investment at the expense of speculative investment, thereby adversely affecting rates of growth, and worsening income distributions by raising the price of foodgrains.[1], [2]

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[1] Some examples of such discussions are found in Patnaik, Sanyal and Rao (1976), Mitra (1977), and Pushpangadan (1979). Taylor (1982) suggests that speculation in foodgrains could reduce growth rates and warns that governments in less developed economies should keep such activity under control, but does not incorporate the phenomenon explicitly into his model. Taylor, Sarkar, and Rattso (1981) consider the phenomenon in an empirical macro-model for India. However, their treatment of the phenomenon is rather crude, and obviously meant to be merely illustrative.

[2] All this seems to be far removed from the traditional view of speculation having welfare improving effects by introducing price stability in the economy. It was argued (see Kaldor (1939) and Johnson (1976)) that destabilizing speculators would incur losses and be driven out of business, so that only stabilizing, and hence welfare improving, speculators would remain. However, Kaldor (1939) has argued that speculation need not always stabilize prices; and even if it does so, it may destabilize incomes. In any case, the traditional arguments are couched in microeconomic terms, and usually in terms of partial equilibrium analysis, so that the effects mentioned in the text are precluded.

This discussion of the adverse effects of food speculation, however, has not been presented in a rigorous manner, which makes it difficult to understand the exact channels through which they operate or to get a feel as to whether they in fact exist. Some formalization of the arguments therefore seems in order.

The purpose of this paper is to provide just that. With the help of simple macro-economic models we examine the macro-economic implications of food speculation in less developed economies such as India. Specifically, we are interested in two central questions. First, whether the presence of food speculation implies that such economies may behave in a manner which is different from their behaviour in the absence of such speculation. Second, whether an increase in food speculation, in some sense, has adverse effects on the economy in the form of reducing rates of growth and worsening income distributions.[3]

The rest of this paper proceeds as follows. In section 2 we examine how important the phenomenon of food speculation is for the Indian economy and consider how we can represent the phenomenon in a simple model. In section 3 we describe the main characteristics of the economy modelled in the paper and comment on how realistic the model is as a respresentation of the Indian economy. In section 4 we examine the version of the model which rules

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[3] We will not be concerned with the micro-economic question regarding the effects of such speculation on the price responsiveness of marketed surpluses, since different types of models would be required for that analysis.

out food speculation and show how the economy reacts to different kinds of changes. In section 5 we examine the version of the model which allows for food speculation, considering different variants assuming different kinds of ways in which expecations are formed. In sections 6 and 7 we consider how the economy in which we allow for food speculation reacts to different kinds of changes in the short run and in the long run. Finally, in section 8, we present our conclusions.

2.FOOD SPECULATION IN INDIA

2.0 INTRODUCTION

In this section we examine the importance of food speculation in the Indian economy. First we examine some data to show that food stock-holding is a phenomenon of some importance in the Indian economy. Next, we argue that such stock-holding may be characterized as speculation. Finally we consider how such behaviour can be represented in a formal model.

2.1 THE MAGNITUDE OF FOOD STOCK-HOLDING IN THE INDIAN ECONOMY

We have not been able to obtain time series data showing the size of foodstocks held by different groups of people in the Indian economy. Given the fragmentary nature of the data, we shall confine ourselves to data for two points in time.

The first is concerned with data on proportions of output of foodgrains marketed and retained by farmers during the year 1961-62. Defining 'large farmers' as those having assets of Rs. 5,000 and above (they produced about

73 per cent of the wheat and 62 per cent of the paddy output), Ravi Varma and Shankar have estimated that such farmers kept about 31 per cent of wheat and 22 per cent of paddy produced as stock, after selling 38 per cent of wheat and 31 per cent of paddy out of total production.[4] Duvuury has also presented evidence that large farmers producing jowar also retained a large proportion of their output as stocks after making normal sales.[5] These three crops - paddy, wheat and jowar, account for about 75 per cent of total foodgrain production in India.

The second piece of evidence is concerned with the proportion of investment in the form of (increase in) farm inventories for the agricultural year July 1975-June 1976 gleaned from a survey conducted by the N.C.A.E.R..[6] In this study, investment is split up into physical and financial investment, and the economy is divided into rural and urban sectors. The study shows that investment in inventories of agricultural produce formed a significant proportion - about 15 per cent - of total investment estimated for that year. It was the largest single item of investment among those listed as 'physical investment'. Among all investment items it ranked second only to deposits with commercial banks, cooperatives, and companies. The impor-

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[4] Pushpangadan (1979) quotes Ravi Varma and K.Shankar, "Marketed Surplus of Cereals - Retention and Sales", Economic Times, October 5 and 6, 1971.

[5] N. Duvuury, Price Fluctuations in Jowar, M. Phil. Dissertation, Jawaharlal Nehru University, New Delhi, 1977, referred to in Pushpangadan (1979).

[6] See National Council of Applied Economic Research (1980).

tance of food stock-holding is seen more clearly by looking at the rural sector alone: investment in agricultural inventories was about a quarter of total investment, a third of physical investment, and over a half of 'farm investment' in that sector. To have a clearer idea of how important food-stocks were in relation to total wealth, we would like to have data on the proportion of food-stocks to total wealth in the economy. The study does include food-stocks in its definition of agricultural assets - which form about 61 per cent of total wealth in the economy - which also includes land, agricultutal implements and machinery, irrigation assets and transport equipment. However, it does not give the breakup among these groups so that we must be content with the breakup of additions to wealth.

The above discussion should convince us that food stock-holding is a phenomenon which was quantitatively important for the years for which the data has been presented. Since there is nothing unusual about these years which would lead us to expect that unusually high stocks were held in them, we can conclude that food stockholding is quantitatively important for India.

2.2 MOTIVES FOR FOOD STOCKHOLDING

Before we can incorporate the phenomemon of food stockholding into a macro-model for India, we have to make some judgement as to how one can interpret the phenomenon.

The first question to answer is whether such stock-holding is voluntary or involuntary. Given that there seem to be hardly any demand constraints on food production and the main bottlenecks are from the supply side, and given the observation that large farmers and traders, and not small farmers, hold on to foodstocks, the hypothesis that food stockholding is involuntary can safely be rejected.

Given, then, that one can interpret food stock-holding as voluntary, the question arises as to what the motives for stockholding are. To understand what the possible motives are, we can draw on the inventories literature, confining ourselves to motives for holding output as inventories, which is what is relevant for the Indian case.

The inventories literature mentions several motives for the holding of output stocks in general.[7] First, there is the motive of improved production scheduling, which refers to the fact that the multi-product firms can operate more efficiently if inventories give then flexibility in scheduling production runs. Second, there is the buffer stock motive: given fluctuating demand, firms can hold inventories to reduce the possibility of

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[7] See Blinder (1980) for a fuller description.

stockouts, as argued by Mills (1962), for example. Third, there is the production run model which suggests that firms could bunch production relative to sales when, for example, dramatically increasing returns to scale dictate that production be done in large 'production runs', which are then put into inventory and gradually sold. Fourth, there could be the motive of reducing delivery lags: Maccini (1977), among others, suggests that high inventory stocks may stimulate a single firms' demand by reducing delivery lags. Finally, there is the motive of speculation on future price movements: expectations of high future prices could lead to the postponement of sales.[8]

Which of these motives seem to be valid for food stock-holding in a less developed economy like India? Three comments are in order.

First, some of the motives mentioned above do not seem to be at all relevant. Given that most farmers produce one or two crops which do not use each other in production, inventories would not give flexibility in scheduling production runs, so that the first motive may be rejected. Further, given the limited variability and hence limited uncertainty in the demand for food, the possibility of a stockout in the face of an unexpectedly high demand is unlikely to induce farmers to hold on to foodstocks. Moreover, given the nature of agricultural markets, it does not seem that farmers will be interested in stimulating their own demands and hold on to stocks

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[8] For a definition of speculation, see Kaldor (1939).

to reduce delivery lags. While the increasing returns version of the inventory run model would seem to be inappropriate, another variant seems to be quite relevant. Production in agriculture is by its very nature concentrated at a few points in time when harvesting occurs, while consumption is carried on almost continuously over time: this makes it necessary that someone must hold on to inventories.[9] Finally, note that the speculative motive seems to be acceptable if the costs of storage are not prohibitive.

Second, the different motives enumerated above do not seem to be contradictory. For example, even if there is some advantage to be gained from holding on to food stocks for motives entirely different from speculation, there is no doubt that those holding on to such stocks will consider the returns to, and the costs of, holding such stocks, so that the higher the expected speculative return, the more stocks they would wish to hold. Hence even if other motives for holding stocks exist and produce some kind of yield which we shall somewhat vaguely call the 'convenience yield'[10] the speculative motive would still be in play.

Third, from our discussion we can conclude that there is nothing that suggests that the gains from food stockholding would accrue specifically to food producers, or even be greater for food producers. There would there-

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[9] See Samuelson (1957) for an examination of price fluctuations due to seasonal factors.

[10] The term 'convenience yield' is usually attributed to Kaldor (1939), though Keynes (1936) was aware of the concept. See Van Duyne (1981).

fore seem to be no argument in favour of restricting, for our theoretical purposes, food stock-holders to producers of food: stock-holding would be equally advantageous to anyone in a position to hold such stocks. Hence, the ownership of wealth, rather than one's occupation, seems logically to determine who will hold foodstocks.[11]

2.3 CHARACTERIZATION OF FOOD STOCKHOLDING IN A FORMAL MODEL

We argued in the previous subsection that one could imagine that any wealth-holder could hold on to food stocks primarily for speculative reasons, although other reasons connected with 'convenience yield' could also exist. For theoretical purposes, therefore,we shall assume that any wealth-holder can hold stocks of foodgrains - an activity which we shall refer to as 'food speculation' given that the speculative motive is the major motive for such stock-holding - as one of several forms which wealth may take. We shall assume that asset holders will want to hold food and other assets as some fractions of total wealth, the fractions depending on

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[11] We are abstracting in this paper from other factors which may restrict food stock-holding to some segment of wealth holders, for example, storage facilities, or social taboos on such behaviour.

[12] We shall abstract from any explicit consideration of risk and uncertainty in the models considered below. Any differences in riskiness are assumed to be reflected fully in the functional forms of the asset demand functions.

the rates of return on different assets. Since these different assets have different attributes and different risks associated with their holding,[12] the rates of return on the different assets actually held do not have to be equalized in equilibrium.

We conclude by commenting on how we will measure the net return on holding foodstocks. The return on holding foodstocks can be looked upon as consisting of a 'convenience yield' and of a speculative return, which is obviously the expected rate of increase of food prices. The costs would have to include the costs of storage and depreciation (since foodgrains could rot). We shall ignore the costs by assuming that storage costs and depreciation are zero.[13] Since the 'convenience yield' can be assumed to be fixed per unit, we will not include that explicitly in our formulation. Thus only the expected rate of inflation in food prices, ρ^e, will give us the return to holding foodstocks.[14]

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[13] This assumption is introduced for simplicity, and our analysis could easily be modified to take these costs into account. For example, suppose that a fraction δ of the total foodstock depreciates (by rotting) in every period, but there are no other costs of stockholding. Then a unit of money invested in food will yield a return of $\rho^e (1-\delta)-\delta$ where ρ^e is the expected rate of increase in food prices, and where the 'convenience yield' has been ignored. Then, replacing our expression for the rate of return on foodstocks by this expression would take account of depreciation, without any fundamental change in our analysis.

[14] Given that we will assume that ρ^e enters as an argument affecting the ratio of the value of foodstocks to the value of wealth, this means that given ρ^e, an increase in wealth would increase the demand for foodstocks, implying the somewhat peculiar, though harmless, simplifying assumption that the total 'convenience yield' depends on the total wealth.

3.CHARACTERISTICS OF THE ECONOMY

3.0 INTRODUCTION

In this section we shall examine the main characteristics of the economy we shall model in this paper and comment on how realistic these characteristic are in depicting the Indian economy. Many of the assumptions used are adopted for simplicity, as a part of modelling strategy, while other assumptions are introduced to model Indian reality.

For simplicity, and without undue injustice to the Indian economy, we shall assume a closed economy. The government shall not appear explicitly in the model other than in its central banking capacity as the source of money supply. Two broad sectors of the economy shall be considered, a subsistence sector, and a capitalist sector, where the former contains self sufficient economic agents, and where the latter contains firms or capitalists hiring wage labour. The first sector will not be explicitly considered in the model, except as playing one important role. We shall introduce explicitly as few commodities into our model as are essential for our purposes, so that we shall consider two commodities, food, and a manufactured product. Finally, for simplicity, only three types of economic agents will be considered explicitly, and these shall be assumed to be suf-

ficiently homogeneous within their group to be dealt with as if there was only one representative agent of each type.

3.1 THE SUBSISTENCE SECTOR

For simplicity, we shall not be concerned explicitly with this sector in our model, and shall make assumptions about it that will allow us to ignore it except in one crucial respect. We shall assume that economic agents in this sector 'produce' at constant average product with only their labour, and consume this average product which just equals their subsistence consumption level, somehow defined. No one outside this sector consumes products produced in it, and no one in this sector consumes products produced outside it. Agents will leave this sector when they can obtain employment in other sectors at any real wage above their subsistence consumption level.[15] The number of agents in this sector is assumed to be very large, reflecting overpopulation.

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[15] Since geographical migration need not be taking place (see the next paragraph in the text) we need not introduce Harris and Todaro (1970) type complications in considering migration from this sector to other sectors. Further, when the demand for labour in other sectors falls, agents will be pushed back to this sector.

Physical counterparts of sectors of this sort in actual economies could consist of 'depressed classes' in backward areas producing and consuming inferior cereals, petty commodity production for self consumption, begging, gathering food in forests, and so on. This list suggests that this sector could be located in urban areas as well as in rural areas, although predominantly in the latter.[16]

The only role this subsistence sector plays in our model is to provide the economy with an unlimited supply of labour at any real wage above the subsistence consumption level in that sector.[17]

3.2 THE CAPITALIST NON-AGRICULTURAL SECTOR

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[16] Models of dual economies often identify the subsistence sector with the agricultural sector and the capitalist sector with the non-agricultural sector. Our sectoring seems to be more realistic.

[17] The assumption that the subsistence sector is otherwise self-contained is an assumption of convenience. Quite contrary to what is being assumed, there has been much discussion of the way in which even the poorest agricultural households have been forced into the commercial nexus. See, for example, Dharm Narain (1962), who argues that the smallest farms sell a larger part of their output than medium sized farms. Patnaik (1975), however, reconsiders the facts and aruges that the market involvement of poorer farmers is far less than that claimed by Narain. Perhaps we are not doing serious injustice to reality by making this simplifying assumption after all.

The capitalist sectors of the economy can be divided into two sectors. The first is the non-agricultural sector which we describe in this subsection, postponing the discussion of the other sector, the agricultural sector, to the next subsection. For brevity, for the rest of this paper we shall refer to these sectors as the N sector and the A sector, respectively.

In the N sector firms produce a single output, a manufactured industrial good, which can either be consumed or invested. This assumption is obviously a simplifying one, and the good can be thought of as a composite commodity. Only two factors are used in the production of the good: homogeneous labour, and homogeneous capital, which is physically the same as the produced commodity and owned by capitalists (see below). The technology used in the production of the good is represented by a fixed-coefficient, constant returns-to-scale Leontief production function. The assumption of fixed coefficients makes the analysis simple, and much of the analysis would carry over if we allowed for some substitution in production.[18] The assumption can also be justified as an approximation to observed technological rigidities in less developed economies.[19]

Production in this sector is assumed to take place in an oligopolistic market environment characterized by an excess capacity of capital, in which producers are assumed to use the rule of thumb of setting prices as a fixed

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[18] See, for example, Taylor (1982a).

[19] See Eckaus (1955). See also Hawrylyshyn (1978) for a discussion of factors underlying such rigidities.

markup over prime costs. These assumptions are meant to reflect actual Indian conditions. The fairly large literature on industrial organization in India has pointed out the oligopolistic nature of Indian industry. Bain(1960), Chaudhuri (1975), and Ghosh (1975), for example, have looked at the high degree of concentration in particular Indian industries, while Chaudhuri (1975), Chandra (1979), and Sau (1981) summarise the evidence on aggregate concentration in the Indian manufacturing sector. There is also a great deal of evidence on the existence of excess capacity in a large number of Indian industries. The evidence, summarized in Raj (1976) and in Mitra (1977), for example, suggests that the excess capacity of capital is a generalized phenomenon in the Indian manufacturing sector.

The level of the money wage in this sector will be taken to be given throughout the analysis, either as a result of minimum wage fixation, or through wage bargaining. This assumption is a simplification and not essential for our analysis. What is crucial for our analysis is that money wages lag behind the price level - somehow defined. To allow money wages to change and thereby introduce inflation of the non-agricultural price, we could introduce wage dynamics into our model, along the lines pursued in Cardoso (1981), Taylor (1982) and Taylor (1982a),for example, in which money wages adjust to cost of living changes with a lag. However, we eschew such complications. The assumption that money wages lag behind prices is not inconsistent with Indian data, summarized, for example, in Bagchi (1975), in Mitra(1977) and in Sau (1981). We shall assume that the given level of the money wage is fixed at a level high enough to ensure that the

real wage is high enough to call forth an unlimited supply of labour into this sector from the subsistence sector.

In sum, this sector operates as a fixprice sector (in Hicksian terminology) in which the level of output responds to the level of demand in the standard Keynesian way.

3.3 THE CAPITALIST AGRICULTURAL SECTOR

In the A sector, capitalist landowners are assumed to organize production on their land.[20] A single product, foodgrains, is produced in the sector with two factors of production, homogeneous labour, which is entirely hired, and homogeneous land (which may be generalized and thought of as land-capital) with the help of a fixed coefficient Leontief production function. The amount of land is taken as fixed throughout the analysis. This assumption, introduced for simplicity, could be relaxed, and land-capital could be assumed to be growing at some exogenously fixed rate.

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[20] Such a description of the agricultural sector certainly does injustice to the diverse forms of tenurial arrangements existing in Indian agriculture. But to consider more fully these diverse relations in agriculture would make our models helplessly complicated. In any case, it should be remembered that a peasant agriculture does exist in our model in the subsistence sector. For a more careful treatment of the agricultural sector, see the next essay in this dissertation.

The crucial assumption is that the amount of land-capital does not respond to changes in other economic variables considered in the model and, given the fixed coefficients assumption, this implies that agricultural output does not respond to changes in any of the variables of the model, for example, the level of the agricultural price. This assumption is consistent with the vision that agricultural output is constrained by conditions of land tenure and agricultural technology, which can be taken, for simplicity, to be depending on factors exogenous to our model.[21] The assumption that the production function is of the fixed coefficients variety is once again a simplifying one, but may not be an unrealistic one.[22] The money wage in the agricultural sector is assumed to be given and equal to that in the N sector, for simplicity. Finally, the market for foodgrains is assumed to be competitive, and prices are assumed to be able to vary to bring demand and supply into equality.

In sum, the A sector is a Hicksian flexprice sector in which output is given, and prices can vary to equilibriate the market.

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[21] This assumption is not necessarily contradicted by the evidence that the level of production of particular agricultural products responds to price changes. Here we are concerned with total agricultural production and not with outputs of specific products.

[22] See, Vaidyanathan (1974), for example.

3.4 THE ECONOMIC AGENTS

Apart from the agents in the subsistence sector, there are three distinct types of agents in the economy we are describing: workers, capitalists, and firms.

Workers - who may work either in the N sector or in the A sector - are all assumed to be identical. They have only one source of income: wages. Given low wages, the workers are assumed to be too poor to save, and hence consume all their incomes. We shall assume that they spend a constant fraction of their income on food and the rest on the manufactured good. While this assumption greatly simplifies our analysis it does assume away the existence of empirically important Engel effects. We shall later comment on the implication of such effects.

As regards capitalists, we do not distinguish between capitalists in the N and A sectors, all of them being assumed to be identical. Capitalists earn income from two types of sources: from the cultivation of agricultural land, and from the other assets that they own. They either save[23] or consume their income. Their consumption is assumed to depend on the value of

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[23] For data on differences in saving propensities of different income groups see N.C.A.E.R. (1980). See also the previous chapter in this thesis for further discussion of saving propensities, and for other data for India on some of the features only touched on in this section.

their marketable wealth, and not on income. They take their marketable wealth to be an indicator of how rich they are, so that as this wealth increases, they are assumed to consume more, though only marginally more, given their already high consumption levels. The assumption that consumption does not depend on income is a simplification, but it would also seem that capitalist consumption would be more likely to depend on their asset positions, than on their current incomes. Capitalists do not consume food in the model, and spend their entire consumption expenditure on the purchase of the manufactured good, an assumption reflecting the low weight of food in the consumption basket of the rich. In addition to deciding on how much they want to consume and save, capitalists must also decide how they want to hold their assets. They are assumed to be holding several types of marketable assets, which can include money, foodstocks, and some kind of claims on capital. Land is assumed not to be a marketable asset, given the fact that land markets are essentially frozen in India, there being hardly any purchase or sale of land.[24] Claims on capital can be thought of as bonds which firms sell to capitalists, for which they get interest payments. The market for such securities is not very well developed in India, but we assume their existence for reasons of simplicity. In India, deposits with commercial banks are quantitatively much more important; we abstract from all consideration of financial intermediation in the model, and assume that capitalists directly buy securities, instead of financial intermediaries doing it for them. The capitalists are assumed to

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[24] See Vyas(1970) and Sau(1981), for example.

hold the different marketable assets as fractions of their total marketable wealth, the fractions depending on the rates of return obtained from the holding of each type of asset, in the usual Tobinesque manner.[25]

Finally, firms, which are assumed to exist only in the N sector, must decide on how much to invest, in addition to deciding how to set prices and how much to produce, decisions which have already been discussed above. Regarding investment, firms are assumed to choose a ratio of investment to capital depending on the difference between the rate of profit in the N sector and the cost of capital, that is, the interest rate paid to capitalists. When the rate of profit is equal to the interest rate, firms are assumed not to invest at all.

3.5 COMMENT ON LONG RUN EQUILIBRIUM

As described above, we shall assume that the level of the money wage and the level of land-capital in the agricultural sector are given. The level of money supply will also be taken to be given. We have also assumed that when the rate of profit equals the interest rate, N sector investment will fall to zero. All these assumptions are simplifying assumptions in the

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[25] See Tobin (1969).

model, which play the role of characterizing long run equilibrium in our models in a very simple way, giving it a stationary solution. Relaxing all these assumptions and allowing money supply and agricultural land to grow exogenously, money wages to respond sluggishly to cost of living chages, and investment also to have an exogenous component,would give us a more complicated long run equilibrium, giving a steady state instead of a stationary state. Since the growth rate in steady state would be exogenously given by the growth of land-capital in the A sector, the analysis would not be fundamentally different from the analysis of the model using our assumptions. Hence we shall abstract from such complications to analysis stationary long run equilibria. Changes from equilibrium positions could then be interpreted as deviations from trend.

4.THE MODEL WITHOUT FOOD STOCK-HOLDING

4.0 INTRODUCTION

In this section we consider a model of the economy described in the previous section in which there is no food speculation. The model is essentially a standard IS-LM model[26] extended to include an agricultural sector.[27] Our rationale for examining such a model is to compare it with a model which differs from it only in so far as it allows food speculation as well.

We first consider the equational structure of the model and see how short run equilibrium is determined. Then we consider how the economy moves through time and examine how long run equilibrium is determined. Finally, we consider how the economy, starting from a long run equilibrium position, reacts to some parametric changes in the short run and in the long run.

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[26] See, for example, Backhouse (1981).

[27] Following Cardoso (1981), Taylor (1982) and Taylor (1982a).

4.1 THE SHORT RUN

The short run is defined as a period of time in which the stock of capital in the N sector can be taken to be given. We first examine the equational structure of the model, then consider the question of short run stability, and finally examine how short run equilibrium may be depicted.

4.11 EQUATIONAL STRUCTURE OF THE MODEL

To describe the equational structure of the model, consider first the agricultural sector. The output of the sector, Q_a, given the Leontief technology and the assumption of unlimited supply of labour, is given by

$$Q_a = a_a A \tag{4.1}$$

where a_a is the output-land ratio in agriculture, and A is the given available stock of land (or land-capital). The demand for labour, and hence actual employment in the A sector is therefore given by

$$L_a = b_a Q_a \tag{4.2}$$

where L_a is employment in the A sector, and b_a is the labour- output ratio.

Consider now the non-agricultural sector. Since firms set the price as a markup over prime costs, and the only factor entering prime costs is labour,[28] the price level in the N sector, p_n is given by

$$(4.3) \qquad p_n = (1+\tau)\ w\ b_n$$

where τ is the rate of markup in the N sector, assumed to be given; b_n is the labour-output ratio in the sector, given technologically; and w is the given money wage in the capitalist sectors of the economy. The demand for labour, and hence actual employment in this sector, L_n, is given by

$$(4.4) \qquad L_n = b_n\ Q_n$$

Since the firms' profit is given by $p_nQ_n - wb_nQ_n$, the rate of profit in the sector, r_n, as a ratio of capital valued at replacement cost, can be written as

$$(4.5) \qquad r_n = [\ \tau/(1+\tau)\ ]\ \ Q_n/K$$

where K is the stock of capital in the sector, which is given in the short run.

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[28] We are assuming that there are no agricultural intermediate goods, for simplicity; the model could be extended to consider that case.

Turning next to expenditures by different classes, we have assumed that workers consume their entire income, and spend on both food and manufactured goods: we shall assume that a fraction a of their income is spent on food, and the rest on non-food. Capitalists consume only manufactured goods, and this consumption depends on wealth, the dependence being represented by a function $c(W)$ where W is the value of wealth. Given these assumptions the consumption demands for the products of the N and A sectors, are given, respectively by

$$p_n C_n = (1-a)w\ (L_a+L_n) + c(W) \tag{4.6}$$

$$p_a C_a = wa\ (L_a+L_n) \tag{4.7}$$

where C_i denotes the physical consumption demand for the product of sector i, and p_a is the price of foodgrains. We shall assume that $c'=dC/dW > 0$, but is very small, given that the consumption of capitalists is already large and that they will therefore not want to increase their consumption by much when W increases.

Land not being a marketable asset in the model and food not being held as a stock in this model without food speculation, marketable wealth can be held in two forms, either as claims to capital, or as money. The stock of money is assumed to be given at the level M. The physical stock of capital K is given, but the price of claims on capital can diverge from the price of investment goods owing to the reasons discussed by Tobin (1969). Firms pay

interest to asset holding capitalists at the rate i for holding claims on capital. The value of wealth is therefore given by

(4.8) $W = vp_nK + M$

where v is the valuation ratio of capital, or the relative price of existing capital to new capital, and is given by

(4.9) $v = r_n/i$

The demand for assets of different kinds depends on the rates of return on different assets. The nominal return to holding money is zero, and that to holding claims on capital is i. The demand for the two assets is therefore given by

(4.10) $M^d = m(i)\ W$

(4.11) $vp_nK^d = k(i)\ W$

where the d superscripts refer to demands to distinguish them from actual quantitites available, and m and k are the fractions in which asset holders wish to hold money and claims on capital. Obviously, $m'=dm/di<0$ and $k'=dk/di>0$, since a rise in i will imply that holding claims on capital becomes more profitable.

Finally, concerning investment demand in the N sector, firms decide on investment by comparing the returns to, and the costs of, investment. We assume a simple form of the investment function given by

$$(4.12) \qquad I = \phi(r_n - i)\, K$$

where I is the investment demand by firms, the first derivative of the function ϕ, that is, $\phi' > 0$ and $\phi(0) = 0$.[29]

Short run equilibrium in this economy is attained when the two commodity markets and the asset markets clear. The market for the non-agricultural good clears when output is equal to consumption and investment demand, the market for the agricultural good clears when output is equal to consumption demand, and the money market clears when the demand for money is equal to the available stock. Hence for equilibrium we require

$$(4.13) \qquad Q_n = C_n + I_n$$

$$(4.14) \qquad Q_a = C_a$$

$$(4.15) \qquad M = M^d$$

Q_n varies to clear equation (4.13), p_a to clear equation (4.14), while i varies to ensure the equality in equation (4.15). Note that by Walras'

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[29] This investment function is identical to Tobin's (1969) function. Tobin's q is equal to our $v = r_n/i$. So in long run equilibrium, (see below), as $r_n=i$, $q=1$.

law, equation (4.15) ensures equilibrium in both asset markets, which can be verified by looking at equations (4.8), (4.10) and (4.11).

4.12 SHORT RUN STABILITY ANALYSIS

The short run has been assumed to be a period of time in which the stock of capital in the N sector, K, is taken as fixed, and in which Q_n, p_a, and i vary to clear the non-agricultural, agricultural, and the asset markets. In this subsection we consider explicitly the short run dynamics of the model to examine what stability conditions must be imposed on the model to ensure that short run adjustment to equilibrium is stable.

We assume that the short run dynamics of the model are given by

(4.13a) $$dQ_n/dt = \theta \left[p_nC_n + p_nI - p_nQ_n \right]$$

(4.14a) $$dp_a/dt = \mu \left[p_aC_a - p_aQ_a \right]$$

(4.15a) $$di/dt = \lambda \left[M^d - M \right]$$

where θ, μ, and λ are positive constants, denoting speeds of adjustment in the three markets, and where t denotes time. The adjustment in each of the equilibriating variables is seen to depend on the excess demand gap in each market; excess demand gaps are measured in nominal units rather than in

physical units for simplicity: in the N market, since p_n is a constant anyway, no difference is made due to this, and in the A market we are actually assuming that the proportional rate of adjustment depends on physical excess demand.

Substitution from equations (4-1) through (4-12) implies that (4.13a) through (4.15a) can be written as

$$(4.13b)\quad dQ_n/dt = \theta\,[(1-a)wa_aA+c(\tau Q_n wb_n/i + M) + p_n\phi((Q_n/K)\,\tau/(1+\tau)- i)-(a+\tau)wb_nQ_n]$$

$$(4.14b)\quad dp_a/dt = \mu\,[wa a_a b_a A+wa b_n Q_n-p_a a_a A]$$

$$(4.15b)\quad di/dt = \lambda\,[m(i)(\tau Q_n wb_n/i + M) - M]$$

The Jacobian for the above three by three system can be written as

$$J = \begin{bmatrix} -[a+\tau(1-\phi'-c'/i)]wb_n & 0 & -[\phi' p_n K+\tau wb_n Q_n\, c'/i^2] \\ wa b_n & -a_a A & 0 \\ m\tau wb_n/i & 0 & -(m\tau Q_n wb_n/i^2 - m'w) \end{bmatrix}$$

Sufficient conditions for the local dynamic stability of the system are that the Jacobian J should satisfy the following properties: the trace must be negative; the sum of the second order principal minors must be positive; and the determinant must be negative. It can easily be checked that all three conditions are fulfilled when $1-c'/i-\phi'>0$, so that a sufficient

condition for the short run stability of the system is that $1-c'/i-\phi'>0$. The condition simply states that the responsiveness of savers exceeds the responsiveness of investors, which is the standard stability requirement of all Keynesian macro-models. We shall assume in what follows that this stability condition is fulfilled.

4.13 THE DETERMINATION OF SHORT RUN EQUILIBRIUM

Consider now the determination of equilibrium in the short run. Substituting equations (4.1) through (4.12) in equations (4.13) to (4.15), or what is the same thing, setting the left hand sides of equations (4.13b) through (4.15b) equal to zero, we get the short run equilibrium conditions for the economy

(4.13c) $(1-a)wa_ab_aA+c(\tau Q_nwb_n/i + M)+ p_n\phi((Q_n/K)\tau/(1+\tau) - i)K -(a+\tau)wb_nQ_n=0$

(4.14c) $wa a_ab_aA + wab_nQ_n- p_aa_aA=0$

(4.15c) $m(i)$ (

The three equations have three unknowns, p_a, i, and Q_n, which are determined by them. Specifically, equations (4.13c) and (4.15c) solve for Q_n and i, and equation (4.14c) then solves for p_a.

The determination of equilibrium is shown graphically in Figure 1. We can depict combinations of Q_n and i satisfying equation (4.13c), that is, ensuring N market equilibrium, as the NN curve in the figure. A rise in the interest rate reduces the value of wealth and hence consumption, and

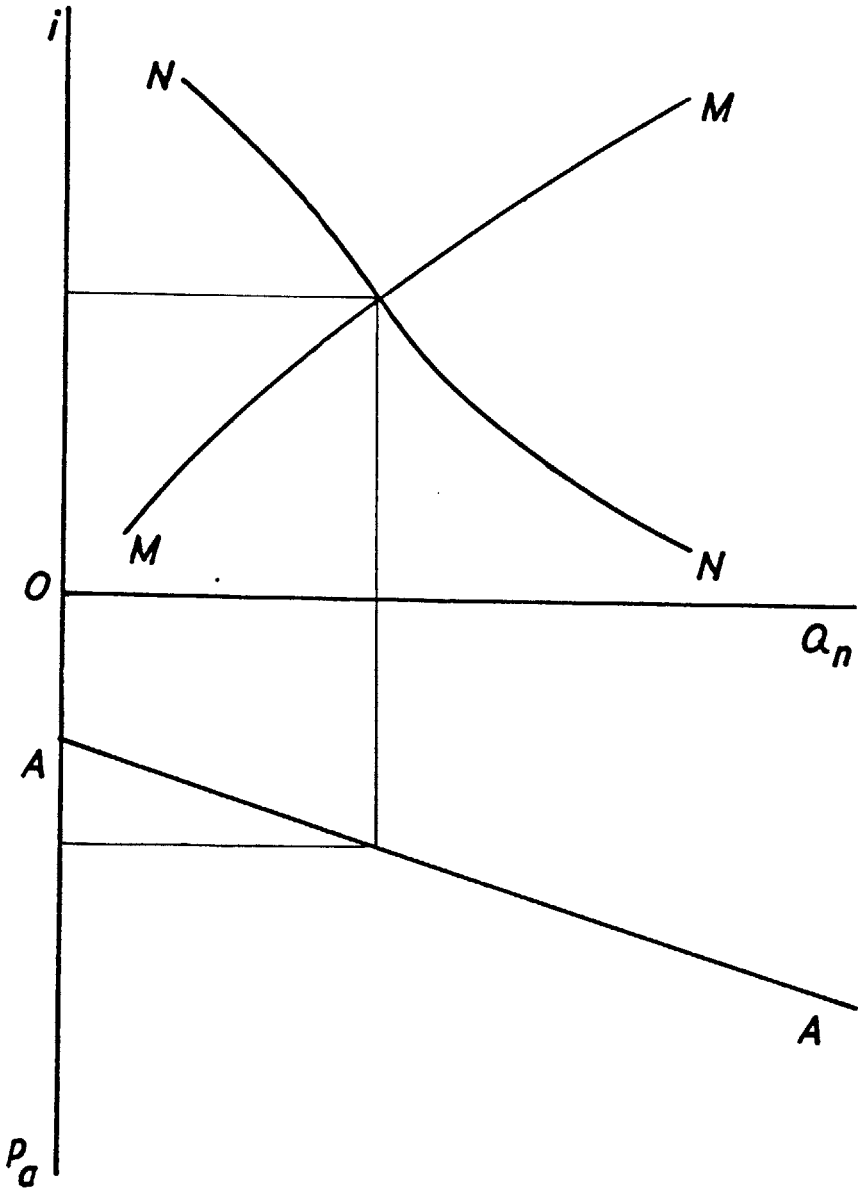


Figure 1. Determination of Short Run Equilibrium in the Model without Speculation

reduces investment implying an excess supply of the N good so that Q_n must fall to restore equilibrium: hence the downward sloping curve. Equation (4.15c), showing combinations of Q_n and i giving money market equilibrium, is depicted as the MM curve in the figure. The curve slopes up because a rise in i reduces the demand for money both by reducing the value of wealth and by reducing the fraction of wealth asset holders wish to hold as money, so that Q_n must rise to increase the value of wealth to restore equilibrium by increasing the demand for money. Equation (4.14c), showing combinations of Q_n and p_a giving A market equilibrium, are shown as curve AA in the lower quadrant. This curve slopes upwards because a rises in Q_n increases the demand for food by increasing non-agricultural employment, and p_a must rise to restore equilibrium. Equilibrium i and Q_n are determined in the upper quadrant by the intersection of the NN and MM curves, and the lower quadrant consequently determines p_a

A final comment on equilibrium. In short run equilibrium, obviously, saving must be equal to investment. This can be shown by writing

$$p_a Q_a = wb_a Q_a + (p_a Q_a - wb_a Q_a)$$

which shows how agricultural output is distributed between workers and capitalists earning profits. In the N sector, the distribution of income is shown by multiplying through (4.3) by Q_n and writing

$$p_n Q_n = wb_n Q_n + rwb_n Q_n$$

Adding the two equations and using equations (4.13) and (4.14) gives

$$rwb_nQ_n + (p_aQ_a - wb_aQ_a) - c(W) = p_nI$$

Since capitalists are the only ones who save, saving is given by their income less their consumption which is shown on the left hand side of the equation, which therefore is seen to give the saving-investment equality.

4.2 LONG RUN EQUILIBRIUM AND STABILITY

The only short run parameter which our model allows to be a variable in the long run is the stock of capital in the non-agricultural sector. In long run equilibrium, this variable attains its long run equilibrium level, and does not grow any further.[30] In this subsection we first examine how the economy moves over time, then examine how long run equilibrium is determined, and finally consider the long run stability property of the model.

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[30] See the comments in the concluding subsection of section 3.

4.21 MOVEMENT OF THE ECONOMY

Assuming away depreciation of capital in the N sector, for simplicity, the addition to the stock of capital at any point in time is given by investment at that point in time. Thus, we have

(4.16) $dK/dt = I$

This equation describes how the economy moves through time. Geometrically, starting from any given level of K, we can solve for the equilibrium values of the variables Q_n, i and p_a in Figure 1; then, from equation (4.12) we can solve for the level of I. This I will be the addition to the stock of capital, so that for the next instant in time we have to start with the new stock of capital, which will only have the effect of shifting the NN curve, leaving the other curves unaffected.

4.22 LONG RUN EQUILIBRIUM

At long run equilibrium we require that $dK/dt = 0$ which implies

(4.17) $I = \phi(r_n - i)\ K = 0$

which implies, for $K>0$, that

(4.18) $(Q_n/K)\ \tau/(1+\tau) = i$

Since at the long run equilibrium (henceforth LRE) the two commodity markets and the asset markets must clear, we must have

(4.19) $(1-\alpha)wa_ab_aA + c(\tau Q_n wb_n/i + M) = (\alpha+\tau)wb_nQ_n$

(4.14c) $w\alpha a_ab_aA + w\alpha b_nQ_n = p_aa_aA$

(4.15c) $m(i)\ (\tau Q_n w_n/i + M) = M$

Figure 2 shows how long run equilibrium is determined. Equation (4.19) gives the LN curve which shows the relationship between i and Q_n ensuring N market equilibrium at LRE. The MM and AA curves are the same as shown in Figure 1. The LRE values of Q_n and i are determined in the upper quadrant, and p_a is determined in the lower quadrant. Once Q_n and i are determined, K can be solved for from equation (4.18).

4.23 THE STABILITY OF LONG RUN EQUILIBRIUM

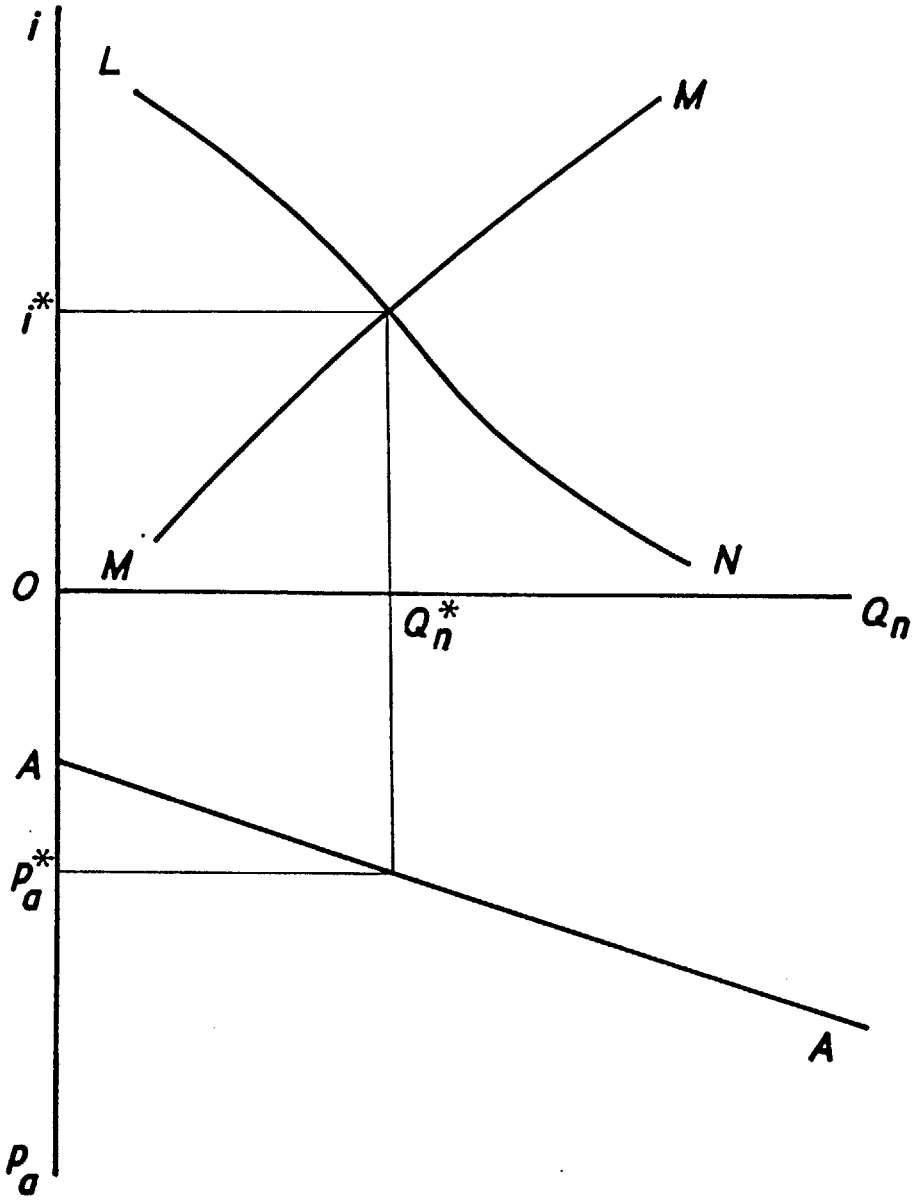


Figure 2. Determination of Long Run Equilibrium in the Model without Speculation

Since we will be concerned with examining the behaviour of the economy when some changes occur when the economy is already at a LRE, we should first examine whether that LRE is locally dynamically stable.

Long run stability merely requires that $d(dK/dt)/dK < 0$ when evaluated at LRE. We have, quite generally,

$$d(dK/dt)/dK = \phi + \phi'[\ (dQ_n/dK)\tau/(1+\tau) - (Q_n/K)\tau/(1+\tau) - (di/dK)K\ ]$$

Also, we have

$$dQ_n/dK = -(a_a A/|J|)(\phi - \phi'(Q_n/K)\tau/(1+\tau))p_n(m\tau Q_n w b_n/i^2 - m'W)$$

$$di/dK = (a_a A/|J|)(\phi - \phi'(Q_n/K)\tau/(1+\tau))\ m\tau w b_n/i$$

where $|J|$ is the determinant of the Jacobian J defined above. Using these, together with the LRE conditions we can check that at LRE we have

$$d(dK/dt)/dK = -\phi' i\,[\phi'(a_a A p_n/|J|)(\tau/(1+\tau))m'W + 1]$$

which, given that $m'<0$ and $\phi'>0$, is clearly negative. The the LRE is seen to be stable. Since we have underutilized capacity in this model, an increase in K has no supply side effects: the only effects it can have are through its effects on aggregate demand. Given Q_n and i, the only effect that an increase in K has on the model is to affect I. The rise has two effects working on opposite directions. First, the increase in K reduces

the rate of profit, and hence reduces investment. Second, there is a rise in investment given the rate of profit. The net effect on aggregate demand will depend on which of these effects is stronger. At LRE, clearly, with I = 0, the second effect is inoperative, so that the rise in K must reduce aggregate demand and investment, so that our stability result follows.

4.3 SHORT RUN EFFECTS OF PARAMETRIC SHIFTS

In this and the next subsection we shall be concerned with the effects of parametric shifts on the economy without food speculation, so that we can compare these effects with those of the same shifts on the economy with food speculation. In this subsection we consider the short run effects of parametric shifts for the economy starting from LRE; long run effects will be discussed in the next subsection.

We shall consider three kinds of parametric shifts: changes in the stock of money supplied by the Central Bank, a temporary change in the amount of agricultural land, and a change in the technological parameters in agriculture. While other parametric shifts could also be considered, they are not pursued here. Apart from the effects of these changes on Q_n, i and p_a, we will look at the effects on the rate of growth of the economy, which we shall measure as g=I/K (since the N sector is the only growing sector in

the short run; no sector, of course, grows in the long run as we have defined it), and on income distribution, which we shall consider by looking at two variables, the level of employment in the capitalist sectors of the economy, and the real wage, which, given the consumption pattern of workers, may be measured as

$$(4.20) \qquad \omega = w/(p_a^{\alpha} p_n^{1-\alpha})$$

An increase in employment will reflect an improvement in the welfare of those agents initially in the subsistence sector, increase in the real wage will reflect an increase in the welfare of workers in the capitalist sector, while a fall in employment will reflect a loss in the welfare of workers in that sector.

4.31 CHANGE IN MONEY SUPPLY

Totally differentiating the short run equilibrium conditions given in equations (4.13c) through (4.15c)with respect to M and imposing the LRE conditions we can see that

$$dQ_n/dM = [\, k^2\phi' + c'(k/i - m') \,] \;/\; wb_n\Delta$$

$$dp_a/dM = \alpha[\phi' k^2 + c'(k/i - m')] \;/\; a_a A\Delta$$

$$di/dM = [\ c'\tau/i - (\alpha+\tau(1-\phi))k\ ] / W\Delta$$

where

$$\Delta = \alpha(mk-m') - \tau m'(1-\phi'-c'/i)$$

Given that $\Delta>0$, given the stability assumption, dQ_n/dM and dp_a/dM are both positive. The effect on i cannot be definitely signed. However, given our assumption that c' is likely to be small, the likely case is for di/dM to be negative.

The rise in M, given Q_n and i, raises the value of wealth, and thereby increases capitalist consumption, creating an excess demand in the N market. For equilibrium, Q_n must rise, so that in Figure 3,which is the same as Figure 1 except that NN is drawn for I = 0 initially, the NN curve shifts to the right. Also, the increase in M raises the value of total wealth, thereby increasing the demand for money, but by less than the increase in supply, so that we have an excess supply of money. i must therefor fall to restore equilibrium, implying that the MM curve will shift downwards. If c' is small, the shift in the NN curve will be small, and the shifts will occur to positions like N'N' and M'M', so that i will fall and Q_n and p_a will both rise.

Since Q_n rises with M, so that the rate of profit in the N sector rises when M increases, and i may be expected to fall when M rises, one would expect that I, and therefore g, will rise when M is increased. Indeed, one can show that

$$dg/dM = \phi' \; [\; (\alpha+\tau)k+\tau\phi'm-c'\tau m'/k \;] \; / \; W\Delta$$

which is seen to be unambiguously positive. Regarding income distribution, since p_a rises as M increases, from (4.20) it follows that ω, the real

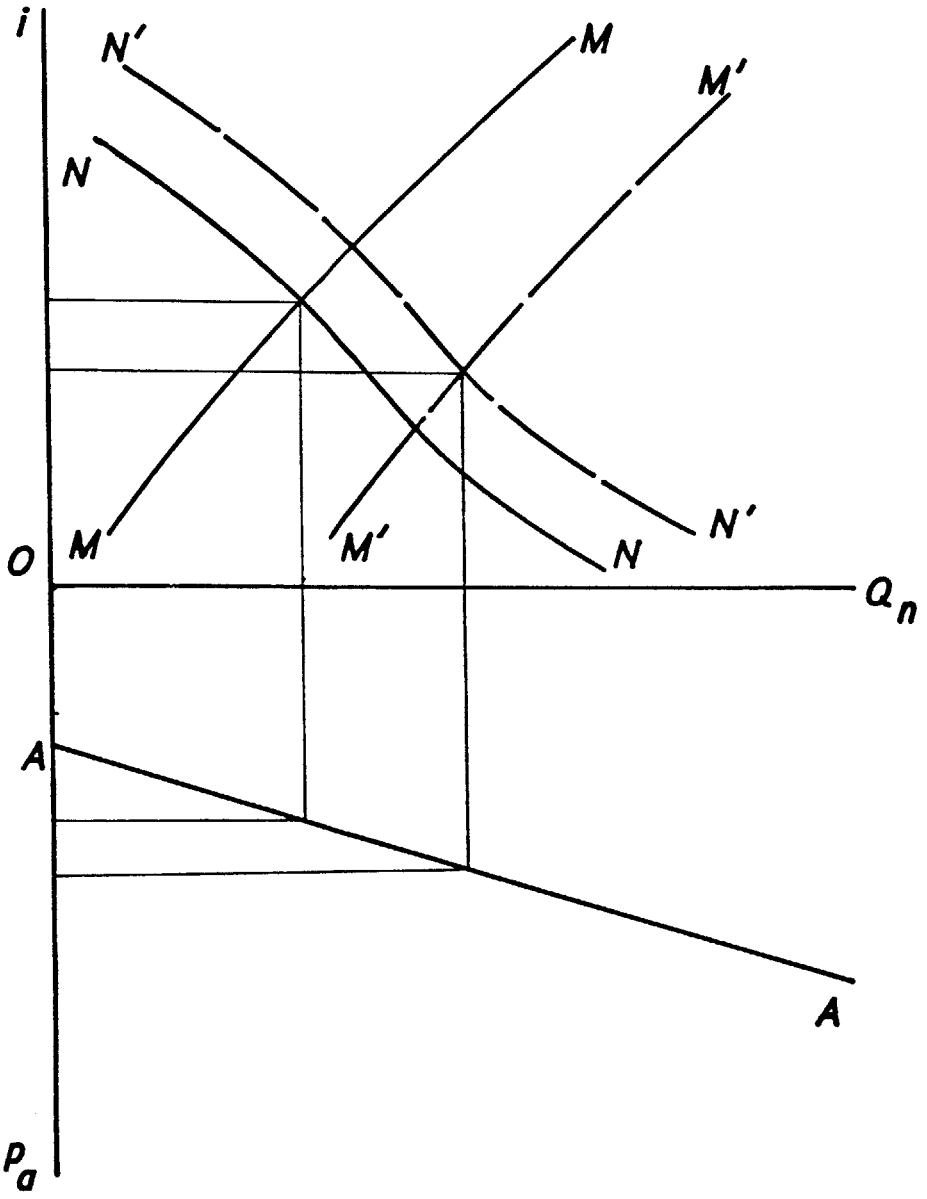


Figure 3. Effects of a Change in Money Supply in the Model without Food Speculation

wage, falls. Workers in the capitalist sector are therefore worse off. However, as employment increases with Q_n, subsistence sector agents will be better off if one believes that coming to the capitalist sector makes them happier.

In sum, an increase in M increases Q_n, p_a, employment, and the growth rate of the N sector, while reducing ω, and probably i.

4.32 CHANGE IN THE AMOUNT OF CULTIVATED LAND

We now examine the consequences of a change in the amount of land (or land-capital), A. This change will be thought of as being a temporary change in A, to be reversed in the long run; that is, at the new long run equilibrium level, A will have returned to its initial level. This exercise can be thought of as an attempt to model the implications of a harvest failure due to bad weather which affects the amount of land harvested, and hence the output and employment.[31] The exercise can also be seen as trying to examine the consequences of a famine caused by a harvest failure,

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[31] Realistically, the employment effect would only be on labour used for harvesting, as farmers would still use labour for ploughing and planting, since bad weather would typically be unexpected. We abstract from such complications arising from the seasonality of agriculture here.

although in a very simplistic way, ignoring many features of such famines. All these changes would imply a fall in A, to be reversed in the long run.

Totally differentiating the equilibrium conditions (4.13c) through (4.15c)with respect to A and imposing the condition that the economy was at long run equilibrium initially we get

$$dQ_n/dA = (1-\alpha)a_a b_a(mk/i - m') \;/\; b_n\Delta$$

$$dp_a/dA = -\{\,(p_a - w\alpha b_a)wb_n\tau[mk/i - m'(1-\phi'-c/i)] + (p_a - wb_a)\alpha(m/i - m')\,\} \;/\; wb_nA\Delta$$

$$di/dA = (1-\alpha)w\tau a_a b_a m/i \;/\; W\Delta$$

where Δ has been defined above. Given that $\Delta > 0$ and $p_a - wb_a > 0$ (that is, capitalist farming is profitable), it is clear that $dQ_n/dA > 0$, $dp_a/dA < 0$ and $di/dA > 0$.

How such effects operate can be seen by looking at Figure 4. The Figure shows the economy initially in short run equilibrium and is identical with Figure 1, except that the NN curve is drawn for I = 0. A fall in A will imply a lower employment of labour in the A sector, and hence a lower demand for N goods and agricultural goods. The reduced demand for N goods reduces the output of N goods, which means that the NN curve shifts to the left to a position like N'N'. The MM curve is obviously unchanged. Howev-

er, the reduced output of food implies that at a given Q_n, p_a must rise, which implies that the AA curve must rotate downwards to a position like AA' as shown in the lower quadrant. Hence, when A falls, Q_n and i fall. Since the retardation in the output of food exceeds the reduction in the demand for food due to the fall in employment in both sectors as long as positive profits are made in agriculture, p_a must rise.

To examine the effects on growth and income distribution, note that

$$dg/dA = - [(1-\alpha)wa_a\tau\phi'm'/k] / W\Delta$$

which shows that a fall in A will reduce the rate of growth by reducing output and the rate of profit relative to the interest rate and thereby reducing investment. Also, since the fall in A implies a rise in p_a and a fall in L_a and L_n, both ω and total employment will fall, workers becoming worse off.

In sum, the bad harvest will have the effect of reducing non-agricultural output and the interest rate, reducing the rate of growth in the non-agricultural sector, raising agricultural price, and reducing the real wage.

4.33 CHANGE IN AGRICULTURAL TECHNOLOGY

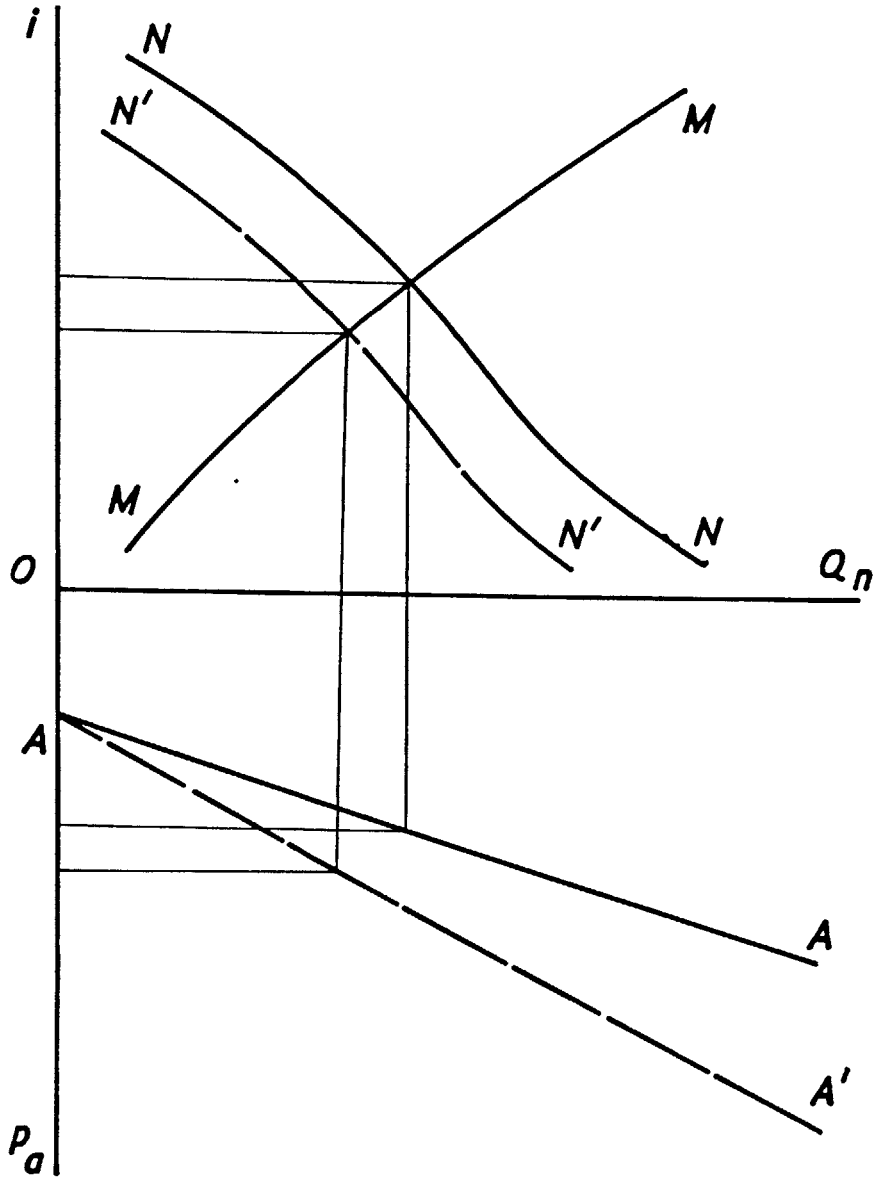


Figure 4. Effects of a Bad Harvest in the Model without Food Speculation

A technological change in the agricultural sector can be represented by a shift in the technological parameters a_a and b_a, technological progress being depicted by a rise in a_a, implying a rise in the productivity of land, and a fall in b_a, implying a rise in the productivity of labour. A rise in a_a, as an inspection of the system of equations (4.13c) to (4.15c) shows, will have the same effect as a rise in A, since a_a always enters multiplied by A in that system, so that this case need not detain us any further. The effect of a fall in b_a is also simple to analyse - agricultural employment would be reduced with no change in agricultural output, so that the demand for N goods and A goods would fall, implying a fall in Q_n, p_a, and i.

We shall be concerned later with a specific kind of technological change which simultaneously raises a_a and reduces b_a, but keeps their product constant. This implies that technological change raises agricultural output, but keeps constant the amount of labour required per unit of land. This kind of a technological change seems to be rather special in character, but makes our analysis of technological progress simple, as shall be seen later. Moreover, it has been argued that in India technological change, as generated by the celebrated Green Revolution, has this special character in the sense that the requirement of labour per unit of land seems to be the same before and after the technological change.[32] The effects of this kind of a change are shown in Figure 5. Since the amount of labour per unit of

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[32] See, for example, Abhijit Sen (1981).

land is unchanged, and since the amount of land is unchanged, there is no change in the level of employment in the A sector, and hence no reason for a change in the demand for either the A good or the N good. Thus both NN and MM curves will be unaffected. However, since agricultural output will rise, there must be a fall in p_a at each level of Q_n to restore equilibrium in the A market, which requires that the AA curve must shift to a position as shown by line A'A' in the Figure. Hence, the change will leave Q_n and i unchanged, but reduce p_a, which implies that g will be unchanged, employment will be unchanged, but ω will rise.

4.4 LONG RUN EFFECTS OF PARAMETRIC SHIFTS

In this subsection we shall be concerned with the long run effects of the parametric shifts discussed in the previous section, that is, after the level of K can change, and attains its new long run equilibrium value.

4.41 EFFECTS OF A CHANGE IN MONEY SUPPLY

The effects of a change in money supply in the long run can be seen by totally differentiating the long run equilibrium conditions given in (4.15c) and (4.19) to solve for dQ_n/dM and di/dM to give

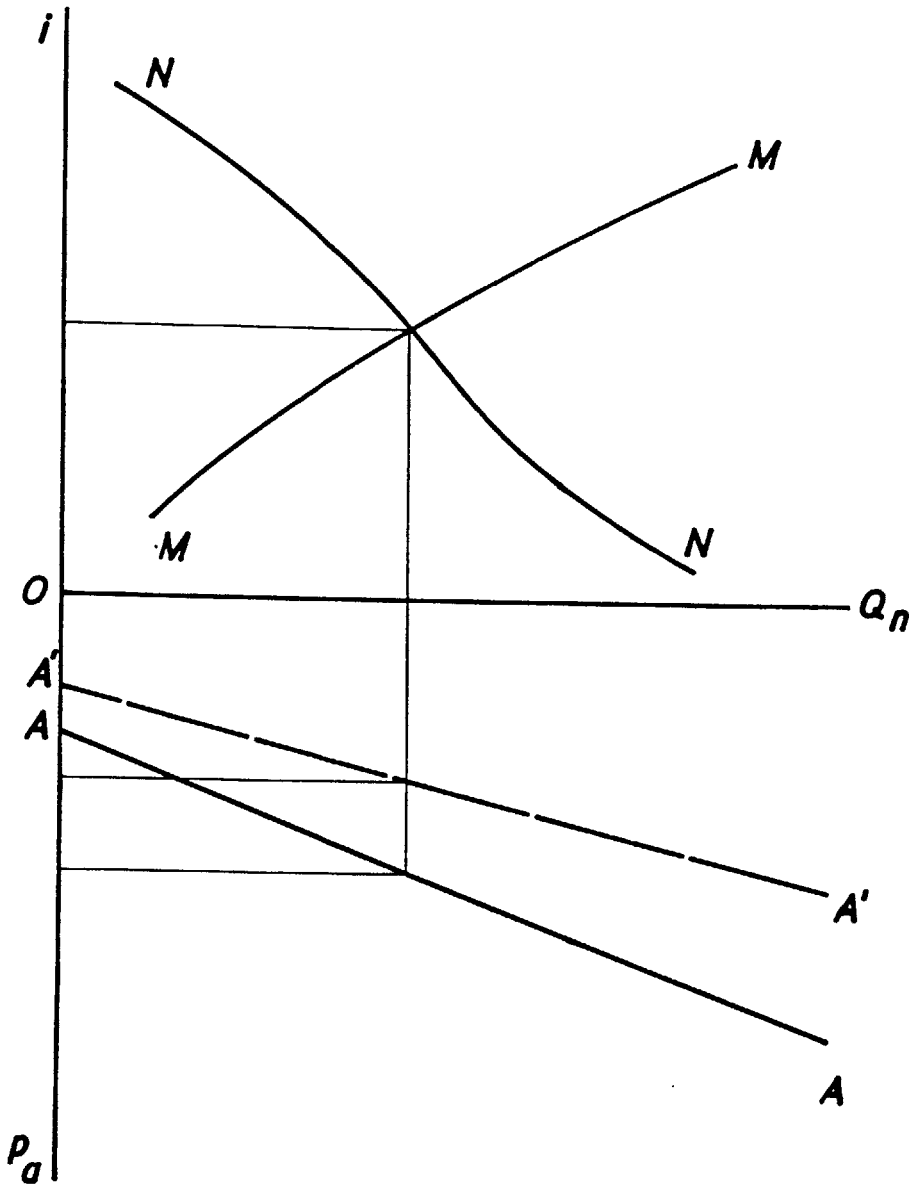


Figure 5. Effect of Technological Change in Agriculture in the Model without Food Speculation

$$dQ_n/dM = c'W(k/i - m') \;/\; D$$

$$di/dM = -[\; wb_n((a+\tau)k - \tau c'/i) \;] \;/\; D$$

where

$$D = wb_nW[(a+\tau)(mk/i - m')+\tau c'm'/i]>0$$

Clearly, $dQ_n/dM>0$ and $di/dM<0$ if c' is small, as assumed. From equation (4.14c) it follows that as $dQ_n/dM>0$, $dp_a/dM>0$, and from equation (4.18) it follows that as $dQ_n/dM>0$ and $di/dM<0$, $dK/dM>0$. Since p_a rises when M rises, w must fall, but total employment will fall as N sector output rises. The rate of growth returns to zero. The effects on Q_n and i can also be seen from Figure 2: a rise in M will cause MM and LN to shift to the right, but if c' is small, as assumed, the shift in LN will be less, so that i must fall and Q_n must rise. This rise in Q_n will, in the lower quadrant, imply a rise in p_a.

4.42 EFFECTS OF A HARVEST FAILURE

Given that the harvest failure only results in a temporary decline in A, which is reversed in the long run, the long run value of A must be the same as before, which implies that in the new long run equilibrium all variables must return to the values that existed before the harvest failure: the short run effects will be washed away as A recovers to its initial level.

4.43 EFFECTS OF A TECHNOLOGICAL CHANGE IN AGRICULTURE

We shall confine our attention to the kind of technological change which leaves $a_a b_a$ unchanged, though raising the productivity of both land and labour in agriculture. It will be recalled that in the short run, this kind of technological change leaves i and Q_n unchanged, which implies that the level of investment will not change, and since I=0 initially, the fact that it still remains at the same level implies that over the long run K will not change. It follows that there will be no further changes in the long run: the short run changes will carry over exactly into the long run.

5.THE MODEL WITH FOOD SPECULATION

5.0 INTRODUCTION

Our purpose in this section is to consider a model of the economy in which food speculation occurs. We shall first consider the equational structure of the model for the short run. Then we shall consider the question of short run adjustment and stability of the model under different kinds of assumptions regarding expectations formation, such as static, adpative, rational, and partially rational expectations. Finally, we shall examine the nature of long run equilibrium in the model, and the question of long run dynamics under different kinds of assumptions regarding expectations formation.

5.1 THE SHORT RUN MODEL

The short run model described here is essentially the same as the model discussed in the previous section, except insofar as it allows asset holders to hold foodstocks, in addition to money and claims on capital, as an asset. In this model the short run is defined as a period in which the

stock of foodgrains held by stock-holders, F, is taken as given, in addition to the stock of capital in the non-agricultural sector, K.

For the agricultural sector we have

(5.1) $Q_a = a_a A$

(5.2) $L_a = b_a Q_a$

and for the non-agricultural sector we have

(5.3) $p_n = (1+\tau)wb_n$

(5.4) $L_n = b_n Q_n$

(5.5) $r_n = \tau/(1+\tau)\ Q_n/K$

Consumption demands for the two goods are given as

(5.6) $p_n C_n = (1-\alpha)w(L_a+L_n) + c(W)$

(5.7) $p_a C_a = w\alpha(L_a+L_n)$

So far there has been no difference in this model as compared to the model of the previous section. The first difference arises in the definition of the value of (marketable) wealth, for which we now have

(5.8) $W = vp_nK + p_aF + M$

to take into consideration the fact that asset holders can now hold foodstocks as an asset. As before, we have the valuation ratio given by

(5.9) $v = r_n/i$

Asset holders now have three assets to choose from, and we assume that they now hold a fraction m of wealth in the form of money, a fraction f as foodgrains, and a fraction k as claims on capital, where, obviously, m+f+k=1. These fractions are assumed to depend on the rates of return on the different assets. As before, the nominal rate of return on holding a unit of money is zero, and the nominal return on holding claims on capital is i. As argued in section 2, the nominal return on holding a rupee's worth of food is ρ^e, the rate of change of the agricultural price. Hence the demand functions for the three assets, with the superscripts d denoting demand, are given by

(5.10) $M^d = m(\rho^e,i)\ W$

(5.11) $vp_nK^d = k(\rho^e,i)\ W$

(5.12) $p_aF^d = f(\rho^e,i)\ W$

where $f_1>0$ and $k_2>0$, where the subscript i denotes the partial derivative with respect to the ith argument, and where all other partial derivatives, that is, m_1, m_2, f_2, and k_1, are assumed to be negative. Clearly, $m_i+f_i+k_i=0$. Also, we shall assume that the assets are gross subsitutes,

implying that $f_1k_2-f_2k_1>0$, which states that the demands for assets are more responsive to own rates of return than to rates of return on other assets, certainly a reasonable assumption to make.

Investment demand by firms, is given as before by

(5.13) $I = \phi(r_n-i)\ K$

Short run equilibrium is attained in the economy when, given the stock of food F and the stock of N sector capital K, the non-agricultural commodity market clears and all the asset markets clear. The N market clears when

(5.14) $Q_n = C_n + I$

The market for foodstocks clears when

(5.15) $F = F^d$

and the market for claims on capital clears when

(5.16) $K = K^d$

It can easily be verified that equations (5.15) and (5.16) imply, using equations (5.8) and (5.10) through (5.12) that $M = M^d$, so that Walras's law

takes care of money market equilibrium when we obtain equilibrium in the other two asset markets. Note that we use the capital market equilibrium equation here instead of the money market equilibrium condition as in the previous section. Here it does not matter which one is used, but it does make a difference which one we use for the dynamic equations to be given below. For, in the presence of three assets it is no longer true that the rate of change on i should depends on the excess demand for money - it should depend on the excess supply of capital.

Two comments on the nature of this short run equilibrium are in order. First, in the way equilibrium is defined in this model, it is not required that the consumption demand for food exhausts total food output. At any short run equilibrium, the divergence between the two will give us the change in the stock of foodgrains held by asset holders, so that we have[33]

(5.17) $$dF/dt = Q_a - C_a$$

Second, the above equations imply that total investment equals total saving in the economy. Multiplying (5.3) by Q_n and using (5.4), (5.5) and (5.9) we get

$$p_n Q_n = wL_n + ivp_n K$$

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[33] If food depreciates at rate δ, we have to write $dF/dt = Q_a - C_a - \delta F$.

Also, we have

$$p_a Q_a = wL_a + (p_a Q_a - wL_a)$$

These show how income is distributed in the two sectors. Adding the two together, and using equations (5.14),(5.6),(5.7), and (5.17) we get, on adding $(dp_a/dt)^e F$ to both sides,

$$(dp_a/dt)^e F + ivp_n K + (p_a Q_a - wL_a) - c(W) = p_n I + p_a \, dF/dt + F \, (dp_a/dt)^e$$

where $(dp_a/dt)^e$ denotes the expected change in food prices. The left hand side of the equation gives capitalist income from food speculation, ownership of claims on capital, and agricultural cultivation, less consumption, that is, capitalist saving, and hence, by our assumptions, total saving in the economy. The right hand side gives total investment in the economy, which includes investment in non-agricultural capital by firms and increase in foodstocks in value terms.

We have yet another matter to take care of before we can go any further, and that is to justify the nature of short run equilibrium assumed in this model, specifically, as regards the market for food. We have assumed that for equilibrium we require that the stock demand for food be equal to the available stock of food, that is, we have required stock equilibrium in the food market. We could have alternatively specified a flow equilibrium in the market, by assuming some kind of a speculation function which shows how

additions to foodstocks depend on different variables in the model, and required that for equilibrium this flow plus consumption demand gets equalised with food output. These two kinds of equilibrium concepts present two different 'visions' of the economic process: the former conceives of the entire stock of food as being at least potentially in the market, while the latter conceives of only a small fraction of the existing stock of food, of the same order of magnitude as additions to the existing stock being on the market at any moment.[34] There are three reasons why we have chosen the stock equilibrium specification rather than the flow specification. First, assuming flow equilibrium would require us to tell a story regarding why complete adjustment to the desired asset position is not possible in the short run and it seems that most such stories would have to be somewhat arbitrary. Second, to analyse the flow equilibrium specification properly would make us introduce, as arguments of the speculation function, time derivatives of rates of return, that is, expectations about the second time derivative of prices; this would make the analysis much more complicated.[35] Finally, and most important, given that there exists an active market for food as an asset, we believe that stock equilibrium for food is a better approximation of reality, a claim which could of course be falsified by empirical research on the matter. In this context we may also quote Hicks (1974), who writes

> One of the most important things which we have learned from Keynes is that prices, in a flexprice market, though they may appear to be

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[34] See Foley (1975).

[35] See Foley (1975) for a further discussion of both points.

> determined by current demand for the commodity and new supplies coming forward, are in reality determined by the willingness of traders to hold stocks. The equilibrium of the market is a stock equilibrium, not a flow equilibrium. Though Keynes made the point (in the 'General Theory') chiefly with reference to financial markets, it is clear that it holds quite generally - for all markets in which there is a holding of stocks.

In a footnote Hicks adds that "Flexprice markets in which there is no holding of stocks are very exceptional - in the real world, though not in economic textbooks!"

Having made these comments, let us return to our exposition of the model. A look at the structure of the model will make us realize that it is still incompletely specified. To complete the specification of the model we must specify how expectations regarding the rate of change in the food price are formed. There seems to be no universally accepted way in which such expectations may be modelled. Our approach will be to consider the implications of several different assumptions regarding expectations formation. We shall consider three different assumptions. The first and simplest one that we can make is that the expected rate of inflation of the food price is given, that is, ρ^e is a constant. If we assume that it is given for all time, that would be tantamount to assuming static expectations. If we assume it to be given in the short run, but changing slowly over time by some kind of adaptive process, then that would imply the assumption of slowly adaptive expectations. We shall call this first case the case of static-adaptive expectations. A second case we shall consider is the case of rational expectations or perfect foresight, in which asset holders are assumed to be able to make accurate forecasts of actual (future) price

changes. The final case we shall consider is the case we shall call the case of 'quasi-rational' expectations, in which asset holders can make exact forecasts of future levels of the price of food, but cannot make exact forecasts of the rate of inflation.

5.2 SHORT RUN DYNAMICS AND STABILITY

In this subsection we consider the nature of short run dynamics under the different assumptions about expectations formation mentioned above, and examine whether short run equilibrium is stable for each case.

5.21 STATIC-ADAPTIVE EXPECTATIONS

Here we take the expected rate of inflation to be given in the short run, so that ρ^e is a constant, which is, as noted above, consistent with static and slow adaptive expectations.

We assume, in this case, that Q_n adjusts to drive N sector excess demand to zero as before; that p_a now reacts to stock excess demand for food to yield

stock equilibrium for food; and the valuation ratio, and hence, the interest rate, varies in response to the excess demand for claims on capital, to bring that market into equilibrium. Hence the short run dynamics for this case are given by

$$(5.14a) \qquad dQ_n/dt = \theta\ [p_nC_n+p_nI-p_nQ_n]$$

$$(5.15a) \qquad dp_a/dt = \mu\ p_a\ (F^d - F)$$

$$(5.16a) \qquad di/dt = \lambda\ vp_n\ (K - K^d)$$

where the last equation implies that an excess supply of claims on capital reduces the valuation ratio of capital and raises i.

Substituting from equations (5.1) through (5.13) we can rewrite these equations as

$$(5.14b) \quad dQ_n/dt = \theta[(1-a)wa_ab_aA+c(p_aF+M+\tau wb_nQ_n/i) \\ (1+\tau)wb_n\phi((Q_n/K)\tau/(1+\tau) - i)-(a+\tau)wb_nQ_n]$$

$$(5.15b) \quad dp_a/dt = \mu\ [f(\rho^e,i)(p_aF+M+\tau wb_nQ_n/i)-p_aF]$$

$$(5.16b) \quad di/dt = \lambda\ [\tau wb_nQ_n/i - k(\rho^e,i)(p_aF+M+\tau wb_nQ_n/i)]$$

The Jacobian for this system, J (note that this J is different from the J of the previous section), is given by

$$\begin{bmatrix} -[a+\tau(1-\phi'-c'/i)]wb_n & c'F & -\phi' p_n K-\tau wb_n \Omega_n\, c'/i^2 \\ f\tau wb_n i & -F(1-f) & Wf_2-f\tau wb_n\Omega_n/i^2 \\ (1-k)\tau wb_n/i & -kF & -[Wk_2+(1-k)\tau wb_n\Omega_n/i^2] \end{bmatrix}$$

Sufficient conditions for the local dynamic stability of the above system of equations is that the trace of J is negative, the sum of its second order principal minors is positive, and the determinant of J is negative. We can check that the condition that $(1-\phi'-c'/i)>0$ is sufficient to ensure that the trace is negative. The same condition and the condition that c' is sufficiently small (or (f_2m-m_2f) is small), together with the assumption that the assets are gross substitutes ensure that the determinant is negative and the sum of minors is positive. Hence, a set of sufficient conditions for the short run dynamic stability of the above set of equations is: (1) $(1-\phi'-c'/i)>0$, (2) c' is small, and, (3) the assets are gross substitutes. The first condition states that the responsiveness of saving should exceed the responsiveness of investment; the destabilising effects of the non-fulfillment of this assumption are well known in Keynesian macro-models. The third condition, regarding gross substitutes, has received much attention in general equilibrium theory; given the general equilibrium nature of our model, it is no wonder that this condition crops up here. The second condition requires that the propensity to consume out of additional wealth by capitalists be small, something we have already assumed. A large c' could be potentially destablising for the following reason. A rise in the price of food would raise the value of foodstocks, the value of wealth, capitalist consumption, output of

non-agricultural goods, the rate of profit, and hence the value of claims on capital, which would further raise the value of wealth and create an excess demand for foodstocks. If the increasing wealth led to too large an increase in capitalist consumption, this chain could become explosive enough to destabilise the economy. We shall assume that the above set of stability conditions are fulfilled, so that short run equilibrium is stable.

Given that short run equilibrium is stable, the economy will arrive at a short run equilibrium when the right hand sides of equations (5.14b) through (5.16b) are equated to zero. These three equations solve for the three variables Q_n, p_a, and i, given all the parameters of the model, together with values of F,K and ρ^e, all given in the short run. Once these three variables are solved for, they can be plugged into the other equations of the model, equations (5.1) through (5.13), to solve for the values of all other variables.

5.22 RATIONAL EXPECTATIONS

In this case we assume that, provisionally, we can take the level of the agricultural price as given, and that the expected rate of inflation, ρ^e, changes in the short run to clear the food market. This expected rate of

inflation of the price of food shall later be set equal to the actual rate of inflation in food prices on the assumption of rational expectations, that is, the assumption that asset holders possess complete information regarding the future movement of the economy, and that they process the information rationally to make perfect forecasts of the rate of inflation.[36] Since there is no place for uncertainty in the model, perfect foresight and rational expectations obviously mean the same thing.

We assume in this version of the model that Q_n varies to clear the N goods market as before, and i varies to clear the market for claims on capital. As regards the market for food, we assume that ρ^e varies to clear the market: specifically, that an excess demand for food implies a rise in ρ^e, and an excess supply implies a fall in ρ^e. Hence, the short run dynamics in this case can be formalized as

$$(5.14c) \qquad dQ_n/dt = \theta[p_nC_n+p_nI-p_nQ_n]$$

$$(5.15c) \qquad d\rho^e/dt = \mu\, p_a(F^d - F)$$

$$(5.16c) \qquad di/dt = \lambda\, vp_n\, (K - K^d)$$

where θ, μ, and λ are positive constants denoting speeds of adjustment.

Using equations (5.1) to (5.13) we can rewrite these equations as

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[36] See Muth (1961) for a pioneering examination of this assumption.

$$(5.14d)\quad d\Omega_n/dt = \theta[(1-\alpha)wa_aA+c(p_aF+M+\tau wb_n\Omega_n/i) + (1+\tau)wb_n\phi((\Omega_n/K)\tau/(1+\tau) - i)K-(\alpha+\tau)wb_n\Omega_n]$$

$$(5.15d)\quad d\rho^e/dt = \mu[f(\rho^e,i)(p_aF+M+\tau wb_n\Omega_n/i)-p_aF]$$

$$(5.16d)\quad di/dt = \lambda[\tau wb_n\Omega_n/i - k(\rho^e,i)(p_aF+M+\tau wb_n\Omega_n/i)]$$

The Jacobian for the above system can be written as

$$\begin{bmatrix} -[\alpha+\tau(1-\phi'-c'/i)]wb_n & 0 & -\phi p_nK-\tau wb_n\Omega_n\, c'/i^2 \\ f\tau wb_n/i & f_1W & Wf_2-f\tau wb_n\Omega_n/i^2 \\ (1-k)\tau wb_n/i & -k_1W & -[Wk_2+(1-k)\tau wb_n\Omega_n/i^2] \end{bmatrix}$$

We can check that for this Jacobian, the trace has an indeterminate sign. However, if we assume that $(1-\phi'-c'/i)>0$ and that the assets are gross substitutes, then we can show that the determinant of the Jacobian is positive. This clearly implies that the system has an equilibrium which is not stable, but which is a saddlepoint. In other words, given any i and Ω_n, asset holders must choose an unique value of ρ^e so that the economy may, in the short run, converge to the short run equilibrium. If they choose a 'wrong' ρ^e which is higher than the 'correct' one then that will imply an excess demand for foodstocks, which will drive up ρ^e even further, and this would imply an unending shift towards foodstocks and out of other assets. The converse can be argued if ρ^e is lower than the 'correct' one.

We can depict the above saddlepoint equilibrium in i - ρ^e space by assuming that Q_n always clears the N goods market. This assumption gives us a functional relationship between i and Q_n which is downward sloping, reflecting the fact that a rise in i will reduce aggregate demand by reducing investment and consumption, so that Q_n must fall to restore equilibrium in that market. Substituting this function in the equilibrium conditions for the two other markets to eliminate Q_n, we can express the equilibrium conditions for these two markets as relations involving only i and ρ^e. Both equilibrium conditions are seen to imply upward sloping relationships between i and ρ^e as shown in Figure 6, where FF shows positions of food market equilibrium, and KK shows positions of equilibrium in the market for claims on capital. Given that the Jacobian for the system is positive we can show that FF has a steeper slope than KK. The dynamics of the variables are then as shown by the arrows in the Figure. If the economy starts from some point on the stable arm SS it will end up at the short run equilibrium E; otherwise it can shoot off in one direction or the other. We shall assume that asset holders have enough foresight to select the right ρ^e, and to reach the short run equilibrium position where i, Q_n and ρ^e take on their equilibrium values given K, F and p_a. We ought to state again that throughout this analysis we have provisionally taken p_a to be given. We shall later examine why we have done this, and see that this kind of short run adjustment makes sense only in one kind of vision of how this particular model actually operates.

5.23 QUASI-RATIONAL EXPECTATIONS

In this version of the model the short run dynamics are exactly the same as in the case of static-adaptive expectations, and can be formalized by using the same set of dynamic equations, that is, (5.14a) through (5.16a). The difference lies in the fact that we do not take ρ^e to be given in the short run, but to be formed according to the following rule:

$$\rho^e = \rho(p_a^* - p_a) \tag{5.18}$$

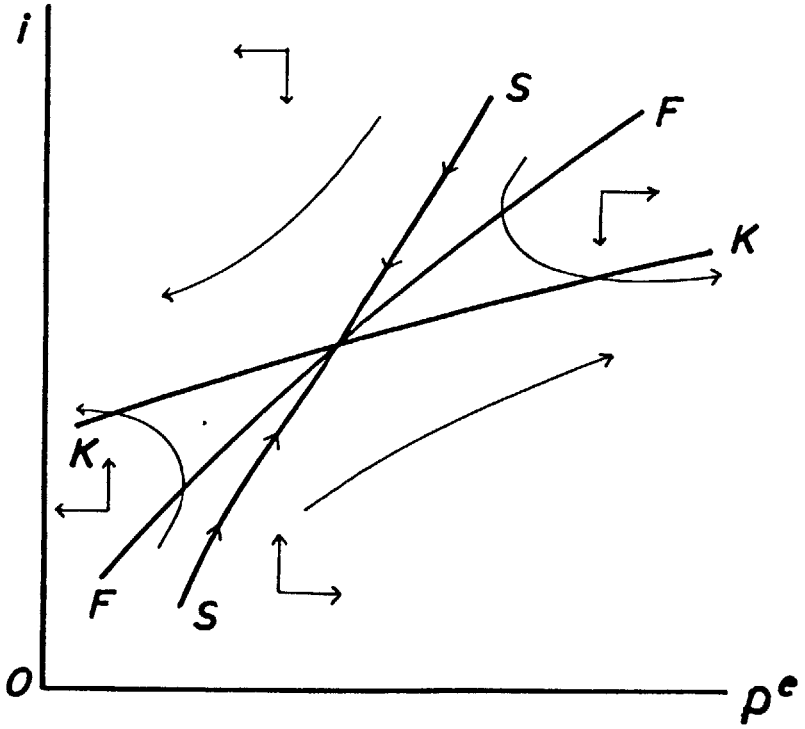


Figure 6. Short Run Equilibrium with Rational Expectations

where ρ denotes a positive constant giving an expectations parameter, and p_a^* gives the long run equilibrium price of food, to be examined later. The assumption made is that asset holders are assumed to have enough knowledge of the economy to be able to estimate the long run equilibrium price of food, but they cannot make accurate forecasts of what the actual rate will be. This assumption can be justified on the grounds that knowledgeable economic agents can make a good estimate of where the economy will end up in the future, but cannot predict exactly how the economy will move through time in each period, which depends on various kinds of unobservable sources of friction in the economy. The equation simply states that if the long run equilibrium price exceeds the current price, asset holders will expect the rate of inflation in food prices to be positive, and conversely when the opposite is true; moreover, the greater the divergence between the long run equilibrium price and the current price, the faster they will expect the price to move.[37]

Substituting equation (5.18) in equations (5.14a) through (5.16a) we get

$$(5.14e)\quad dQ_n/dt = \theta[(1-\alpha)wa_ab_aA+c(p_aF+M+\tau b_nwQ_n/i) + (1+\tau)wb_n\phi((Q_n/K)\tau/(1+\tau) - i)K -(\alpha+\tau)wb_nQ_n]$$

$$(5.15e)\quad dp_a/dt = \mu[f(\rho(p_a^*-p_a),i)(p_aF+M+\tau wb_nQ_n/i)-p_aF]$$

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[37] This kind of equation has been used in several models. See Dornbusch (1976) and van Duyne (1979) for example.

$$(5.16e)\quad di/dt = \lambda[\tau wb_n\Omega_n/i - k(\rho(p_a^*-p_a),i)(p_aF+M+\tau wb_n\Omega_n/i)]$$

The Jacobian for this system of equations can be written as

$$\begin{bmatrix} -[\alpha+\tau(1-\phi'-c'/i)]wb_n & c'F & -\phi' p_n K-(c'/i^2)\tau wb_n\Omega_n \\ f\tau wb_n/i & -[F(1-f)+Wf_1\rho] & Wf_2-f\tau wb_n\Omega_n/i^2 \\ (1-k)\tau wb_n/i & -[kF-Wk_1\rho] & -[Wk_2+(1-k)\tau wb_n\Omega_n/i^2] \end{bmatrix}$$

The stability conditions, as already stated above, require that the trace, the determinant, and the sum of the second order principal minors of this Jacobian fulfill certain conditions. The trace is negative if $(1-\phi'-c'/i)>0$. If this condition is fulfilled, if the assets are gross subsitutes, and if c' is sufficiently small, then the conditions on the determinant and the sum of the minors are also satisfied. We see, therefore, that the conditions sufficient to ensure stability for the case of static-adaptive expectations are sufficient to ensure stability in this version of the model as well. This is not surprising, since that version is a special case of this version with $\rho=0$ and ρ^e given. We ought to mention here, however, that the kind of expectations formation assumed in the present version adds to the stability of short run equilibrium in the sense that if a high c' could create instability, a higher c' would be consistent with stability in this model than in the case of static-adaptive expectations. The reason for this is that having expectations depending on the food price allows changes in expectations to take part of the burden of

short run adjustment, so that p_a does not have to change as much as in the earlier model, so that the possibility of destabilisation through wealth effects on capitalist consumption are reduced.

We assume that the short run equilibrium in this version is stable. Given this assumption, the economy, starting from a position outside equilibrium will achieve equilibrium in the short run. The equilibrium values of Q_n, p_a, and i can be obtained by setting the right hand sides of equations (5.14e) through (5.16e) to zero, and the other variables can be solved for, using equations (5.1) through (5.13).

5.3 LONG RUN DYNAMICS

In this subsection we consider how the economy moves over time from one short run equilibrium to another, examining successively, each of the different cases of expectations formation versions. We examine the dynamics over time, and define long run equilibrium for each case.

5.31 STATIC-ADAPTIVE EXPECTATIONS

Given K, F, and ρ^e, the model solved for the equilibrium values of Q_n, p_a, i, and the other variables, in the short run. To analyse how the economy moves through time, therefore, we have to examine how K, F and ρ^e change through time.

As far as K is concerned, if we assume away depreciation, its change at any point in time is given by

(5.19) $$dK/dt = I$$

As regards F, its change is given, as noted above, by equation (5.17)

(5.17) $$dF/dt = Q_a - C_a$$

In the case of static expectations, ρ^e would be fixed for all time. However, for the case of adaptive expectations, it would move over time according to a rule such as

(5.20) $$d\rho^e/dt = \rho(\rho_a - \rho^e)$$

where ρ is a positive constant denoting the adaptive parameter, and ρ_a is the actual rate of inflation of the price of food, to be solved from the model. Clearly, for the case of ρ=0, the adaptive expectations rule would yield static expectations.

The economy would therefore start from initially given K, F and ρ^e. The model would solve for all the short run variables, which would in turn determine dK/dt, dF/dt, and $d\rho^e/dt$ (which is of course zero in the case of static expectations) which would give the values for K, F and ρ^e for the next instant in time. The economy would move through time in this way. It would attain long run equilibrium when dF/dt = dK/dt = 0, and in the case of adaptive expectations when $d\rho^e/dt = 0$. At this long run equilibrium, the economy would have the same K, F and ρ^e for each successive period, and hence the same values of all variables in each period.

5.32 RATIONAL EXPECTATIONS

In this case, given K, F and p_a, the model solved for Q_n, i, ρ^e, and all the other variables of the model in the short run. The movement over time for K and F would be the same as for the previous case, that is, given by equations (5.17) and (5.19); however, the assumption of rational expecta-

tions implies that the actual rate of change in p_a be equal to ρ^e, the rate expected by asset holders. Thus p_a changes through time according to

(5.21) $\quad dp_a/dt = p_a \rho^e$

Long run equilibrium in this economy is attained when a sequence of short run equilibria converges to a state at which $dK/dt = dF/dt = dp_a/dt = 0$: in this case all variables will take the same value in each successive period.

5.33 QUASI-RATIONAL EXPECTATIONS

In this case, given F and K, the system solves for all the variables of the model in the short run. We need to specify equations of motion for just these two state variables. The equations of motion are obviously the same as those for F and K given for the two previous cases, that is, given by (5.17) and (5.19). Long run equilibrium is attained when $dK/dt = dF/dt = 0$. Obviously, in the long run equilibrium, all variables will take on the same value for each period: clearly, since p_a would take on its equilibrium value, equation (5.18) shows that ρ^e will be equal to zero in long run equilibrium.

5.4 LONG RUN EQUILIBRIUM

In this subsection we describe the nature of long run equilibrium in the model with food speculation. For all the different kinds of expectations formation that we have considered above, with one exception, long run equilibrium can be shown to be identical. For all cases, long run equilibria (henceforth LRE) requires that $dK/dt = dF/dt = 0$. The cases of rational expectations, quasi-rational expectations and adaptive expectations all require that $dp_a/dt = 0$, which requires that $\rho^e=0$. The only exception is the case of static expectations, in which ρ^e, for some strange reason, could be stuck at a value other than zero. Without loss of generality we suppose that for this case too, $\rho^e=0$, so that all the cases imply the same conditions for LRE, that is, $dK/dt = dF/dt = d\rho^e/dt = 0$. Thus we do not have to deal with each case separately: they all imply the same LRE, although different dynamics out of equilibrium.

The condition that $dK/dt = 0$ implies, using equation (5.19) and (5.13), that

$$(5.22) \qquad (Q_n/K)\ \tau/(1+\tau) = i$$

which merely states that in long run equilibrium, the rate of profit, given by the left hand side (see equation (5.5)) is equal to the rate of

interest. Also, $dF/dt = 0$ implies using equations(5.17), (5.7), (5.1), (5.2) and (5.4), that

$$(5.23) \qquad p_a = wab_a + [\, wab_n/(a_aA) \,]\, Q_n$$

Let us note that LRE requires not only that K, F and p_a become constant, but requires that, at it, the economy must also be in short run equilibrium, so that all the variables of the model are constant. This implies that the short run equilibrium conditions, (5.14) through (5.16) must also be satisfied in LRE. We know that by Walras's law, the money market must be in equilibrium in short run equilibrium. Using the condition that $\rho^e=0$ in long run equilibrium, we may write the condition for money market equilibrium as

$$(5.24) \qquad m(0,i)\, W = M$$

Using this equation in the food market equilibrium equation (5.15), substituting back into the money market equilibrium condition, making appropriate substitutions from equations (5.1) through (5.13) and using the condition that $\rho^e=0$ we get

$$(5.25) \qquad -k(0,i)M + m(0,i)\tau wb_nQ_n/i = M$$

Also, using the N goods market equilibrium condition (5.14), using (5.24), noting that investment is zero in LRE, and making appropriate substitutions from (5.1) through (5.13) we get

$$(5.26) \qquad (1-a)wa_a b_a A + c(\ M/m(0,i)\ ) = (a+\tau)wb_n Q_n$$

Equations (5.25) and (5.26) give us two equations in two unknowns i and Q_n, which can be solved to give their LRE values. We can show this determination of LRE using Figure 7. In the upper quadrant the LN curve shows combinations of i and Q_n satisfying equation (5.26), that is, satisfying N market (and money market) equilibrium in the long run. A rise in i implies that falls, so that W must increase. Given that c'>0, this implies that there is a rise in demand for the N good, creating an excess demand for it. Q_n must therefore rise to restore equilibrium. (Note that there are no effects through investment, which is zero in LRE). This explains the upward slope of the LN curve, the slope being given by

$$di/dQ_n = -\ (a+\tau)wb_n\ /\ (c'(M/m^2)m_2)$$

The LA curve gives combinations of i and Q_n satisfying equation (6.25), that is, food and money market equilibria. A rise in i implies a higher k and a lower m, so that the left hand side of the equation is less that the right hand side. Q_n must be increased to restore equality, explaining the positive slope, which is given by

$$di/dQ_n = (m_r wb_n/i) \,/\, [k_2 M - m_2 r wb_n Q_n/i + m_r wb_n Q_n/i^2]$$

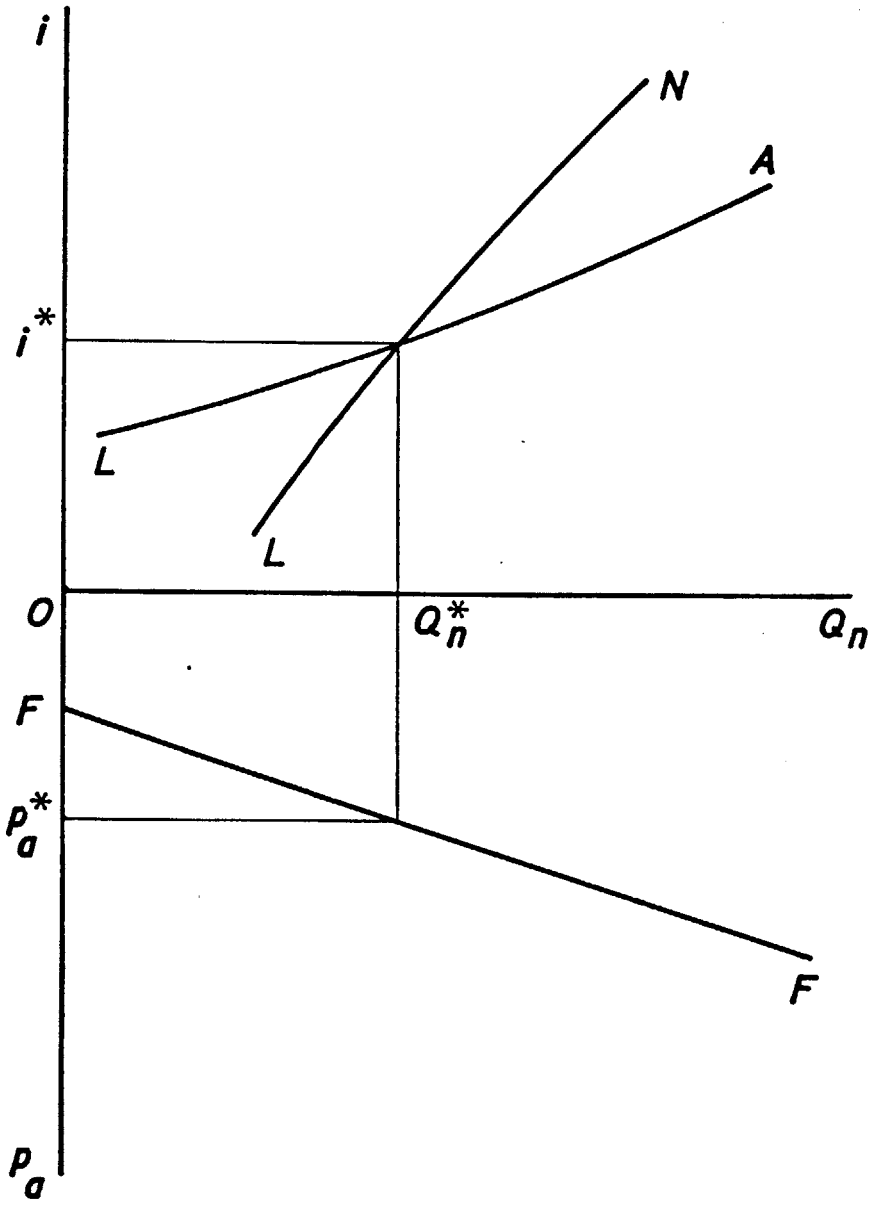


Figure 7. Determination of Long Run Equilibrium in the Model with Food Speculation

If c' is small, then the LN curve will be almost vertical. LRE values of i and Q_n will be determined in the upper quadrant by the intersection of LA and LN. In the lower quadrant the FF curve gives the positive relation between Q_n and p_a satisfying equation (5.23), that is, the requirement that foodstocks remain constant. A rise in Q_n implies an increased demand for food; to keep foodstocks unchanged, p_a must rise to keep food consumption equal to food production. Given that Q_n is solved in the upper quadrant, the lower quadrant solves for the LRE level of p_a, denoted by p_a^* above. One can also solve for the LRE value of K from equation (5.22) by plugging in the solved values of Q_n and i, and for F using equation

$$(5.27) \qquad [f(0,i)/m(0,i)]\ M = p_a F$$

which is obtained by substituting (5.24) into the food market equilibrium condition. Using all the other equations of the model, that is, (5.1) through (5.13), all the other variables can be solved for their LRE values.

5.5 THE QUESTION OF STABILITY OF LONG RUN EQUILIBRIUM

Though the LRE position of the model under all three types of assumptions regarding expectations has been shown to be the same, with different laws

of motion, the three different kinds of expectations assumptions will not give identical dynamic paths for the economy. In this subsection we examine the question of the stability of LRE in each case by examining the nature of the dynamic adjustment path around LRE.

5.51 STATIC-ADAPTIVE EXPECTATIONS

We shall consider the dynamic path and check for the stability of LRE only for the case of static expectations. The case of adaptive expectations need not be considered separately, for two reasons. First, we shall later be concerned with the short run and long run effects of different kinds of parametric changes; since the short run and long run effects under both static and adaptive expectations cases are the same, we need not study the dynamic path under adaptive expectations. Second, the case of static expectations is a special case of adaptive expectations with the adaptive parameter ρ=0. We shall argue in this section that for this case, with ρ^e=0, LRE is indeed stable. For the case in which ρ is very large, LRE can intuitively be seen to become unstable. What this suggests is that there seems to be a maximum value of $\rho > 0$ for which the adaptive process is just stable. We shall assume that the adaptive parameter does not exceed this value, so that proving that the static expectations case is stable, and further assuming that the adaptive parameter is small enough, is enough to

ensure that the adaptive process we consider is stable. This being said, let us confine our attention to the case of static expectations with $\rho^e=0$.

To examine the question of the stability of LRE, we must examine the sign pattern of the Jacobian of a system of equations of the following form

(5.28) $dK/dt = \kappa(K,F)$

(5.29) $dF/dt = \psi(K,F)$

evaluated at LRE. Given K and F, we can find solutions for all the variables of the model, and substituting into equations (5.17) and (5.19) we can solve for dK/dt and dF/dt. Then we can differentiate partially with respect to K and F to determine the sign pattern of the Jacobian for the above system.

We find that dK/dt falls as K rises in the neighbourhood of LRE. A rise in K at LRE implies, given Q_n, a fall in the rate of profit, which reduces investment demand, and hence Q_n, and also i. It can be shown that the fall in the rate of profit exceeds the fall in the interest rate, implying a fall in investment, and hence in dK/dt. As regards the effect of a change in F on dK/dt we find that a rise in F leaves dK/dt unaffected. The reason for this is that F enters everywhere in the equational structure of the model multiplied by p_a, so that a rise in F reduces p_a by the same proportion to keep their product constant, so that all other variables of the model are left unaffected. Hence, the rate of profit and the interest rate

are unaffected, so that investment, and hence dK/dt are unchanged. Regarding dF/dt, the effect of a rise in K on dF/dt is indeterminate. The rise in K at LRE reduces both Q_n by the mechanism described above, while the effect on p_a is uncertain. For, when Q_n falls, there is a fall in the demand for food as an asset which results in a tendency for p_a to fall; but the fall in i will also switch asset demand from capital to food which will create a tendency for p_a to rise: the net result will depend on how closely substitutable food and capital are as compared to the extent of substitutability between capital and money, which will determine by how much the demand for food will rise when i falls, relative to the demand for money. While the unambiguous fall in Q_n will reduce employment and consumption demand, implying a rise in F, given the ambiguity regarding the effect on p_a, one cannot be sure of the final outcome. Finally, a rise in F at LRE will reduce dF/dt, for as argued above, the change will leave Q_n unchanged, but reduce p_a, implying a rise in the consumption demand for food. With output of food given, this implies a higher increase in F.

The sign pattern of the Jacobian therefore ensures a negative trace and a positive determinant, ensuring that the system is stable. The phase diagram for the system is shown in Figure 8, in which the KK curve shows values of F and K along which dK/dt = 0 and the FF curve shows combinations of F and K which imply dF/dt = 0. Given the ambiguity in the direction of change in dF/dt with changes in K the FF curve may either slope up or slope down, the adjustment path being stable in either case.

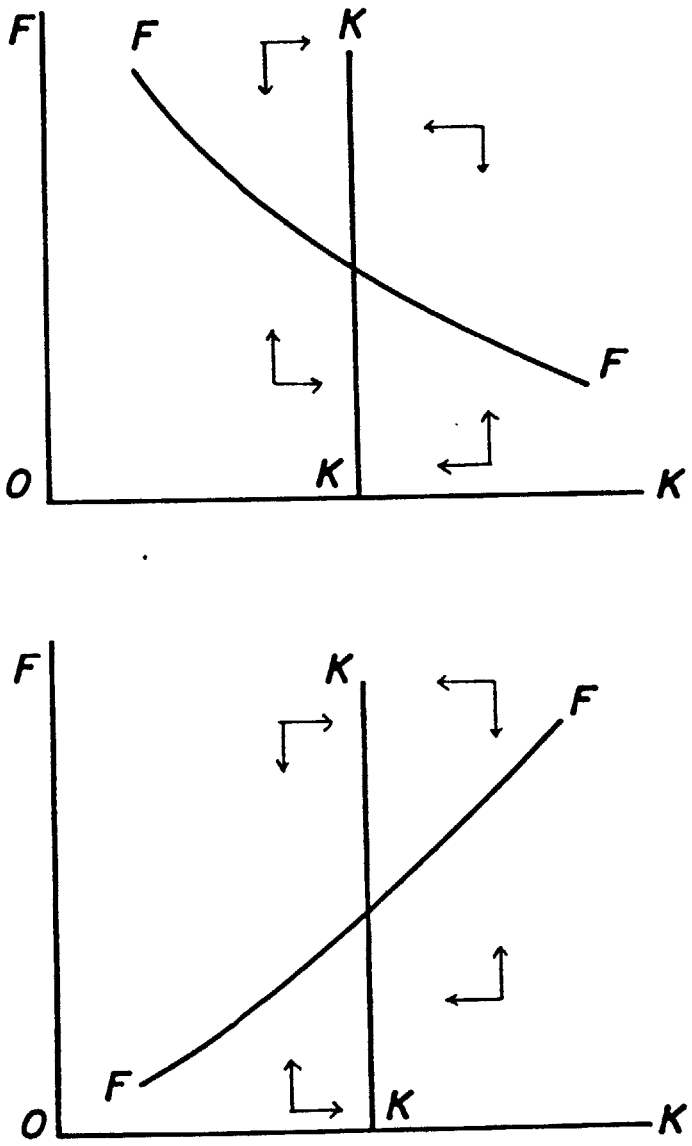


Figure 8. Long Run Adjustment under Static Expectations: Two Possibilities

5.52 RATIONAL EXPECTATIONS

In this case, to examine the stability of LRE we have to examine the sign pattern of the determinant for the system given by

$$dK/dt = \kappa(K, p_a, F) \tag{5.30}$$

$$dp_a/dt = \rho(K, p_a, F) \tag{5.31}$$

$$dF/dt = \psi(K, p_a, F) \tag{5.32}$$

evaluated at LRE. Given K, p_a, and F, at an instant of time, the system solves for Q_n, ρ^e, i, and all the other variables of the system, and given the long run dynamic equations, we could solve for the time derivative of K, p_a, and F, to get the above sets of equations. Then we can examine the partial derivatives of these time derivatives with respect to each of K, p_a, and F.

It can be shown that it is likely that the determinant of the Jacobian for the above system has a positive sign, implying that we have a saddlepoint at LRE: while this is not the only possibility, it seems that under realistic values of the parameters, this is the outcome.[38] Given this result, one

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[38] This saddlepoint property has been found in various growth models with heterogeneous assets assuming perfect foresight. The pioneering work is that of Hahn (1966), after whose work this saddlepoint result has been said to produce the 'Hahn problem'. See also Burmeister (1980) for a recent survey of these models.

can interpret this version of the model in two ways. One interpretation would be to treat the economy as going along a path described by the above differential equations (5.30) through (5.32) with K and F being given by initial conditions and p_a being given by the terminal condition that the system reaches LRE, so that the system would move along the saddlepoint path in three-space. The economic implication is that K and F are given by initial stocks, while p_a is set by asset holders assuming that they have perfect foresight which makes it inconsistent to believe that they could set p_a at a level which would make the system shoot off from LRE.[39] Using this version, we could examine the effects of parametric shifts which would make p_a jump to get to the saddlepoint path in the long run. In three-space this kind of analysis would be rather complicated, and in any case, one can question whether asset holders - at least in less developed economies - have the amount of information to set such prices, even if they have their share of rationality. Hence we do not go into this. A second interpretation would be to interpret the economy to be moving along a path described by the above differential equations, from historically given values of K, F and p_a (some story of short run price rigidity being necessary in this case). In this case, unless it accidentally starts from a position on the saddlepath, the economy will find itself on a path which reduces K and increases F and p_a, or conversely, implying bubbles of the sort quite common in the rational expectations literature. The model would not be able to tell us how the bubble ends. While speculative bubbles of this

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[39] See Blanchard and White (1981) for some recent comments on this.

sort probably do occur in reality, they are relatively short-lived. Given this problem with this model, we shall not be concerned with this version further. Thus we shall have no more to say in this paper on the case of rational expectations, although we shall consider the case of limited rationality, that of quasi-rational expectations, to which we now turn.

5.53 QUASI-RATIONAL EXPECTATIONS

In this case we have to examine the sign pattern of the Jacobian of the system given, once again, by equations (5.28) and (5.29), evaluated at LRE. The difference with the earlier case is that now, given K and F, the system determines Q_n, p_a, i and the other variables of the model, with the help of the model which allows ρ^e to vary, rather than keeping it constant, as was done in the earlier model. Given solutions to all these variables, the equations of motion determine dK/dt and dF/dt.

Consider the sign pattern of the Jacobian. A rise in K is seen to result in a fall in dK/dt. The rise in K, for the same kinds of reasons as described in the case of static expectations, results in a fall in Q_n and a fall in i, and given that the resulting fall in the rate of profit exceeds the fall in the interest rate, investment falls, and hence so does dK/dt. The only added complication in this model is that the expected rate of

inflation in this model can change, and given that an additional rate of return on an asset can change, the required fall in i to restore short run equilibrium is less, so that the tendency for a fall in dK/dt is strengthened. A rise in F will now have an effect on dK/dt in this case, since now p_a and F do not always appear in the equational structure of the model together, unlike that in the static expectations case. In this case the increase in F will imply an excess supply of foodstocks, so that p_a will fall. This fall in p_a will imply a rise in ρ^e, which, by affecting the demand for the different assets, will affect i and Q_n. The effects are ambiguous, however: the rise in ρ^e will have the tendency of shifting asset demand away from money and capital towards food; but since p_aF rises with a rise in F and a fall in p_a which is less than the proportional rise in F since ρ^e takes on a part of the burden of adjustment, it is not clear if an excess supply of capital will result. The outcome will depend on the degree of substitutability between food and capital as compared to food and money: the more the extent of substitutability between food and capital, the more likely it is that i falls, and given the fall in i, Q_n, through increases in aggregate demand, rises. Given these ambiguities, the direction of change is ambiguous. However, we saw that these effects come about only because ρ^e depends on p_a and hence the magnitude of these effects depends on the responsiveness of ρ^e to changes in p_a, which is given in this model by the parameter ρ. Coming now to effects on dF/dt, we know that a rise in K implies a fall in Q_n, but has an ambiguous effect on p_a, which depends, as described in the case of static expectations, on the extent of substitutability in the demand for capital and food on one hand

and capital and money on the other. Given this ambiguity, the effect of a rise in K on dF/dt cannot be predicted unambiguously. Regarding the effect of a rise in F we know that that will reduce p_a, and thereby imply a rise in the consumption demand for food, implying a fall in dF/dt. However, there will also be effects on Q_n, which could go in either way, either increasing or reducing N sector employment, and therefore food demand. The magnitude of these effects, as argued above, depend on the magnitude of ρ. If ρ is not too large, the effects operation through p_a will dominate, so that the rise in F will reduce dF/dt.

In sum, therefore, dK/dt falls with K and dF/dt falls with F if ρ is not too large. This implies that with ρ not too large, the trace of the relevant Jacobian will be negative. Given that ρ is sufficiently small, the product of the unsigned off diagonal terms will turn out to be small, so that the determinant will be positive. We conclude that given all our earlier assumptions, a ρ which is sufficiently small will ensure that LRE is stable under the assumption of quasi-rational expectations. We assume that ρ satisfies this requirement.

6.LONG RUN EFFECTS OF PARAMETRIC SHIFTS IN THE MODEL WITH SPECULATION

6.0 INTRODUCTION

In this section and the next we shall consider the short run and long run effects of parametric shifts for the model with food speculation assuming static-adaptive expectations and quasi-rational expectations. The parametric shifts we shall consider are in part the same as the shifts we have already considered for the model without food speculation, that is, a change in the supply of money, a temporary shift in the amount of land, and a change in agricultural technology of the kind brought about by the Green Revolution, and for the rest, shifts in asset preferences towards foodstocks. In this section we shall consider the long run effects of these shifts, which are the same under the two different assumptions regarding expectations formation, as LRE, as shown in the previous section, is independent of the nature of expectations formation, at least for the two cases to be considered. The analysis of short run effects is postponed to the next section, although, of course, those are the effects which will first be felt in the economy.

6.1 EFFECT OF A CHANGE IN MONEY SUPPLY

Differentiating equations (5.25) and (5.26) totally with respect to M we get

$$dQ_n/dM = [(c'/m)M(k_2+k/i)] \;/\; \Sigma$$

$$di/dM = wb_n[-k(a+\tau)+c'\tau/i] \;/\; \Sigma$$

where

$$\Sigma = (k_2M-(Q_n\tau wb_n/i)(m_2-m/i))(a+\tau)wb_n + c'Mm_2\tau wb_n/im$$

Given, as assumed, that c' is small, it is obvious that $\Sigma>0$;then $dQ_n/dM > 0$ and with c' small, $di/dM < 0$. A rise in the supply of money, is therefore seen to result, in the long run, in a higher non-agricultural output and a lower interest rate. With a small c', however, the rise in Q_n is likely to be very small.

These effects can be examined by looking at Figure 9 which is initially showing the same thing as Figure 7, that is, long run equilibrium for the model with food speculation. The rise in M in the Figure causes LN to shift to the right: given that c' is small, the shift will be very small, to a position such as that shown by L'N', the shift occuring because a higher M raises capitalist consumption, creating an excess demand for the N good which must be satisfied by increasing Q_n(investment effects being

absent in the long run). The rise in M also creates an excess supply of money, and to restore equilibrium there must be a rise in Q_n to increase the value of W in LRE, so that LA will shift to the right to a position such as L'A'. Thus, Q_n will rise and i will fall. With FF being unchanged in the lower quadrant, there will be a small rise in p_a since Q_n rises slightly.

As regards the other variables, we can check from equation (5.22) that as Q_n rises and i falls due to a rise in M, K must rise. With F being given by equation (5.27), the effect on F can be seen to be ambiguous, the rise in p_a reducing it, but the fall in i having an ambiguous effect. Regarding income distribution, the real wage will fall slightly as p_a increases, but employment will rise slightly as Q_n rises. In sum, therefore, a rise in the supply of money will reduce the interest rate, increase N sector output slightly, increase agricultural prices slightly, raise the stock of N sector capital, reduce the real wage and raise employment marginally, and have an ambiguous effect on the stock of food.

6.2 EFFECT OF A BAD HARVEST

In this case we examine the effects of a bad harvest, which results in a temporary decline in the amount of agricultural land, but which is cor-

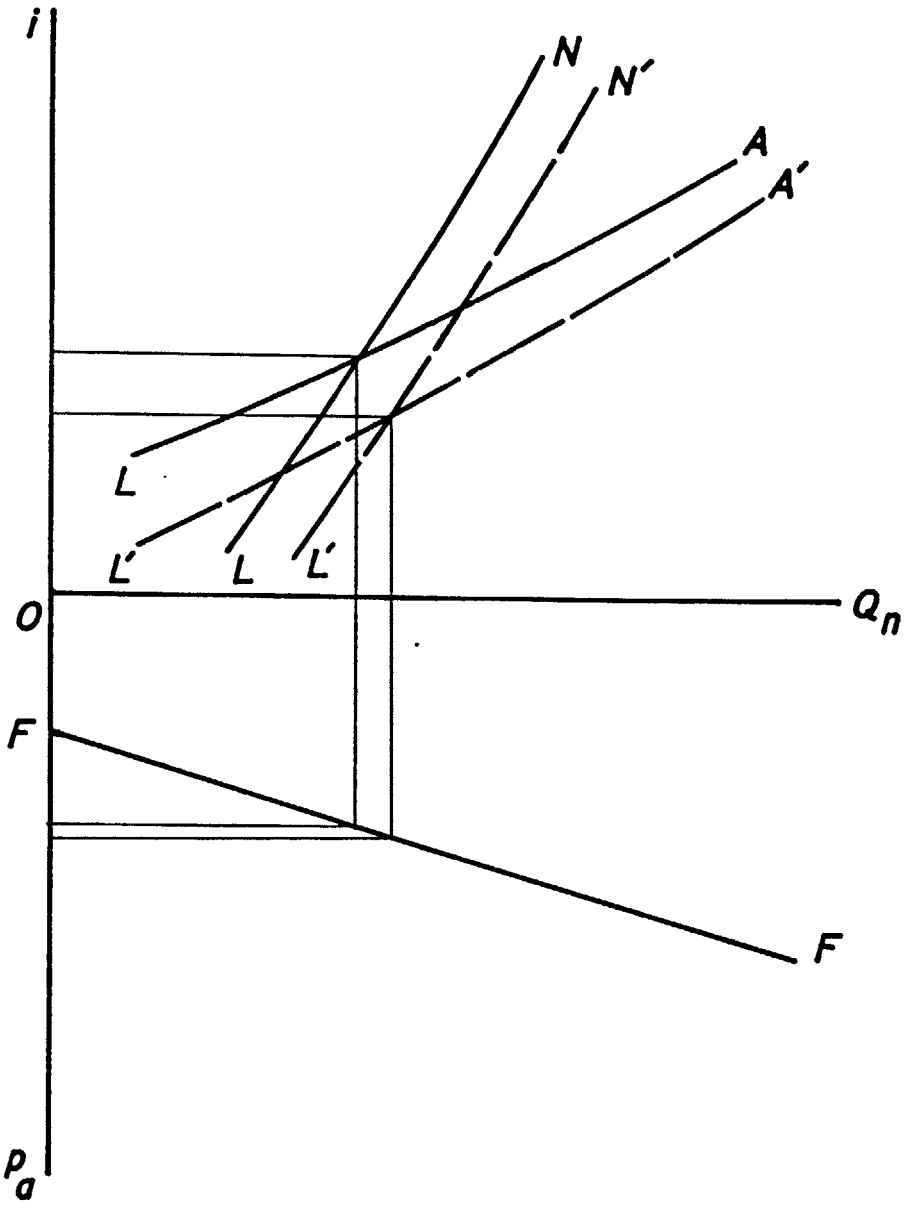


Figure 9. Effect of a rise in Money Supply in the Model with Food Speculation

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[40] A permanent reduction in A would have reduced Q_n, i and K, increased P_a, reduced employment and increased the real wage.

rected in the long run. In this case, since in the long run A is restored to its initial level, there are no changes in any of the variables in the long run: all possible short run effects (see the next section) are washed away.[40]

6.3 EFFECT OF A TECHNOLOGICAL CHANGE IN AGRICULTURE

As noted in section 4, we are interested in a special kind of technological change - characteristic, perhaps, of India's Green Revolution - which raises a_a, lowers b_a, but leaves their product unchanged. The effects of this change are examined in Figure 10, in which the LA and LN curves in the upper quadrant are left unchanged by the shift which leaves agricultural employment unchanged, but in which FF shifts to a position like F'F' since a rise in output implies a rise in dF/dt, which must be brought back to zero by allowing workers to consume more food by reducing p_a. The result is that Q_n, i, and K are left unchanged, Q_a is higher, p_a is lower, F is higher (this follows since p_aF must be constant, from equation (5.27)), employment is unchanged, and w is higher.

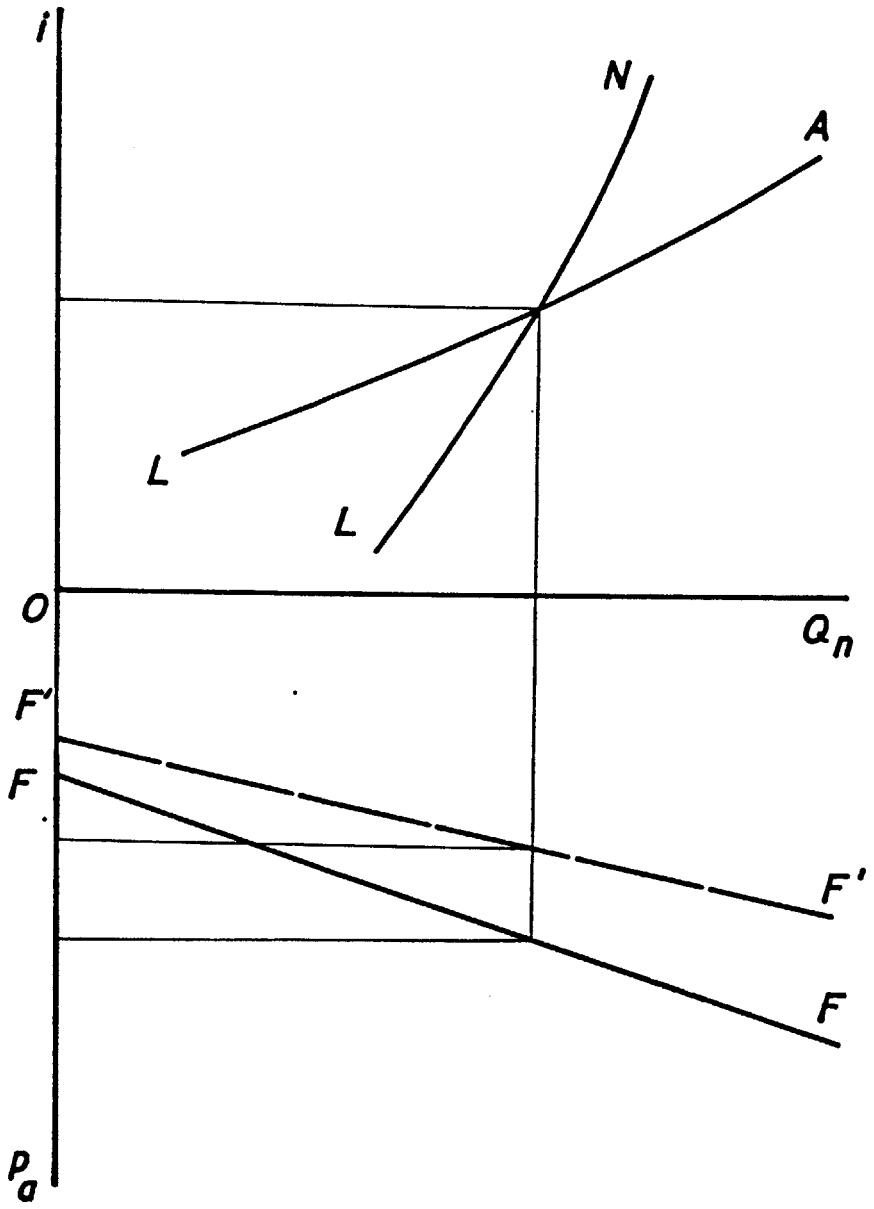


Figure 10. Effect of Technological Change in Agriculture in the Model with Food Speculation

6.4 EFFECTS OF CHANGES IN ASSET PREFERENCES

To examine the effects of shifts in asset preferences we shall imagine, for simplicity, that such shifts can be expressed as multiplicative shifts from one asset to another. We shall thus imagine that each of the asset demand ratios f, m, and k are multiplied by positive constants β, γ, and ϵ, respectively, which initially take on values equal to unity so that f+m+k=1 initially, but then can differ from unity, keeping

$$\beta f+\gamma m+\epsilon k = 1 \tag{6.1}$$

For the purpose of this analysis we can then rewrite equations (5.25) and (5.26) as

$$-\epsilon k(0,i)M + \gamma m(0,i)\tau w b_n \Omega_n/i = 0 \tag{6.2}$$

$$(1-a)w a_a b_a A + c(M/\gamma m(0,i)) = (a+\tau)w b_n \Omega_n \tag{6.3}$$

We can consider various kinds of shifts in this framework. What we shall do is to consider two kinds of pure shifts, both increasing the demand for food, one purely at the expense of claims on capital, and the other purely at the expense of money.

6.41 SHIFT FROM CAPITAL TO FOOD

A shift from capital to food implies that $d\beta f + d\epsilon k = 0$ with $d\beta > 0$, and with $d\gamma = 0$. This implies, from (6.1) that $d\epsilon = -(f/k)\, d\beta$. Totally differentiating (6.2) and (6.3) we can then show that

$$dQ_n/d\beta = - c'(M/m)^2 m_2 \;/\; \Sigma$$

$$di/d\beta = fM(\alpha+\tau)wb_n \;/\; \Sigma$$

where Σ has been defined above. Clearly, $di/d\beta > 0$ and $dQ_n/d\beta > 0$ but small. From (5.23) it then follows that $dp_a/d\beta > 0$. From (5.22) we see that since $dQ_n/d\beta$ is small with a small c', $dK/d\beta < 0$. The effect on F is ambiguous. There will be a small increase in employment with a rise in Q_n, and a slight fall in ω with a rise in p_a.

Some of these effects can be seen graphically by looking at Figure 11, which shows that a shift from capital to food will imply an excess supply of capital, and hence a rise in i to restore equilibrium, thereby shifting the LA curve upwards. The LN curve is unaffected by the shift.

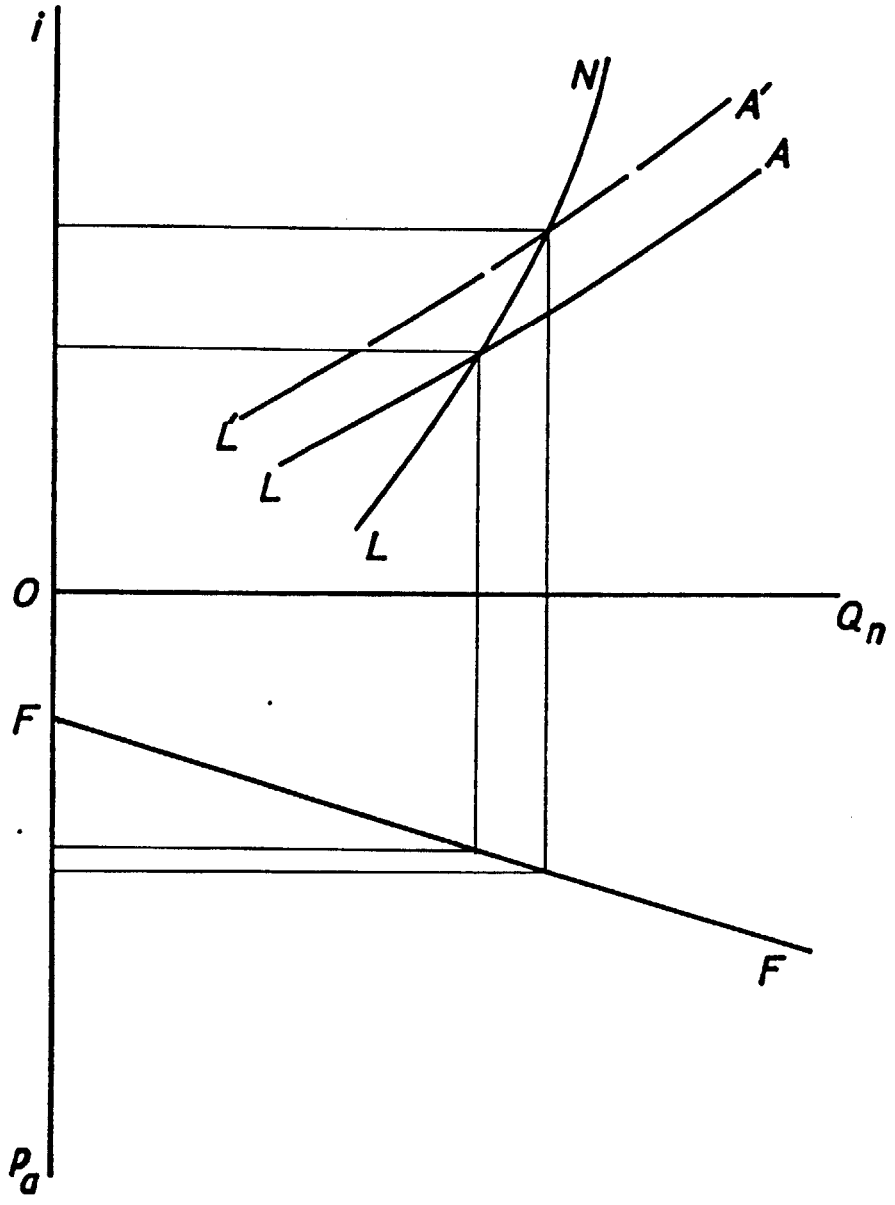


Figure 11. Effect of a Shift in Asset Preferences from Capital to Food

6.42 SHIFT FROM MONEY TO FOOD

In this case we have $d\beta f+d\gamma m=0$ with $d\beta>0$ and with $d\epsilon=0$. We therefore have in this case, $d\gamma=- f/m\ d\beta$. Totally differentiating (6.2) and (6.3) we get

$$dQ_n/d\beta = [c'(M/m)^2 f(k_2+k/i)] \ / \ \Sigma$$

$$di/d\beta = (f\tau wb_n/i)[- (a+\tau)wb_nQ_n + c'M/m] \ / \ \Sigma$$

Clearly, $dQ_n/d\beta>0$, although small, since c' is small. Also, since c' is small we have $di/d\beta<0$. Since $dQ_n/d\beta>0$, we have, from (5.23), that $dp_a/d\beta>0$. From (5.22) it follows that as $di/d\beta<0$ and $dQ_n/d\beta>0$, $dK/d\beta>0$. The effect on F is uncertain. As regards income distribution, there will be a slight rise in employment and a slight fall in the real wage since Q_n and p_a are both slightly higher with a higher β. Some of these effects are shown in Figure 12, where the shift is seen to cause a rightward shift in both LN and LA curves.

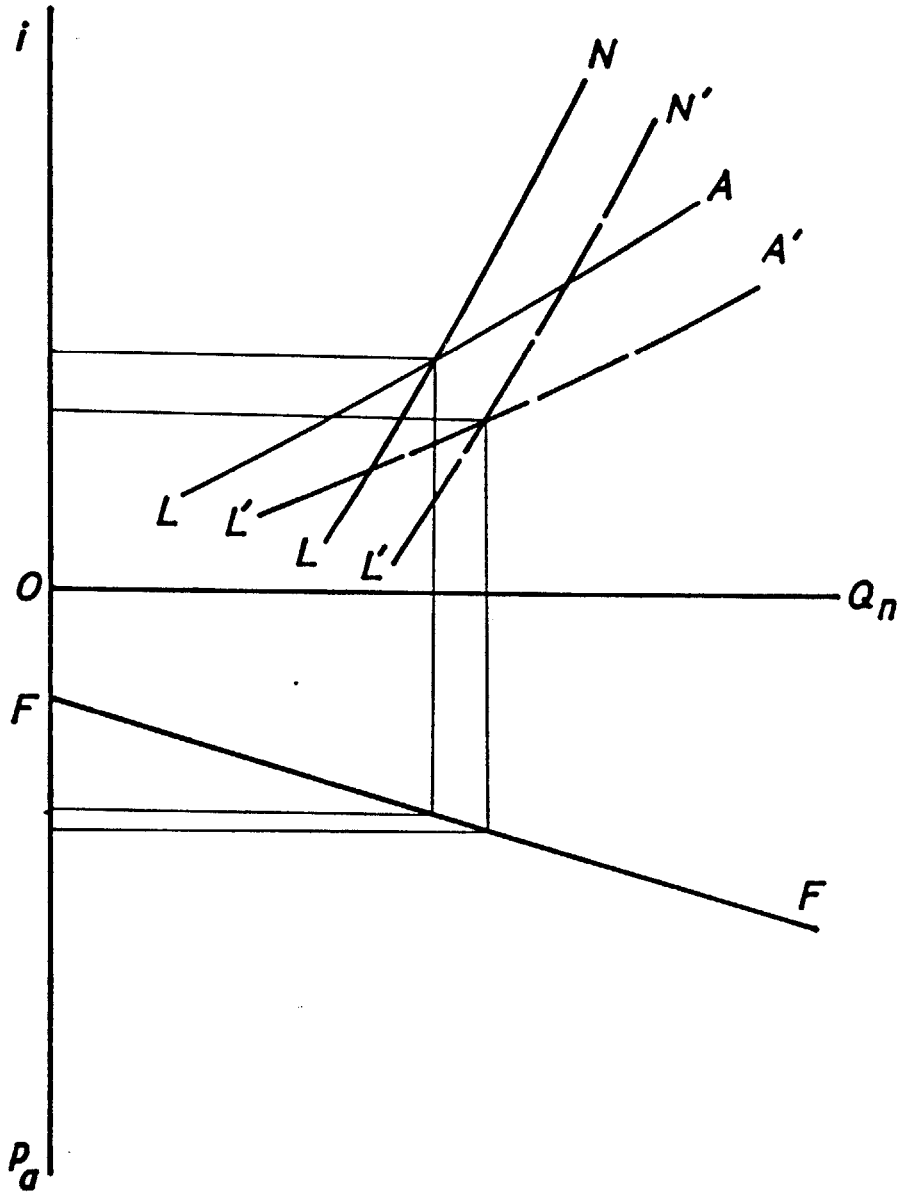


Figure 12. Effect of a Shift in Asset Preferences from Money to Food

7.SHORT RUN EFFECTS OF PARAMETRIC CHANGES IN THE MODEL WITH SPECULATION

7.0 INTRODUCTION

In this section we shall consider the short run effects of shifts in the parameters of the model with food speculation, assuming that the economy was initially at LRE. We shall consider both the case of static-adaptive expectations and quasi-rational expectations, although, except when crucial for our analysis, we shall focus our attention on the simpler case of static-adaptive expectations, commenting briefly on the complications resulting from allowing quasi-rational expectations.

7.1 EFFECT OF A CHANGE IN MONEY SUPPLY

To consider the effects of a change in money supply, we first consider the case of quasi-rational expectations. Taking the short run equilibrium conditions for this case obtained by setting the right hand sides of equations (5.14e) through (5.16e) equal to zero, differentiating with respect to M, and imposing the LRE conditions we get

$$dQ_n/dM = (1/wb_n\Omega)\,[\phi' k\{Fk+\rho W[(f_1k-k_1f)+(dp_a^*/dM)F(k_1m-m_1k)]\}$$
$$+\ c'\{F(k_2+k/i)+\rho W[(f_1k_2-f_2k_1)+(f_1k/i)(dp_a^*/dM)F((f_1k_2-k_1f_2)-m_1k/i)]\}\ ]$$

$$dp_a/dM = (1/\Omega)\,[\ \{a+\tau(1-\phi'-c'/i)\}\{\rho W(dp_a^*/dM)(f_1k_2-f_2k_1)\}$$
$$+\{a+\tau(1-\phi')\}(fk_2-kf_2)+(c'\tau/i)f_2+(a+\tau)\{(fk/i)+\rho W(dp_a^*/dM)(k/i)(f_1m-m_1f)\}\ ]$$

$$di/dM = -(1/W\Omega)\,[\{a+\tau(1-\phi')\}\{Fk+\rho W((f_1k-k_1f)+(dp_a^*/dM)F(mk_1-m_1k))\}$$
$$-(c'\tau/i)\{F+\rho W(f_1-m_1(dp_a^*/dM)F)\}\ ]$$

where

$$\Omega = F\ [(a+\tau)(mk/i)+\{a+\tau(1-\phi')\}(mk_2-km_2)+c'\tau m_2/i\ ]$$
$$+\ \rho W[\{a+\tau(1-\phi'-c'/i)\}(f_1k_2-k_1f_2)+(a+\tau)(k/i)(f_1m-fm_1)]$$

which is positive, given the short run stability assumption.

To make any sense of these rather unpleasant expressions it is best to focus on the case of static-adaptive expectations, henceforth SAE, which is a special case of QRE with $\rho = 0$. If we set $\rho=0$ in the above expressions we get

$$dQ_n/dM = (1/wb_n\Omega)\,[\ \phi' k^2+c'(k_2+k/i)\ ]$$
$$dp_a/dM = (1/F\Omega)\,[\{a+\tau(1-\phi')\}(fk_2-kf_2)+(a+\tau)(kf/i)c'\tau f_2/i\ ]$$
$$di/dM = -(1/w\Omega)\,[\{a+\tau(1-\phi')\}k-c'\tau/i\ ]$$

where Ω for this case is obtained by setting $\rho=0$ in the above definition of Ω (in what follows we shall switch back and forth between these two definitions of Ω - since one is relevant for QRE and the other for SAE, there need be no confusion). With $\Omega>0$ it is clear from the above expressions that $dQ_n/dM>0$ while $di/dM<0$ and $dp_a/dM>0$ if c' is small, as has been assumed throughout. The economics behind these results are as follows. A rise in M, given Q_n,i and p_a, has the effect of increasing total wealth and hence capitalist consumption; it also creates excess demands for food and capital assets and an excess supply of money. There is therefore a rise in Q_n and p_a and a fall in i in response to excess demands.[41] The rise in Q_n implies a rise in employment, while a rise in p_a implies a fall in the real wage ω. The fall in i and rise in Q_n implies a rise in investment, and hence in g = I/K, the short run rate of growth.

We now comment on the general case in which ρ is positive. Given our assumption that for the stability of LRE, ρ is small, a small ρ is unlikely to alter any of the qualitative conclusions reached for the special case in which $\rho=0$. However, allowing it to be positive, for the case of QRE, has the further effect of changing ρ^e. The rise in M makes asset holders believe that p_a^*, the long run equilibrium food price, will rise, so that they will expect a fall in the current rate of inflation of the food price,

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[41] If c' is very large, the rise in Q_n could be so large as to create an excess supply of capital implying a rise in i, which could possibly make asset holders switch to capital from food and create an excess supply of food, reducing p_a. By assuming c' is small we do not allow such effects to occur.

implying a switch from food to other assets. These are the effects captured in the unpleasant expressions for the case of QRE given above. However, with c' being small, we know from the previous section that dp_a^*/dM is small, so that these complications will have very small effects. There is also, of course, the fact that p_a^e takes part of the burden of adjustment, so that even with p_a^* not being changed at all, the results for QRE and SAE will be different.

7.2 EFFECT OF A BAD HARVEST

In this case we are concerned with the effects of a temporary change in A. We note at once that since the change in A is temporary, as seen in the previous section, there is no change in the LRE values of variables, so that $dp_a^*/dA = 0$. With this comment in mind, we can find out the effects of a change in A by differentiating the short run equilibrium conditions by setting the right hand sides of equations (5.14e) through (5.16e) with respect to A. We get

$$dQ_n/dA = \{(1-\alpha)a_a b_a/b_n\Omega\}\,[F(mk_2-m_2k+mk/i)+\rho W\{(f_1k_2-k_1f_2)-(f_1m-fm_1)k/i\}\,]$$

$$dp_a/dA = (1-\alpha)wa_a b_a \tau(mf_2-fm_2)/i\Omega$$

$$di/dA = \{(1-\alpha)wa_a b_a \tau/Wi\Omega\}\,\{mF+\rho W(f_1m-m_1f)\}$$

where Ω has been defined above.

Once again, it is easiest to interpret the results for static-adaptive expectations, in which we have the same results as above, though with $\rho=0$. In that case, it is obvious from the expressions above that $dQ_n/dA>0$, and $di/dA>0$, but that dp_a/dA cannot be signed, or that a fall in A reduces Q_n and i, but the effect on p_a cannot be ascertainted unambgiuously. What happens when A falls is that there is a fall in agricultural employment which implies that there is a reduced demand for N sector products, which implies an excess supply of the N good. This causes Q_n to fall, which, given K, reduces r_n, implying, via a fall in the valuation ratio of capital, a fall in the value of claims on capital and a corresponding decline in W. There is, consequently, an excess demand for capital and an excess supply of food (and money). In response to the excess demand for capital the price of capital claims will rise, implying a reduction in the rate of interest. This fall in i will imply a shift in demand from capital to food and money, which may or may not reverse the excess supply of capital resulting from the fall in Q_n. Whether or not it will, will obviously depend on how large the shift from capital to food is when i falls, or, on the extent of substitutability in asset holding between capital and food as compared to the substitutability between capital and money. If the extent of substitutability between capital and food is high, the fall in i will bring about a very large rise in demand for food which will more than compensate for the fall in demand caused by the fall in Q_n, resulting in an excess demand for food, and hence require a rise in p_a. On the other hand,

if the extent of substitutability is small, then the excess supply may persist, implying that a fall in p_a will occur. All this explains why Q_n falls and i falls with a fall in A, and why p_a may either rise or fall. The argument above also makes clear what determines the sign of dp_a/dA. The expression above shows that dp_a/dA can be signed the same as (f_2m-m_2f), which, noting that f_2 and m_2 are negative, has the same sign as $|m_2/m|-|f_2/f|$. This last expression compares the extent of substitutability between capital and the two assets. For example, if this expression is positive, that implies that money and capital are closer substitutes than are food and capital, which implies that $dp_a/dA>0$, implying, as we have expected, that a fall in A will imply a fall in p_a.

Allowing $\rho>0$, as the more general case of QRE allows, implies that we are allowing the expected rate of inflation in the price of food to change. In this case the expressions are changed because ρ^e can change to some extent to share the burden of adjustment with the other variables. Thus the rise (fall) in p_a will imply a fall (rise) in ρ^e, given that p_a* is constant, which will imply a shift from (to) food to (from) the other assets, which might have the effect of reversing the effects on i and Q_n. With a small ρ, however, (which we require for long run stability), all this seems unlikely, and the same qualitative conclusions of the case of SAE go through. (Note that the effects on all the variables will be in general different, since Ω is not the same in both cases).

To examine the effects on growth and the distribution of income, we may first compute, using the above results, that

$$dg/dA = \{\phi'(1-a)wa_a b_a \tau/kW\Omega\}\{F(mk_2-m_2k)+\rho W(f_1k_2-f_2k_1)\}$$

which is seen to be unambiguously positive, given that $\Omega>0$ by the stability conditions. This implies that a fall in A will lead to a fall in the rate of growth of the N sector. In the SAE case, in which the results are easiest to interpret, this comes about due to the contraction in N sector output reducing the rate of profit in that sector more than the reduction in the interest rate, thereby reducing investment.

Regarding employment, since a fall in A reduces N sector employment as well as A sector employment, there is a fall in total employment; but since the effect on p_a is not unambiguous, one cannot unambiguously sign $d\omega/dA$. If p_a rises with the fall in A, due to a high degree of substitutability between capital and food, then the real wage clearly falls. The converse is true if p_a falls.

In sum, it seems that a bad harvest will have the temporary effect of reducing N sector output, the rate of interest, and the rate of growth of the N sector, but its effect on the price of food and on the real wage are uncertain. If capital and food are close substitutes in asset portfolios, one would expect the food price to rise and hence the real wage to fall.

7.3 EFFECT OF A TECHNOLOGICAL CHANGE IN AGRICULTURE

In this subsection we examine the effects of the special kind of technological change in agriculture we have considered above: a rise in productivity keeping $a_a b_a$, that is, the amount of labour per unit of land, constant. An inspection of equations (5.14b)through (5.16b) shows that since $a_a b_a$ is constant, even though agricultural output rises in the short run, in the case of SAE, there will be no change in Q_n, p_a, and in i, or in any of the short run variables. Since employment in agriculture does not change, there is no effect on either Q_n or on i, and since p_a depends on asset demands and supplies which are unchanged, the rise in Q_a has no short run impact on p_a. The only thing that changes is dF/dt, since Q_a exceeds c_a which is unchanged. Consequently changes occur in the next instant: the rise in F will, in this SAE case leave Q_n and i unchanged as seen in section 5, but will reduce p_a.

If any change in the short run comes about as a result of this kind of a technological change, it must come about through a change in expectations resulting from a change in future conditions. To consider this type of a change we must consider the case of QRE. In this case, this kind of a technological change which raises a_a, lowers b_a, but keeps their product constant, will change p_a^*, the long run equilibrium price of food. We can compute this change by looking at equation (5.23). Differentiating it with respect to a_a and imposing the condition that $a_a b_a$ is a constant implies

that $dp_a^*/da_a = -p_a^*/a_a$, implying that this sort of a technological change will reduce the long run price of food. Also, from the short run equilibrium conditions obtained by setting the right hand sides of equation (5.14e) through (5.16e) to zero, we obtain, by differentiating with respect to p_a^*, the long run equilibrium price of food,

$$dQ_n/dp_a^* = (\rho FW/wb_n\Omega)\{c'[(f_1k_2-k_1f_2)-m_1k/i]+\phi'k(k_1m-m_1k)\}$$

$$dp_a/dp_a^* = (\rho W/\Omega)\{[a+\tau(1-\phi'-c'/i)](f_1k_2-k_1f_2)+(a+\tau)(f_1m-m_1f)k/i\}$$

$$di/dp_a^* = -(\rho F/\Omega)\{[a+\tau(1-\phi')](k_1m-m_1k)+c'\ m_1\tau/i\}$$

We can see that $dp_a/dp_a^*>0$, but the other two have ambiguous signs. If c' is small, as assumed, then most of the action will come through the other terms, implying that the signs of the derivatives will depend on k_1m-m_1k, which cannot be definitely signed.

To explain the economics behind all this, note that a rise in p_a^*, or the long run equilibrium price, implies that asset holders expect the LRE price to go up to that level, so that they will expect the rate of inflation of food prices to be higher (that is, become positive). This rise in ρ^e implies that asset holders will want to switch from capital and money into food, which is now more profitable to hold. That will imply, given the initial levels of p_a, Q_n, and i, an excess demand for food and an excess supply of capital. The excess demand for food raises the food price unambiguously. This rise in p_a will increase the value of wealth, implying an increase in the demand for money and capital (and a weak and probably neg-

ligible increase in capitalist consumption, which may therefore be ignored). This rise in the demand for capital may or may not reverse the initial excess supply of capital arising from the rise in ρ^e. Whether it will or will not depends on the extent of substitutability between food and capital on the one hand, and between food and capital on the other. If food and capital are strong substitutes, then the rise in ρ^e resulting from the rise in p_a^* will imply a large reduction in the demand for capital, and hence the subsequent rise in p_a will not be able to produce an excess demand for capital, necessitating a fall in the price of claims on capital, and hence a rise in i. Conversely, if food and money are closer substitutes, one would expect a fall in i. The rise (fall) in i, will by cutting (boosting) investment in the non-agricultural sector, reduce (raise) aggregate demand, thereby reducing (raising) Q_n. We have seen that the sign of dQ_n/dp_a^* and di/dp_a^* depend on the sign of (k_1m-m_1k), which in turn depends on whether $|m_1/m|-|k_1/k|$ is positive or negative. This confirms, for example, that if money and food are closer substitutes, so that the immediately preceding expression is positive, then $di/dp_a^*<0$ and that $dQ_n/dp_a^*>0$, as our explanation would lead us to expect.

There are thus two possibilities. If food and money are closer substitutes for asset holders, then the technological change of the type described above will reduce LRE price of food, and therefore reduce, in the short run, the price of food and N sector output, and increase the interest rate. By driving up the interest rate and reducing N sector output and hence the profit rate in that sector, it will reduce investment, and hence the growth

rate of the sector. Employment in the economy will fall with a fall in N sector employment while A sector employment will remain unchanged; the real wage, however, will rise with a fall in the price of food. On the other hand, if food and capital are closer substitutes, then the fall in the long run equilibrium food price will reduce the current food price, but increase N sector output and reduce the interest rate, thereby increasing the rate of growth of the N sector and total employment in the capitalist sectors. The real wage rises as well.

7.4 EFFECTS OF CHANGES IN ASSET PREFERENCES

We consider the two types of shifts in asset preferences considered in the previous section.

7.41 SHIFT FROM CAPITAL TO FOOD

Let us consider first the case of SAE, in which ρ^e is assumed to be a constant in the short run. In this case we can show that

$$dQ_n/d\beta = -(fW/wb_n\Omega)(c'm_2+\phi'km)$$

$$dp_a/d\beta = (p_a/\Omega)[(a+\tau)km/i-m_2(a+\tau(1-\phi')+c'/i)]$$

$$di/d\beta = (fm/\Omega)[a+\tau(1-\phi')]$$

where Ω has been defined above, and has the value relevant for the case of SAE. It is obvious that $dp_a/d\beta>0$ and $di/d\beta>0$. If we assume that c' is small, which we have done, $dQ_n/d\beta$ is seen to be negative.

To look at the economics behind what is going on here, note that the shift in tastes from claims on capital to foodstocks implies an excess demand for food and an excess supply of capital. The former implies a rise in the price of food, while the latter implies a fall in the price of claims on capital, and hence a rise in the interest rate. The rise in the interest rate reduces investment demand by firms, while a rise in food prices raise wealth and hence capitalist consumption. Assuming, as we have done, that the wealth effect on capitalist consumption is weak, the former effect dominates, implying an excess supply of N goods, which implies that N sector output must fall.

Regarding effects on growth and income distribution, note that a rise in β implies a fall in Q_n (which implies a fall in r_n) and a rise in i, and both these serve to reduce investment, and hence growth, in the N sector. The rise in the output of the N sector also implies that total employment declines. Finally, the rise in the price of food implies that the real wage falls.

In the SAE case, therefore, we find that a change in the preferences of asset holders towards foodstocks, at the expense of claims on capital, implies reductions in N sector output, growth and employment, and real wages, thus worsening both growth and income distributional prospects of the economy. We have assumed away Engel effects throughout this paper. If we considered such effects, the rise in the price of food would further eat into the demand for N goods and aggravate the contraction.

The case of QRE, which allows ρ^e to change introduces two further complications in the analysis. First, it allows asset holders to revise their currently expected rate of inflation of the price of food based on their rational expectation of the long run equilibrium price which, as seen from our analysis of the previous section, is raised by the shift towards food. This increase implies a rise in the expected rate of inflation of the price of food. Second, since the current price will also affect the expected rate of inflation of the food price, the latter will also be able to play a role in the adjustment mechanism, taking the economy back to short run equilibrium. Both these complications strengthen the result that p_a will rise with the shift in asset preference, while, given, as we have seen in the previous section, that the LRE food price will change very little, and that ρ or the expectations adjustment parameter is required to be small for long run stability, these complications are unlikely to alter our conclusions regarding the other variables.

7.42 SHIFT FROM MONEY TO FOOD

Turning now to the shift from money to food, as formalized in the previous section, we can show that starting from an initial LRE position, such a shift has the following short run effects:

$$dQ_n/d\beta = (fW/wb_n\Omega)[k^2\phi'+c'(k_2+k/i)]$$

$$dp_a/d\beta = (kW/\Omega)\{[a+\tau(1-\phi'-c'/i)]k_2+(a+\tau)(1-k)/i\}$$

$$di/d\beta = (f/\Omega)\{[a+\tau(1-\phi')]k-\tau c'/i\}$$

Clearly, $dQ_n/d\beta>0$ and $dp_a/d\beta>0$, while if c' is small as assumed, $di/d\beta<0$. What happens is that this shift in asset preference creates an excess demand for food and an excess supply of money, which implies that there is a rise in p_a. This rise implies a rise in the value of wealth, and hence a rise in the demand for claims on capital, so that the price of capital claims rises and the interest rate falls. Both the wealth effect operating on capitalist consumption (which is small) and the interest effect on investment imply an excess demand for N goods, which must be satisfied by a rise in N sector output. This rise in Q_n and the fall in i implies a rise in N sector investment and hence in N sector growth. The rise in N sector output implies a rise in employment, though the rise in the level of the food price implies a fall in the real wage.

For the case of SAE, therefore, we find that a shift in asset preferences from money to food implies a rise in nonagricultural output, in the price of food, in the rate of growth in the non-agricultural secto, and in employment, and implies a fall in the interest rate and the real wage. As in the previous case of the shift from capital to food, allowing ρ^e to change in the short run for the case of QRE implies two kinds of changes in our analysis. Since long run equilibrium food price will change only slightly as a result of this shift, and since the expectations parameter is assumed small, these changes are unlikely to alter the conclusions reached above.

8.CONCLUSION

In this paper we have been concerned with the effects of the empirically important phenomenon of food speculation in an economy like the Indian one, with the help of simple two sector macro-economic models. As stated in the introduction, we had two main questions in mind. First, given the importance of the phenonmenon of food speculation, do macro-economic models which ignore it give different results regarding the response of the economy to different kinds of exogenous changes as compared to models which take the phenomenon into consideration? Second, does an increase in food speculation - somehow defined - have various kinds of adverse growth and income distributional effects on the economy like those pointed out in informal discussions of the question? In this concluding section we summarize the main results that we have obtained which are relevant for answering these questions.

To examine the first of these two questions we may compare the implications of the two models of the Indian economy that we have constructed in this paper, one assuming away food speculation, and the other taking the phenomenon into consideration. Since the two models differ only in whether they consider food speculation or not, and to the extent that our formalization of the phenomenon of food speculation in one of them is adequate, the comparison of the implications of the models regarding the effects of

different parametric shifts provides a suitable framework for answering the question.

We have considered three kinds of parametric shifts for both kinds of models: an increase in the supply of money, a bad harvest, and a technological change of the type brought about by the Green Revolution. The rise in the supply of money was found to imply similar effects - in direction, though not necessarily in magnitude - for both the models: in the short run, we found that both models predicted increases in non-agricultural output and growth rates, increases in the food price, and an increase in employment but a reduction in the real wage. In the long run, higher levels of non-agricultural output and agricultural price were implied, with increasing employment but lower real wages. However, the effects of changes originating in the agricultural sector were seen to have, possibly, substantially different effects, for the short run, though not at all for the long run.

The bad harvest in the model without food speculation resulted in a fall in non-agricultural output and growth rate, a rise in the price of food, and hence a fall in employment and the real wage. All these effects would be washed out as soon as agricultural output returned to its earlier level, so that in the long run, the economy would return to its previous long run equilibrium. In the model with food speculation, however, while the results regarding the fall in non-agricultural output and growth rate, and total employment are the same, the short run impact on the price of food,

and hence on the real wage could be different. It is possible, with money and capital being closer substitutes in the preference patterns of asset holders than are food and capital, that the price of food could actually fall, and the real wage rise, with the bad harvest. For those who would therefore pray for harvest failures in their philanthropic desires to help workers should, however, remember that employment falls in the short run, and that if in fact food and capital are closer substitutes than are capital and money, the woes of the poor last for a much longer period of time with speculation than without it. In the latter case, the rise in the price of food is corrected as soon as agricultural output goes back to its normal level. In the presence of speculation, however, this is not the case: imagine a rise in price of food due to a harvest failure in the short run; with adapative expectations, for instance, this will imply a rise in the expected rate of inflation in food prices, which, in turn, would make asset holders switch further towards food in the next period, even with the harvest failure being corrected. Famines could therefore last longer if this speculative element was operative, as Amartya Sen (1981) rightly points out.[42] Though finally, in the long run, the economy would return to the pre-harvest failure state, it would take a longer time to do so. This result is not dependent on the assumption of adaptive expectations used in our example here.

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[42] Sen, of course, is interested primarily in famines caused by causes other than harvest failures. In the case of those famines too, speculation, modelled along the lines suggested in this paper, would give similar kinds of speculative bubbles.

Turning to the effects of our stylization of the Green Revolution, we find that if the technological change is in fact of the type we have assumed, and there seems to be some evidence that it is of that type, the model without speculation would imply in the short run no change in non-agricultural output, employment, or growth, but a rise in agricultural output, a fall in agricultural price, and hence a rise in the real wage. In the long run there would be no further effects: all effects would be felt immediately in the short run. In the model with food speculation the long run effects are identical to that of the model without speculation. In the short run, however, there are important differences. The price of food and hence the real wage will change in the same direction as in the other model, but the effect on the non-agricultural sector will be in general different. The output and the rate of growth of the agricultural sector could go up or down, depending on the nature of asset preference functions. Hence it is likely that if food and money are closer substitutes than are food and capital, that the Green Revolution may have the short run effect of reducing non-agricultural output and growth, and also total employment in the economy! Advocates of technological change which do not expand employment in agriculture would do well to take note of these possibilities.

Our comparison of the effects of these two models therefore suggests that for several kinds of exogenous changes, especially those originating in the agricultural sector of the economy, the existence of the phenomenon of food speculation does make an important difference as regards the macro-economic

response of the economy. Given that in the case of India and other countries with such large agricultural sectors the major changes that affect the economy come from the agricultural sector (a comparison of the state of the agricultural harvest and the state of the Indian economy over even the last twenty years is enough to convince us of this), this is a finding of some importance.

Turning now to the other question of whether an increase in food speculation is bad for the economy, we can try to examine this by considering shifts in the preferences of asset holders towards food-stocks in the model with food speculation. We have considered two kinds of exogenous shifts in asset preferences - one, from claims on capital towards food, and the other from money towards food. We found that in both cases the long run effects were negligble - both on real wages, and on output and employment. However, for the short run, our results throw a great deal of light on this question. For the shift from capital to food, we have found that the effects are just like those claimed in the informal descriptions of effects of speculation: a lower rate of growth and a worsening in the distribution of income in the sense of reduced employment and real wage. However, for the case of the shift from money to food, while the effect on the real wage is the same, there is a rise in employment and the growth rate of the non-agricultural sector. We thus find only limited theoretical support for the claim that more food speculation is bad for the economy both from the growth and the income distributional point of view.

One question that these results raise is, how can one empirically characterise more speculation in the Indian economy - as a shift primarily from money or primarily from capital? While no hard evidence on this exists, there have often been complaints by analysts of Indian economic history[43] that Indian capitalists have shown a tendency to shift to trading and speculative operations which yield quick returns at the expense of investment in industrial capital. If we interpret this sociological characteristic of the Indian business community as some sort of evidence that speculation increases mainly at the expense of investment in industrial capital, then our results would give complete support to the claim that more speculation is bad for the economy in the short run.

We conclude with two suggestions on how research along the lines pursued in this paper could go for a better understanding of the macro-economic effects of food speculation in the Indian economy, and in other economies with similar structures. First, our analysis has made clear that the effects of various kinds of exogenous changes on the economy depend on the nature of asset preferences, specifically on the relative degrees of substitutability between different assets. While important structural shifts in the economy have been modelled as simple shifts along asset preference functions in this paper, the findings of this paper warrant some empirical excursions into the question of what asset functions look like in less developed economies like India, though work in this area is likely to

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[43] See, for example, Chaudhuri (1975). See also Bagchi (1972) and Rungta (1970).

be hampered by the non-availability of good data. Second, our models have assumed that the long run equilibrium of the economy is a stationary one, a simple way of assuming that the long run growth of the economy is determined by exogenous factors. Given this assumption, speculation could not have any long run impact of any kind on the economy. While we have focussed on short run effects in this paper, speculation could have long run effects on the economy as well, by affecting adversely capital accumulation in the agricultural sector by diverting resources and effort towards food speculation. The analysis of such effects could be formalized with the help of a more complicated model which endogenises the rate of productive investment in the agricultural sector, making it depend, among other things, on returns to alternative forms of investment, in particular, on speculative food stocks.

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Essay 3

RENT, INCOME DISTRIBUTION AND GROWTH IN AN UNDERDEVELOPED AGRARIAN ECONOMY

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1.INTRODUCTION

Theories of the determination of agricultural rent usually take one of the following two approaches. One is that of the English classical economists, who had in mind a scenario in which capitalist farmers hired land from landlords and used hired labour to produce agricultural products. Thus Ricardo (1817), for example, considered three classes in his analysis - capitalists, landlords, and workers, with capitalists paying rent to the landlords.[1] The other approach visualizes a scenario in which small peasant producers hire land from landlords and produce with their own labour to eke out a living from the land. This approach has a Marxist two-class flavour to it: rent is paid by a class of poor peasants to a class of rich landlords, with capitalist farmers having either no role in the story, or being identical with the landlord. A large part of the discussion on underdeveloped agriculture, including Indian agriculture, has proceeded essentially along this line.[2]

While these two approaches may be suitable for analyzing the agrarian structures of certain types of economies at certain periods, for most parts

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[1] See also Pasinetti (1960) and Casarosa (1978) for formal presentations of the Ricardian model of growth. For a discussion of Ricardian and neo-Ricardian rent theory see Kurz (1978).

[2] Examples are Bardhan and Srinivasan (1971) and Cheung (1968) to name only two contributions to a large and growing literature.

of India, the use of either for analyzing the determination of rent and income distribution, seems inappropriate. Although there is a very large number of tenants in the Indian agrarian economy who can be described as poor farmers, the phenomenon of large capitalist farmers renting in land has assumed an increasing importance. With the progress of the Green Revolution a group of rich farmers has emerged, with an increasing demand for cultivable land. This has occured in a situation in which the purchase and sale of land is severely restricted by attitudes towards land and by land reform legislations, so that the capitalists have entered the land market as tenants in a large way.[3] The identification of tenants as either capitalist farmers (following the English classical economists) or as poor subsistence peasants (following the traditional approach of development economists of today) therefore seems to be unsuitable for the purpose of analyzing the Indian agrarian economy: the crucial feature of this economy seems to be the coexistence of capitalist tenants with the more traditional peasant tenants.

The purpose of this paper is to examine the theoretical implications of the coexistence of the two types of tenants when both can rent in land on the

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[3] See, for example, Vyas (1970).

[4] There have been some sporadic contributions for the case of two types of tenants. Sau (1981) is an important exception to the comment in the text. This paper draws from this work. Bardhan (1977) also allows for two kinds of tenants, but the difference between the two types has to do with whether they pay a share rent or a fixed rent. The model has some superficial similarity with ours insofar as fixed rent tenants also own some land and sharecroppers are landless (see below), but the two classes rent land in dichotomized markets.

same market, something which has not been adequately considered in the literature on underdeveloped agriculture.[4] In section 2 we build a simple model of a purely agrarian economy which can help in understanding these implications. The model has unproductive landlords renting out land to two kinds of cultivators - large capitalist farmers who own some land and use hired labour for cultivation, and small subsistence cultivators who have no land of their own and who can alternatively work for wages. The model examines how rent is determined in this scenario, and thereby shows how income distribution and capital accumulation are determined in this economy.

The model can be used for the analysis of different kinds of questions that have been raised in the development literature. The remaining sections of the paper do just that.

One question we consider for the economy has to do with the criss-crossing of interests of different classes in underdeveloped rural areas. Myrdal (1968) has written on how different classes in such economies can be divided in different ways in their attitudes towards different kinds of socio-economic changes, such that this criss-crossing of interests militates against the polarization of agents into two classes, thereby preventing many kinds of changes from occuring in these economies. While the traditional analysis with two kinds of agents precludes any analysis of this question, the existence of three classes in our model allows us to examine how each of the three different classes will view different kinds

of changes, depending on how their incomes will be affected by these changes. This analysis will be conducted in section 3 where we consider some comparative statics properties of the model.

A second question that we may consider, the prospects of capitalist development in agriculture, has received a great deal of attention in the literature on underdeveloped areas, especially for the case of India. Such economies have often been seen as having two types of producers - peasants and capitalists - and two types of rich agents - capitalist and precapitalist or semi-feudal. Two related questions have then been asked, though not always by the same people. First, which of the two forms of cultivation will develop at the expense of the other, or will both flourish? Second, which of the two groups of rich agents will dominate in the long run - capitalist farmers or precapitalist elements like usurious moneylenders or unproductive landlords? Economists with different ideological backgrounds have been concerned with these questions. Marxist economists have examined the question of the growth of capitalism at the expense of precapitalist forces, given their interest in the question of the transition to capitalism, in preparation, perhaps, for the transition to socialism. Non-Marxist economists have been concerned with the dynamism of capitalist farmers in promoting agricultural growth in underdeveloped economies. In section 4 we take up this question concerning the dynamics of capitalist development by using a simple long run extension of our model of income distribution, with the hope that tighter conclusions could emerge from a more formal, if special, representation of an agrarian economy.

All of the above discussion was concerned with the agricultural sector in isolation. A final question that we can consider is the examination of agriculture-industry interactions by extending our partial equilibrium model of the agrarian sector to a general equilibrium model which also has a non-agricultural sector of the type we find in the Indian economy. While there are by now several models of interaction between a flex-price agricultural sector and a fix-price non-agricultural sector - and this would be relevant for the Indian economy - none of these pay much attention to the agrarian sector, the output being assumed to be produced entirely in either capitalist farms, as in Taylor (1982), or in peasant farms, as in Taylor (1982a). Hence these models cannot consider the question of income distribution within the agricultural sector in depth, especially the question of the distribution between capitalist farmers and landlords. In section 5 we extend our model to include a non-agricultural sector and, with it, consider the effects on rent, income distribution, and growth in the agricultural sector as a result of an expansion of the non-agricultural sector.

2.A MODEL OF UNDERDEVELOPED AGRICULTURE

In this section we first describe the economy we are trying to model, then present our model of the economy, next examine how equilibrium is determined in the economy at a point of time, and finally consider the nature of investment and growth.

2.1 DESCRIPTION OF THE ECONOMY

The economy we are concerned with is a purely agrarian economy producing a single product - a foodgrain. It has three distinct types of economic agents - landlords, capitalist farmers and peasants. Each type of agent is homogeneous within its class so that we can aggregate over them and consider the behaviour of classes. Land is owned only by landlords and capitalist farmers,[5] while labour is provided only by peasants.[6] There is absolutely no purchase or sale of land.[7]

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[5] We could also allow peasants to own some land; this would call for only minor changes in our analysis.

[6] Capitalists are assumed not to work except in a supervisory capacity.

[7] See Vyas (1970) and Sau (1981) for some justification of this assumption in the Indian context.

Landlords are unmotivated and lazy; hence they do not conduct any sort of productive activity and live off the rent that they earn.

Peasants are in abundant supply so that there exists a surplus of labour in the economy. These peasants can either work on land rented from landlords by paying a rent that deprives them of their entire product in excess of their subsistence consumption level, or work for capitalist farmers for a wage which merely covers their subsistence requirements. The peasants cannot afford a technology which uses productive capital and thus use only labour and land to produce output with a fixed coefficient production function reflecting the absence of substitution possibilities between land and labour in production.[8] Since labour is in abundant supply, this implies that peasant production is constrained by the amount of land that they can rent in.

Finally, capitalist farmers can use a technology which uses 'capital', land and labour, once again in fixed proportions, reflecting the absence of substitution possibilities between the three types of inputs.[9] The stock of capital accumulated by capitalists is given at a point of time and is a result of past investment, so that the stock of capital constrains the out-

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[8] See Vaidyanathan (1974).

[9] 'Capital' can be thought of as machinery, though it may also refer to irrigation facilities and other forms of land improvement. In section 5 we shall assume this 'capital' to be entirely produced in the non-agricultural sector, so that its interpretation as machinery would be appropriate.

put of capitalist farms. These producers can use their own land in production, and can also lease in land from landlords at the same rent at which peasants rent in land. Over time the capitalists can accumulate capital and thereby increase their output.

2.2 EQUATIONAL STRUCTURE OF THE MODEL

To describe the model, consider first the landlords. Assume that their total holding of homogeneous cultivable land is given at a point of time by T_1. This land is entirely rented out, either to peasants or to capitalist farmers, the landlords not being interested in self-cultivation. When they rent out land to poor peasants, they take advantage of the plight of the peasants resulting from the fact that they are in surplus, and thus set the rent so as to squeeze the peasants of their surplus production after their subsistence consumption requirement - somehow defined - has been met. Capitalist farmers can rent in land from landlords at the same rent, provided that they do not demand the entire land owned by landlords. Since they can conceivably pay an infinitesimally higher rent than that paid by peasants, they can rent in whatever amount of land they want to (given that they demand less than the total supply), and the remainder of the land will be rented to peasants who will not want to compete for the land by paying a higher rent since they will be indifferent between renting in more or less

land (their consumption being at the subsistence level in either case). Let the rent be r per unit of land. Landlord income is then given by

$$(2.1) \qquad Y_l = rT_l$$

Denoting the amount of land leased in by capitalists and peasants, respectively, as T_r and T_p, we get

$$(2.2) \qquad T_l = T_r + T_p$$

Next, consider peasants, who own no land, and whose total number is given at L. We shall assume that one peasant always supplies one unit of labour. Peasants can either work on their own plot rented from landlords, or work on capitalist farms for a wage. Denoting the number of such peasants by L_p and L_c, respectively, we have,

$$(2.3) \qquad L = L_p + L_c$$

Peasants hire land for use in production. If they rent in T_p units of land, their level of production is given by

$$(2.4) \qquad Q_p = a_p T_p$$

where a_p is the output-land ratio on peasant farms. Suppose that the minimum number of units of labour required to produce an unit of output using peasant technology is b_p. The assumption of surplus labour then implies that

$$L_p \geq b_p Q_p$$

Assume that the subsistence consumption requirement of peasants is given by c in terms of the agricultural good, the only good they consume.[10] According to the discussion in the previous paragraph, then, the rent (in terms of the agricultural product) per unit of land that peasants pay is given by

$$r = a_p - c\,(L_p/T_p) \tag{2.5}$$

Provided that capitalist farmers do not demand more labour than is available, which is ruled out by our assumption of surplus labour, they can hire labour in any quantity that they want at a wage infinitessimally higher than c. We shall assume that they can do the same at a wage equal to c, so that we have

$$w = c \tag{2.6}$$

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[10] This may not be a biological minimum, but may be determined by social and cultural factors.

where w is the wage in terms of the agricultural good. L_c is given by the capitalist farmers' demand and L_p is determined as a residual from (2.3), with all peasants not getting employed outside staying back on the peasant plot.

Turning finally to capitalist farmers, at a point in time they have a given stock of capital, K_a, consisting of a non-agricultural good, accumulated in the past, which can be bought at a fixed price from outside the sector which we do not consider explicitly for now. Assuming, as done above, that they can hire all the labour from peasants and all the land from the landlords that they want, their output is given by

$$Q_c = k\, K_a \tag{2.7}$$

where k is the output-capital ratio in capitalist agriculture. The demand for land and labour (and hence their actual employment on capitalist farms), respectively, are therefore given by

$$T_c = Q_c/a_c \tag{2.8}$$

and

$$L_c = b_c\, Q_c \tag{2.9}$$

where a_c is the output-land ratio and b_c the labour-output ratio in capitalist agriculture. Capitalists can own some land, the quantity of which we denote by T_o, so that the amount they use is given by

$$T_c = T_o + T_r \tag{2.10}$$

where T_r is the amount of land they rent in from landlords. The income of capitalists in terms of agricultural output is thus given by

$$Y_c = Q_c - wL_c - rT_r \tag{2.11}$$

We end this discussion of the model with two comments on some simplifications we have made. First, we have assumed that the wage level is always fixed at the subsistence level. This ignores the fact that the wage may rise in the very short run in response to an increase in the demand for labour on capitalist farms. However, as long as surplus labour exists, the wage will never rise permanently. By assuming the wage to be given as a constant we are making the convenient assumption that this this very short run adjustment occurs instantaneously. Second, we have assumed that the technology can be represented by fixed coefficient production functions, which implies, for instance, that with the capital stock given, the output of capitalist farms would be determined technologically. This assumption of rigidly fixed coefficients is merely a simplifying one. Our analysis would carry through if we allowed for some factor substitution in pro-

duction, provided such possibilities were limited: given their stock of capital, capitalist farmers would be able to increase their output by increasing the use of labour and land, but given limited substitution possibilities, there would still be a maximum limit on their output and hence on the amount of land they would rent in. In what follows we shall forget such complications and stick to our simplifying asssumptions.

2.3 SOLUTION OF THE MODEL

It is now a simple matter to solve for the values of the variables we are interested in, in terms of the parameters of the model. We shall first solve for the crucial variable, rent, and then look at the incomes of the three classes and total agricultural output.

Using equations (2.2),(2.5) and (2.7) through (2.10) we get

$$(2.12) \qquad r = a_p - \frac{c\ (L - b_c k K_a)}{T_1 + T_o - k K_a / a_c}$$

which simply states that rent per unit of land is the surplus of peasant output per unit of land and the total subsistence consumption divided by amount of peasant land.

The income of landlords and capitalist farmers follows by substituting (2.12) in (2.1) and (2.11), respectively, to get, also using (2.6),

$$(2.13) \qquad Y_l = \left[a_p - \frac{c\ (L - b_c k K_a)}{T_l + T_o - k K_a / a_c} \right] T_l$$

which states that landlord income is the rent per unit of land times the amount of land rented out by landlords, and

$$(2.14) \qquad Y_c = (1 - c b_c) k K_a - \left[a_p - \frac{c(L - b_c k K_a)}{T_l + T_o - k K_a / a_c} \right] (k K_a / a_c - T_o)$$

which is capitalist output less labour and land costs. For peasants, the relevant income variable to consider is per capita income, which is simply given as

$$(2.15) \qquad y_p = c$$

The final variable which is of some interest to us is total agricultural output, and that is given by

$$(2.16) \qquad Q_a = k K_a + a_p\ (T_l + T_o - k K_a / a_c)$$

The model solution with capitalist farmers renting in land obviously implies that the parameters of the model must obey some restrictions. Specifically, we assume that

(2.17a) $$T_o + T_1 - kK_a/a_c > 0$$

(2.17b) $$kK_a/a_c - T_o > 0$$

(2.17c) $$a_p - \frac{c\ (L-b_c kK_a)}{T_o+T_1-kK_a/a_c} > 0$$

(2.17d) $$L > b_c kK_a + b_p a_p (T_1+T_o-kK_a/a_c)$$

(2.17e) $$cb_c + \left[a_p - \frac{c(L-b_c kK_a)}{T_1+T_o-kK_a/a_c}\right] 1/a_c \leq 1$$

Conditions (2.17a) and (2.17b) ensure that both peasants and capitalists use hired land in production; (2.17c) ensures that rent is positive, that is, peasants produce above their subsistence requirements; (2.17d) ensures that the available supply of labour exceeds the technologically required amount for production, that is, there exists surplus labour; and (2.17e) states that the return to capitalist farming is higher than the rent obtainable by renting out the land instead, a condition that must be fulfilled for the viability of capitalist farming. It is easy to see that (2.17d) also ensures that $L_p = L - b_c kK_a > 0$ given (2.17a), and (2.17e) implies that $Y_c > 0$ given (2.17c).

2.4 INVESTMENT AND GROWTH

To consider how the system described by the model could grow through time, note that at any instant of time capitalist farmers add to their capital stock, and that increases K_a. Given the new value of K_a for the next instant, we can solve for the values of all the variables for that instant, and in this way study how the economy moves through time. It is obvious, however, if this were all there was to growth in this model, we could tell only a partial story along these lines, for, with capital being accumulated, the stock of land would soon be exhausted and the restrictions on the parameters assumed above would no longer be satisfied. Land would then constrain capitalist production and peasants would be completely proletarianized, that is, be transformed completely into wage labourers. Our model of rent determination would then cease to be relevant and rent would have to be determined in a different manner. To bail out our model we could do several things. We could assume that the stock of land increases through time, either by bringing in new land under cultivation, or by increasing the intensity of cultivation, thereby increasing the effective amount of land. Alternatively, we could assume that the present stock of land is large and concern ourselves with the immediate future without going into very long run consequences of growth. It is the second option that we shall follow here.[11]

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[11] The first option is followed in section 4, however.

The question arises as to what determines the level of investment by capitalist farmers. We shall assume that investment by them proceeds according to the following function:

$$(2.18) \quad dK_a/dt = I_a = g(\rho-\rho_o)K_a \qquad g'>0$$

where t denotes time and where

$$(2.19) \quad \rho = Y_c/p_nK_a$$

is the rate of profit in agriculture with p_n being the given price of the capital good in terms of food which we will subsequently set equal to unity without loss of generality, and where ρ_o denotes the rate of profit in alternative avenues of earning open to capitalist farmers, examples being usury, trade and transportation.[12] It follows from equation (2.7) that the growth rate of capitalist agriculture, the only growing sector of agriculture, is determined by the rate of profit in capitalist agriculture, given ρ_o. This implies that the higher the capitalist income, the higher is the rate of agricultural growth.

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[12] See Sau (1978) for the consequences of the existence of alternative investment opportunities for farmers in another context.

3.SOME EXERCISES IN COMPARATIVE STATICS

In this section we will consider how the values of the variables in the model change when the parameters of the model are changed. In particular, we are interested in the effects on the incomes of different classes and on growth, of changes in the different institutional and technological parameters of the model. The effects on the income of different classes throw some light on the question of the criss-crossing of class interests referred to above.

3.1 CHANGE IN SUBSISTENCE CONSUMPTION

A rise in c can be considered to be a rise in peasant consumption, somehow forced by the government, or by social agreement. It is clear from (2.12) that

$$dr/dc = -\frac{L - b_c k K_a}{T_l + T_o - k K_a / a_c} = - L_p / T_p$$

which is clearly negative, showing that a rise in peasant consumption will reduce rent. Higher consumption implies that peasants will have a smaller

surplus which can be mopped up as rent by the landlords. It follows immediately from (2.1) that landlord income, falls as r falls when c rises. As regards Y_c, the income of capitalist farmers, the effect is not clear: an increase in c on the one hand increases wage costs; on the other hand, rent costs are reduced. It can be seen from (2.14) that

$$dY_c/dc = -b_c k K_a + \left[\frac{L - b_c k K_a}{T_1 + T_o - k K_a/a_c}\right](k K_a/a_c - T_o)$$

It follows that this derivative will be positive if

$$L > \frac{a_c b_c T_1 k K_a}{k K_a - T_o a_c}$$

which is clearly possible with our parameter restrictions. What is more, even as our agrarian economy grows with K_a increasing, and with even possibly L increasing due to population growth, the above inequality will be more strongly satisfied if it were satisfied to begin with.

We therefore find that with a rise in peasant consumption, peasant per capita income will increase, the income of landlords will go down, and the income of capitalist farmers may go up or down. Total output will be unchanged, but the rate of growth of (capitalist) agriculture may either go up or down, depending on whether capitalist income rises or falls.

It is of interest to examine whether the inequality condition ensuring $dY_c/dc>0$ is likely to be satisified under the conditions prevailing in India. We can show that the condition can be alternatively expressed as

(3.1) $\quad t_r\ (L_p/T_p) > (L_c/T_c)$

where $t_r = T_r/(T_c+T_r)$ is the ratio of rented land to total land operated by capitalist farmers. The condition states that capitalist income will rise with peasant consumption if the labour-land ratio on peasant farms multiplied by the ratio of rented land to total operated land in capitalist farms exceeds the labour-land ratio on capitalist farms. The Farm Management Surveys conducted in the mid fifties in India and the large literature which has grown up around them have shown that large farms tend to use less labour per unit of land than small farms.[13] Identifying small farms with peasant farms and large farms with capitalist farms, and noting the large extent of renting in of land by capitalist farmers in India, it seems that for many parts of India the inequality condition may be satisfied, especially in those regions in which capitalists rent in a large part of their operated land, so that their gain from lower rent more than off-

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[13] We refer to Studies in the Economics of Farm Management published by the Ministry of Food and Agriculture of the Government of India, in 1966-67 and 1968-69. The substantial literature which has grown up around these studies is surveyed in Bharadwaj (1974) and in Sen (1975), while a recent assessment is to be found in Rudra and Sen (1980). See also Sen (1981), Part 1. Actually the labour intensity result has become quite standard since Chayanov (1966).

[14] Kurz (1978) has a similar result from his model of Ricardian intensive rent, but the result is explained by intersectoral price movements.

sets their loss from higher wages. So it is possible that improving peasant income may be associated with increasing the incomes of capitalist farmers at the expense of landlord income,[14] and also increasing the growth rate of agriculture: growth and equity seem to go hand in hand.

3.2 TECHNOLOGICAL CHANGE

We now consider various kinds of technological changes. We will consider changes in the output-land ratios and the labour-output ratios in each of the two producing sectors - peasant and capitalist - and the output-capital ratio in capitalist agriculture.

Consider first a rise in a_p, the productivity of land in peasant agriculture. Peasant output is raised, but landlords mop up the entire increase in the form of rent, so that peasant income is unchanged and the rent, and hence landlord income, increases. An increase in the rent implies a fall in capitalist income, so that the growth rate of capitalist agriculture falls, although current agricultural output rises. These results vividly illustrate the point that purely technological changes in agriculture designed to help the poor, without efforts to change agrarian structure and institutions, may not achieve their purpose, and in fact may make things worse.

Next consider a fall in b_p, that is, a fall in the technologically required amount of labour per unit of output in peasant agriculture. There are no effects on any of the variables at an instant of time. However, since this change implies that total labour requirements are reduced, the amount of labour in surplus, that is, the difference between the two sides of (2.17d), increases. Since the fact that labour is in surplus reduces the wage and peasant consumption to the subsistence level, this change actually aggravates the plight of the peasants without changing anything immediately.

A rise in a_c, or a rise in the productivity of land on capitalist farms, reduces capitalist demand for land (with output given by their stock of capital) and allows peasants to rent in more land to produce more and increase their surplus over subsistence requirements, which is promptly mopped up by landlords in the form of higher rent. Thus with a rise in a_c, peasant consumption does not change, while a higher rent implies a higher landlord income. The income of capitalist farmers is adversely affected by the rise in the rent, but since they now rent in less land to produce the same output, there is also a positive effect. The change is given by

$$dY_c/da_c = kK_a/a_c^2 \left[a_p - \frac{c(L-b_c kK_a)}{T_l+T_o-kK_a/a_c} (T_l/T_r) \right]$$

If T_r were close to T_l so that peasant farming was almost non-existent, then T_l/T_r would be close to unity and the term within square brackets

would almost be equal to r, so the dY_c/da_c would necessarily be positive. However, given a large peasant sector, T_1/T_r may be sufficiently larger than one to make the expression negative. Hence, the rise in a_c may either reduce or raise capitalist income. Total agricultural output, however, will rise with peasant output, but the rate of growth of (capitalist) agriculture may fall if capitalist income falls.

A fall in b_c or a rise in the productivity of labour in capitalist agriculture will reduce the rent since the demand for labour by capitalist farmers will fall and an increase in the number of peasants on self cultivated land will increase peasant consumption out of their constant output, thereby reducing their surplus, and hence the rent. Landlord income will fall, capitalist income will rise (both due to a low rent and lower wage costs), and peasant income will be unaffected. Total output will be unchanged, but the growth rate will increase. By intensifying the degree by which labour is in surplus, moreover, the fall will worsen the long run condition of labour, even though it has no immediate impact on them.

Finally, a rise in k, or an increase in the productivity of capital in capitalist agriculture, will have an ambiguous effect on rent. Increased productivity will increase the output of capitalist farms, and increase the demand and hence employment of both land and labour by capitalist farmers. An increased employment of labour reduces the number of peasants left in self-cultivation without reducing output, increases their surplus over subsistence consumption, and therefore allows landlords to mop up a higher

rent. But the increased use of land by capitalists reduces the amount of land self-cultivated by peasants, reduces their output, and hence their surplus over subsistence consumption, thereby exerting a downward pressure on rent.

To examine the conditions under which rent will fall we first prove the following lemma.

Lemma. If $a_c b_c \leq a_p b_p$ then $L > a_c b_c (T_1 + T_o)$.

Proof: If $a_c b_c \leq a_p b_p$, then $b_c a_c (T_c/T) + b_p a_p (T_p/T) \geq a_c b_c$ where $T = T_c + T_p$. From (2.17d) we get, using (2.2), (2.4), (2.7), (2.8) and (2.10), and dividing through both sides by T, that $L/T > a_c b_c (T_c/T) + a_p b_p (T_p/T)$. Using the last two inequalities we get $L/T > a_c b_c$. Since $T = T_1 + T_o$ it follows that $L > a_c b_c (T_1 + T_o)$. ||

Remark: With $a_c b_c > a_p b_p$, but with the difference not very large, it is still possible that $L > a_c b_c (T_1 + T_o)$ if L is much larger than the right hand side of (2.17d).

We can show that

$$dr/dk = cK_a \frac{(T_1 + T_o) b_c - L/a_c}{(T_1 + T_o - kK_a/a_c)^2}$$

Using the lemma we can then see that if $a_c b_c \leq a_p b_p$ then $dr/dk < 0$, though even with $a_c b_c > a_p b_p$ it is still possible for that result to hold.

Consider whether we may expect $a_c b_c < a_p b_p$ in the Indian context. Capitalist technology uses capital in production in addition to labour and land. One would expect, then, that the use of capital increases the productivity of land and labour so that $a_c > a_p$ and $b_c < b_p$. The question is whether the use of capital results in a greater saving of land or of labour. A fair amount of evidence has accumulated from various parts of India on this issue, and we consider some of it here.

On the one hand there have been several studies suggesting that the use of capital in the form of machinery has resulted in a fall in the required amount of labour per unit of land. Pearse (1980) cites Bartsch's hypothetical models based on Indian employment data which show that man hours per hectare are reduced 74 per cent and 90 per cent respectively when moving from 'traditional' to 'intermediate' and 'mechanised' techniques under 'traditional' technology, and reduced 77 per cent and 93 per cent, respectively, if technology is already 'modern'.[15] Rao (1975) shows that the rise in employment due to an increase in output, as a result of a rise in cropping intensity and yield per cropped acre, due to tractorization, does not compensate for the technological displacement of labour in the Ferozepur district of Punjab. Similarly, he shows that harvest combines result in a net displacement of labour on a large scale. Sarkar and Prahladachar (1966) have estimated a 17 per cent fall in perma-

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[15] William H. Bartsch, "Employment Effects of Alternative Technologies and Techniques in Asian Crop Production", mimeo., UNRISD, Geneva, 1972. See Pearse (1980) for definitions of the terms contained in the text.

nent labour requirements as a result of tractorization in the Dharwar district of what is now Karnataka. While this is a small sample of the evidence in this direction, conflicting evidence is also not very hard to find. Lockwood (1972) finds from survey data of the Programme Evaluation Organization of the Planning Commission of India, for the second half of the sixties, that for the wheat belt of the Indo-Gangetic plain 'tractors are associated with a slight increase in hired labour'. However, he adds that 'this situation may not last' when other operations not yet mechanized are also put under machines, which 'seems inevitable'. Billings and Singh (1970), using data from detailed farm survey reports and making forecasts to 1983/84 of the spread of high yielding varieties and of various elements of mechanization, estimate that the rise in human labour requirements in Punjab and Maharashtra will be of the order of 14 and 15 per cent, respectively. Finally, as if two sides are not enough, Sen (1981), looking at the effects of tractorization on farms in Punjab, concludes that tractors do not seem to have reduced labour use but, rather, allowed higher output without requiring more labour.

While the evidence does not always point in one direction, it seems fair to conclude that capitalist farming has not resulted in an increase in the productivity of land more than the increase in the productivity of labour (especially if we focus our attention on mechanization), so that it is unlikely that $a_c b_c > a_p b_p$. We may thus expect $a_p b_p \geq a_c b_c$. Note that this is a condition on technological requirements, not on actual uses.

We may therefore expect that $dr/dk<0$. Clearly, then, Y_1 falls with a rise in k. Regarding capitalist income we find that

$$dY_c/dk = (1-cb_c)K_a - rK_a/a_c - cK_a\frac{(T_1+T_o)b_c-L/a_c}{(T_1+T_o-kK_a/a_c)^2} \quad (kK_a-T_o)$$

Given (2.17e) and $a_pb_p \geq a_cb_c$, clearly, the sign of the above derivative is positive so that Y_c rises with k. Peasant income is obviously unchanged. Q_a rises with k as $a_c>a_p$. If capitalist income rises, so does the rate of growth of (capitalist) agriculture.

In sum, the rise in the productivity of capital on capitalist farms will probably reduce the rent and landlord income, raise capitalist income and the rate of growth of agriculture, and increase agricultural output.

3.3 CHANGES IN FACTOR ENDOWMENTS

We now consider changes in factor endowments. Specifically, we shall be concerned with changes in L, in K_a, and in T_1 and T_o.

A change in L, the total number of peasants, can be looked upon as a change in population due to natural causes, or due to migration. The rise in L

will increase total peasant consumption out of their product, reduce the surplus which landlords can mop up, and therefore reduce rent. Peasant income will remain unchanged, the income of landlords will fall, capitalist income and hence the rate of growth of (capitalist) agriculture will rise, and current output will not change. The extent of surplus labour is increased, implying a long run deterioration of the position of workers, as argued above.

A rise in K_a, the stock of capital in capitalist farms, can occur due to the accumulation of capital by capitalist farmers. The results in this are the same as for a rise in k, which has already been discussed above. Thus, with $a_p b_p \geq a_c b_c$, a rise in K_a will leave peasant income unchanged, reduce rent and hence landlord income, increase capitalist income, and raise output if land is more productive in capitalist farms, which we can assume to be the case. The rate of growth of capitalist agriculture may either rise or fall, depending on whether the rate of profit rises or falls in agriculture. (See the next section.)

Regarding land, one could examine the effects of changes in the distribution of land given a constant total, or examine the effects of a rise in the total amount of land owned by one class or the other. Concerning the first kind of change, one can imagine a redistribution of land from landlords to capitalists, for example, caused by land reforms. In this case the level of peasant income, rent and total output would be unaffected, capitalist income would rise at the expense of landlord income, and the

growth rate would increase. Concerning the second kind of change one, could imagine a rise in T_1, the amount of land cultivated by landlords, either through new land being brought under cultivation or through increasing the intensity of cropping and hence increasing the effective amount of land. The rise in T_1 would increase the amount of land hired by peasants, increase their output, increase their surplus production over consumption, thereby allowing landlords to mop up a higher rent. Consequently, the income of capitalists is reduced, and the growth rate of agriculture falls.

3.4 SOME COMMENTS

The above analysis shows how the different parametric shifts considered affect the incomes of the members of the three different classes considered in the model, and provided that the different agents understand how the economy functions, our results throw some light on how each class would view each of the changes discussed. Three comments on this are in order.

First, one idea which our analysis clearly illustrates is the idea of the criss-crossing of class interests which prevents the polarization of the dramatis personae in agrarian economies into two distinct and opposed classes. For example, we find that capitalists may side with either peasants or landlords on the issue of raising peasant consumption; landlords

and capitalists can be divided on the issue of technical progress involving a rise in the productivity of land in peasant agriculture, a rise in the productivity of labour in capitalist agriculture, or a rise in the productivity of capital on capitalist farms; but quite possibly be united on the issue of increasing the productivity of land in capitalist farms.

Second, the model illustrates that different types of technological progress may have very different implications for the fortunes of the different classes, and this fact can contribute to our understanding of the nature of technological progress in underdeveloped agriculture. The factor saving bias of a specific package changing the technology may not be known to the different agents. Further, the effects of some types of technological changes, even if their exact effects on the production functions are known, depend on the values of certain parameters of the model, which may be unknown to prospective adopters of the new technology. Given all these uncertainties regarding the effects of a given package of technological changes, our results could explain the disinterest shown by possible adopters of such changes in carrying them out, thereby explaining agricultural stagnation. It follows that it is not just landlords who would want to block technological changes as in Bhaduri(1973); capitalists could also want to block certain kinds of technological changes, as in the case of those increasing the productivity of land in peasant farms (though of course, by doing so, they would be doing the economy a service).

Third, our results show that apart from a rise in the level of subsistence consumption, none of the other changes will have any effect on peasant income at a point in time. This has two implications. First, peasants are likely to view almost any kinds of changes with disinterest, as nothing would seem to improve their immediate condition. It would therefore be very difficult to mobilize the peasantry and make them demand changes which would be in their interests in the longer run by reducing the extent of surplus labour in the economy. Second, the fundamental conflict in agrarian economies of the type considered in this paper seems to be between capitalists and landlords. We shall examine the nature of this conflict in more detail in the next section.

4.LONG RUN DYNAMICS

In this section we examine the long run movement of the agrarian economy considered above. We have already examined how one of the short run parameters of the model, K_a, moves through time as capitalist farmers invest. We could examine how the economy moves through time by specifying, in addition, how some other short run parameters move through time. As an example we shall consider the case in which, in addition to the growth of K_a, the stock of cultivated land belonging to landlords can also grow. This example is of interest since these two parameters can be looked upon as showing the importance of the two classes - capitalist farmers and precapitalist landlords - so that one can use the model to look at the long run tendencies of the two parameters - K_a and T_1 - so as to examine the nature and the outcome of the conflict between these two classes, a conflict which, we have seen, is so fundamental in our model.

4.1 DYNAMIC EQUATIONS

We therefore write out the long term dynamics of the model with two differential equations, one each for the capital stock and land of landlords.

For capitalist capital we write, almost in the same manner as before,

$$(4.1) \qquad dK_a/dt = g(\rho - \rho_o) \qquad g'>0$$

in which the growth of the stock of capital is assumed to depend on the excess of the rate of profit in capitalist agriculture over the rate of return on alternative avenues of investment. Negative changes in K_a could be interpreted as the depreciation of agricultural machinery.

For landlord land we write

$$(4.2) \qquad dT_1/dt = f(r - r_o) \qquad f'>0$$

where r_o is the minimum rent at which landlords will want to increase the amount of cultivated land they rent out. It may reflect alternative earning possibilities, or just the socio-cultural characteristics of landlords; note, however, that this is not dimensionally the same as ρ_o. A rise in T_1 can be interpreted either as an increase in the amount of actual cultivable land of landlords due to land clearing, or as an increase in the effective amount of land brought about by extending irrigation, thereby increasing the intensity of land use. The equation implies that the change in the amount of cultivated land owned by landlords depends on the rent that they can earn from the land. The increase would also depend on the costs of bringing new land under cultivation - for example, for irrigation and clearing - but these costs are ignored or absorbed into r_o for simplicity.

A negative change in T_1 can be interpreted as letting cultivated land lie fallow and fall into disuse, due to the rent being too low.

While equation (4.1) is a standard investment function, equation (4.2) raises some logical and empirical questions.

First, there is the empirical question regarding whether there is fallow land which may possibly be brought under cultivation, in Indian agriculture. There are two possible lines one can take by way of answering this question. First, the sources of growth literature on Indian agriculture suggest that the extension of area under cultivation has contributed substantially to agricultural growth right down to the seventies, though the importance of this factor vis-a-vis the growth of productivity has probably diminished through time. If we divide the period from 1949/50 to 1973/74 into two periods, one from 1949/50 to 1960/61, and the other from 1960/61 to 1973/74, we find that foodgrains output in India grew at the annual average rate of 3.34 per cent in the first period, and at 2.28 per cent in the second, while for all crops the corresponding rates were 3.42 per cent and 2.07 per cent. The crop area during these periods grew at the rates of 1.75 per cent and 0.51 per cent for foodgrains, and at 1.91 per cent and 0.47 per cent for all crops.[16] The additions to cultivated land have come mainly from land previously classified as 'barren and uncultivable' and 'cultivable waste', although some have come from a net

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[16] See Blyn (1979).

reduction in fallow land and from grazing land. For the future, Mellor (1976) uses the projections of Desai to predict that for the period 1969-70 to 1978-79 the contribution of growth, due to the increment in area under cultivation, in the total growth of foodgrain output will be 19.0 per cent, and for 1978-79 to 1983-84 it will be 22.7 per cent.[17] Second, we ought to remember that an increase in land under cultivation can also be interpreted as an increase in the number of times per year land is used, that is, an increase in the effective amount of land under cultivation. In this sense there seems to be an enormous amount of excess capacity of land in Indian agriculture, as argued, for instance, by Sau (1978). On an average, the intensity of cropping in India in the middle seventies was 1.18; in 1960/1 it was 1.15. The duration for which a crop is on land varies from crop to crop within the range of two to six months. Assuming that one crop therefore needs a maximum of six months, India's 350 million acres of cultivated land can produce two crops a year (with the use of the appropriate amount of irrigation).[18] Given that only 18 per cent of the land is used for multiple cropping, it follows that no less than 280 million acres of land remains unutilized for six months in the year. All this would seem to show that there is much possibility of bringing in more land under cultivation and one could argue that much of the excess capaicty of land lies with

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[17] See Gunvant M.Desai, "Nitrogen Use and Foodgrain Production, India, 1973-74, 1978-79, and 1983-84", Department of Agricultural Economics, Occasional Paper No. 55, Cornell University, USAID Employment and Income Distribution Project, March 1973.

[18] On the possibilities of extending irrigation facilities and increasing the intensity of cropping in India, as well as in other underdeveloped economies, see International Food Policy Research Institute (1979).

landlords and not with peasants or capitalists, both of whom produce as much as they can from their land, to earn their subsistence, and to maximise profits, respectively.

Second, there is the logical question as to why landlords can have land fallow or less than fully utilized since they could increase their income by increasing the amount of land cultivated. The answer may partly lie in the pre-capitalist attitudes of rich landlords who are not rational optimizers, and can be satisfied with whatever rent they might be earning. Higher rents, however, gnaw into their 'irrational' attitudes and induce them to bring more and more land on the market. A second interpretation could be that it is costly to bring land under cultivation and they will only do so if the return to doing so is high enough.

4.2 MOVEMENT OF THE ECONOMY

To examine how the economy moves through time obeying equations (4.1) and (4.2) let us derive a phase diagram in K_a,T_1 space. To do that, let us derive two curves showing, respectively, values of K_a and T_1 which imply $dK_a/dt=0$ and $dT_1/dt=0$.

To derive the shape of the curve for $dT_1/dt=0$ let us examine the signs of the partial derivatives $\partial f/\partial K_a$ and $\partial f/\partial T_1$. Regarding the former, we can show, differentiating (4.2) with respect to K_a and using (2.12) that

$$\frac{\partial f}{\partial K_a} = f'ck \frac{(T_1+T_o)b_c-La_c}{(T_1+T_o-kK_a/a_c)^2}$$

Assuming that $a_cb_c \leq a_pb_p$, as we shall do throughout this section, we can show using the lemma above that $\partial f/\partial K_a<0$. A rise in the stock of capital increases the hiring of land by capitalists, reduces the land holding of the peasants, and reduces rent if the factor intensity condition is satisfied (since otherwise the increased demand for labour by capitalists could reduce the number of self-cultivating peasants sufficiently to raise rents). Regarding the latter partial derivative we can show, differentiating (4.2) partially with respect to T_1, that

$$\frac{\partial f}{\partial T_1} = f'c \frac{L-b_ckK_a}{T_1^2}$$

which is positive. A rise in T_1 implies higher rent, as argued in the previous section, and therefore leads to larger increases in T_1. All this shows that given initially that $dT_1/dt=0$, a rise in K_a makes $dT_1/dt<0$ which requires a rise in T_1 to return to $dT_1/dt=0$. This implies that the curve showing combinations of T_1 and K_a giving $dT_1/dt=0$, labelled TT in Figures 1 and 2, must be upward rising, with a slope given by

$$(4.3) \qquad dT_1/dK_a\Big|_{TT} = \frac{T_1^2\{L-(T_1+T_o)a_cb_c\}}{a_c(T_1+T_o-kK_a/a_c)^2(L-b_ckK_a)}$$

All points above the curve show T_1 to be rising, and conversely for points below it, as shown by the direction of the arrows in the figures.

To derive the curve for $dK_a/dt=0$, labelled KK in the figures, we must examine the signs of $\partial g/\partial K_a$ and $\partial g/\partial T_1$. Regarding the latter we have,

$$\frac{\partial g}{\partial T_1} = -g'(k/a_c - T_o/K_a)\,\frac{c\,(L - b_ckK_a)}{(T_1+T_o-kK_a/a_c)^2}$$

which is clearly negative: the rise in T_1 implies an increase in the land hired by peasants, higher rents, lower profit rates for capitalist farmers, and hence lower rates of investment. Regarding the response to K_a we have

$$\frac{\partial g}{\partial K_a} = g'\left[(k/a_c - T_o/K_a)ck/a_c\,\frac{L-a_cb_c(T_o+T_1)}{(T_1+T_o-kK_a/a_c)^2} - \left[a_p - \frac{c(L-b_ckK_a)}{T_1+T_o-kK_a/a_c}\right]T_o/K_a^2\right]$$

Given that $a_cb_c \leq a_pb_p$ the first term within the large brackets is positive. Since the term within the brackets in the second term is $r>0$, we cannot sign the above partial derivative definitely. By inspecting the expression it can be verified that the second term becomes smaller as K_a increases, so

that the negative component falls with K_a. Also, the first term, or the positive component, rises with K_a. So even if the partial derivative is negative for low levels of K_a, it may become positive for higher levels. Neither case can be ruled out. If it is negative, then, starting from $dK_a/dt=0$, a rise in K_a will imply $dK_a/dt<0$ so that T_1 must be reduced to make $dK_a/dt=0$ again; hence the KK curve must be downward sloping as in Figure 1. If $\partial g/\partial K_a>0$, however, KK will be upward rising as in Figure 2. The slope of the curve is given by

$$(4.4)\quad dT_1/dK_a\Big|_{KK} = \left[(k/a_c - T_o/K_a)\ ck/a_c \frac{\{L-a_cb_c(T_o+T_1)\}}{(T_1+T_o-kK_a/a_c)^2} - \left[a_p - \frac{c(L-b_ckK_a)}{T_1+T_o-kK_a/a_c)}\right] T_o/K_a^2\right] / D$$

where

$$D = (k/a_c - T_o/K_a)\ \frac{c(L - b_ckK_a)}{(T_1+T_o-kK_a/a_c)^2}$$

In either case, K_a falls in the region above the curve and rises below it, as shown by the direction of the arrows in the figures.

Whether the KK curve is rising or falling, however, it can be shown that the KK curve must have a smaller slope than the TT curve, so that even if

KK slopes up as in Figure 2, the two curves must intersect in the way shown in the figure. To prove this we must show that

$$dT_1/dK_a\Big|_{TT} > dT_1/dK_a\Big|_{KK}$$

which implies, using (4.3) and (4.4) that

$$\frac{T_1^2 k\{L-(T_1+T_o)a_c b_c\}}{a_c\ (T_1+T_o-kK_a/a_c)^2} > k/a_c\{L-a_c b_c(T_o+T_1)\}$$

$$-\left[a_p - \frac{c(L - b_c kK_a)}{T_1+T_o-kK_a/a_c}\right] T_o/cK_a^2 \left[(T_1+T_o-kK_a/a_c)^2/(k/a_c-T_o/K_a)\right]$$

from which it follows that we merely have to show that

$$\frac{T_1^2\{L-a_c b_c(T_o+T_1)\}k}{a_c(T_1+T_o-kK_a/a_c)^2} > k/a_c\ \{L-a_c b_c(T_o+T_1)\}$$

which implies that $T_o<kK_a/a_c$ which must be true since capitalist farmers rent in land. This concludes the proof.

Given any initial values of T_1 and K_a, we can trace out the path along which the agrarian economy will move on the phase diagram. Given that KK is necessarily flatter than TT we find that the point of intersection of

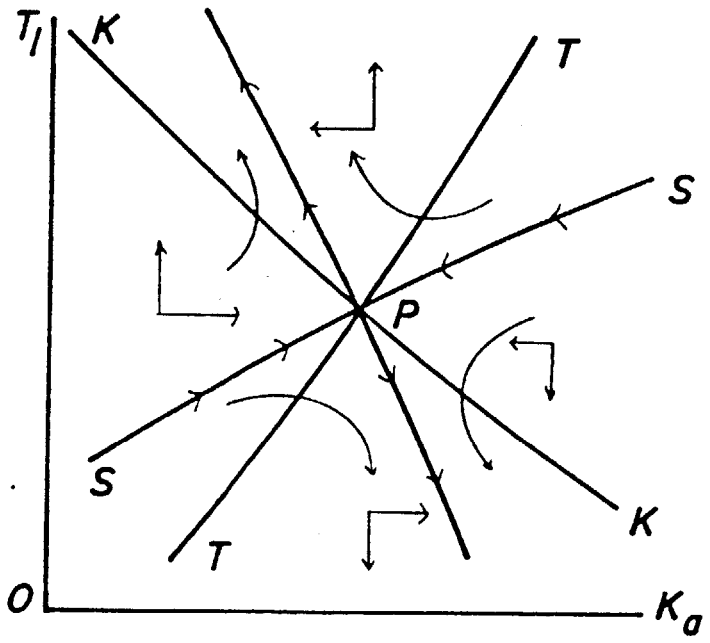


Figure 1. Long run dynamics with falling KK

the two curves must be a saddlepoint with the separatrix given by SS in the figures.

Three comments can be made from the figures regarding the movements of the economy. First, given that we have a saddlepoint equilibrium, unless the economy accidentally happens to start from a position on the separatrix, it will never attain an equilibrium with K_a and T_1 both at high levels; instead, the economy will be on a path on which, eventually, one of these two parameters continuously increases at the expense of the other, reflecting the growth of one class at the expense of the other. Second, which of

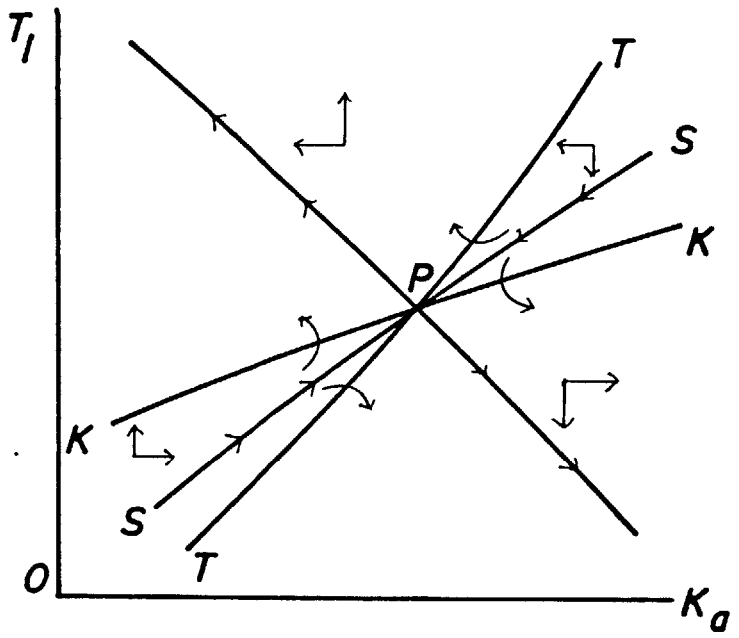


Figure 2. Long run dynamics with rising KK

the two classes will 'triumph' depends on which side of the separatrix we are initially at. Third, one cannot say, by looking at the direction of movement of K_a and T_1 for some length of time, what form the movement of the economy will eventually take. Thus for example, a phase of rising K_a and T_1 may be followed by an eventual tendency of either increasing K_a with falling T_1, or conversely.

We have found that the model admits of two kinds of long run tendencies: one in which T_1 rises at the expense of K_a, and the other in which K_a rises and T_1 falls. What happens in the first case, that is, in the case in

which the economy starts from above the separatrix SS (the region we shall henceforth call the region of capitalist decline), is that there is eventually a rise in the amount of land landlords bring under cultivation, while the capital stock in capitalist farms will fall absolutely, implying that land is increasingly cultivated by peasants, until eventually capitalist farming may disappear altogether. This is the case of the decline of capitalism in agriculture: peasant agriculture increasingly predominates with landlords exploiting peasants to deprive them of their entire surplus production above subsistence. In the second case, when we start from below the separatrix, that is, the region of capitalist triumph, landlords eventually allow more and more of their land to fall into disuse while capitalists cultivate increasing amounts of land - renting more land from landlords while peasants are driven off the land and pushed on the labour market. This is the case of capitalist development of agriculture.

Despite the fact that our simple model can throw some light on the long run tendencies of a dual agriculture of the type considered in this paper, the model is not a complete model of long run development, and this, for two main reasons. First, the movement of the economy along any dynamic path cannot proceed forever in the manner analyzed above. Second, the number of peasants has been taken to be given at the level L in the dynamic model, which implies that we have abstracted from population growth. We comment briefly on each of these two issues.

Regarding the first issue, suppose, for example, that the economy starts from initial conditions that put it in the region of capitalist triumph. Then, as described above, the amount of land under cultivation will decline, while capitalist agriculture will grow, with capitalist farmers hiring in increasing amounts of a diminishing total amount of land. Eventually, peasant agriculture will be completely displaced, and our model will cease to be relevant: rent will have to be determined in some other way. The model cannot throw light on these long run implications: it is a model showing dynamic tendencies within a given system of relations of production, not a model which show how these relations are transformed, or what happens after the transformation takes place.[19]

Regarding population growth, we can examine how the curves KK and TT in the phase diagram change with increases in L. Consider first what happens to the TT curve. As seen in section 2, a rise in L implies a fall in r, so that for given values of T_1 and KK, dT_1/dt must be lower than what it was before the change, implying that points on the TT curve will now imply $dT_1/dt<0$, showing that the TT curve must shift up to a position like T'T' as shown in Figure 3. Similarly, a rise in L increases ρ so that the KK curve must shift up to a position like K'K', whether KK slopes up or down. The result is that the saddlepoint P moves above to a point like P',

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[19] It is likely that even before peasant agriculture is annihilated, with landlords leaving more and more of their land idle, there will be pressures by capitalists for buying up the land of the landlords; purchase and sale of land may be expected to occur under these conditions, something that has been assumed away in our model.

with the separatrix moving upwards as well. If we assume that population grows at an exogenously given rate, the two curves will gradually move upwards as shown in the figure, the economy being portrayed by a moving saddlepoint. The economy will still move along a path, with the difference that if the path were above the separatrix to begin with, it might get below it as population grows. The chances of capitalist triumph are therefore increased when we allow for population growth, although the other outcome is also possible if the rate of population growth is not too high. We ought to add that if the population keeps on rising, rent will eventually become zero and then turn negative, so that our model will cease to be operative unless we assume that subsistence consumption falls with population pressures, or peasant technology improves, in a Boserupian manner, perhaps under landlord guidance.

In what follows both of these two complications will be ignored to keep things simple.

4.3 COMPARATIVE DYNAMICS

We can conduct some exercises in comparative dynamics by examining the effects on the phase diagram of shifts in some of the paramters of the mod-

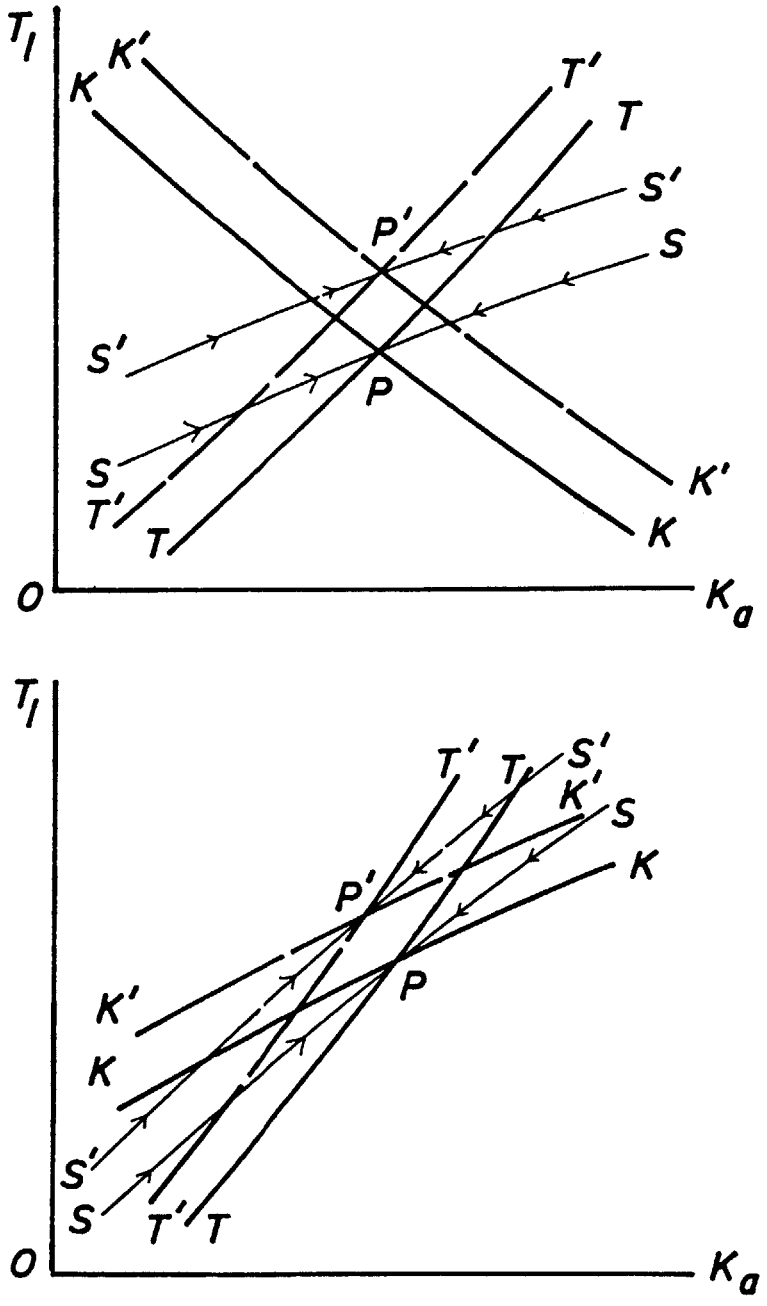


Figure 3. Effect of a rise in population

el in the same manner that we have analyzed the effects of population growth.

Without any additional analysis we can consider the implications of migration to urban areas, as a result, say, of an increase in industrial output, assuming urban (real) wages to be higher than rural peasant income. This migration would have the effect of reducing L, and therefore, shifting the economy from the dotted lines of Figure 3 to the solid lines. The result is an increase in the region of capitalist decline, implying a rise in the probability of the triumph of landlords. A sufficiently large migration could move the economy from a path implying (eventually) capitalist growth, to a path implying the decline of capitalism in agriculture. The growth of capitalism in industry, reflected by a rise in industrial output, may well imply a decline of capitalism in agriculture. This result seems to be at variance with the Lenin-Kautsky laws of capitalist development in agriculture (see below); however, it should be taken with a grain of salt since a proper analysis of the question can only be conducted with a model which explicitly considers an industrial sector: this analysis will be conducted in the next section.

To take up another example, consider the effects of an improvement in the productivity of land in peasant farms, that is, a rise in a_p. We have seen in section 3 that this implies, given T_1 and K_a, a rise in r and a fall in ρ. This implies that the TT curve will shift down as at a given K_a, a lower T_1 is required for the same change in T_1. So will the KK curve, as at a

given K_a, a lower T_1 is required for the same change in K_a. An inspection of Figure 3 implies that this kind of shift will shift the separatrix downwards, increasing the region of capitalist decline.

As a final example, consider the effects of a rise in the level of subsistence consumption, c. We know that a rise in c will reduce r but may increase or reduce ρ, depending on whether or not (3.1) is satisfied. If it is satisfied, so that a rise in c raises ρ, then it is easy to see that both TT and KK will shift upwards, so that SS will shift upwards, thereby implying an enlargement of the region of capitalist triumph. If (3.1) is not satisfied, however, and ρ falls as c rises, then TT will still shift up, but KK will shift down. In this case it is not clear whether the region of capitalist triumph expands or not. Hence it is still possible that a rise in c may imply an improvement of the chances for capitalist triumph even if it reduces ρ at a point in time.

We can go on to analyze the implications of all the different parametric shifts. For our purposes, however, it is unnecessary to do that since our few examples show the following fact: for given T_1 and K_a, any parametric shift which increases (reduces) r will shift down (up) the TT curve and a shift which increases (reduces) ρ will shift up (down) the KK curve. It follows immediately that any shift which raises r and reduces ρ instantaneously will expand the region of capitalist decline; and conversely, any shift which reduces r and increases ρ will expand the region of capitalist triumph. In the cases in which both rise or both fall we cannot

be certain; both outcomes are possible, depending on the values of the parameters.

4.4 SOME COMMENTS ON THE GROWTH OF CAPITALISM IN AGRICULTURE

Much has been written on the growth of capitalism in agriculture from both historical and strictly economic perspectives.[20] Our present model can certainly do little justice to this rich literature, since it addresses itself to a rather specific type of an economy[21] and that too, using some very simple assumptions for the sake of analytical tractability. Indeed, the model can claim to be no more than an example of the way in which agrarian classes interact. Nevertheless, one can argue that the example is an important one and may capture some of the salient features of the Indian agrarian structure. Here we comment on some of the implications of the model regarding the growth of capitalism in agriculture, relating them to some existing ideas in the literature.

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[20] See, for example, Lenin (1899,1899a) and Kautsky (1899). For discussion on India see Sau (1973,1978) and Patnaik (1971). Lenin's ideas and their relevance to underdeveloped economies of today are discussed in Lehmann (1982).

[21] We have portrayed an economy in which peasant and capitalist producers both rent in land from non-cultivating landlords, with peasants owning no land. Other scenarios are possible. Sen (1966), Eckaus (1970) and Bardhan (1973), for example, consider an economy in which peasants own their land.

One important implication of the model, commented on above, is that in the long run one of the dominant agricultural classes - capitalist farmers or pre-capitalist landlords - will triumph at the expense of the other: there cannot be a long run equilibrium with the two classes sharing the spoils (if the assumptions of our model are fullfilled).

We can compare this result to Bhaduri's (1981) analysis of the pattern of accumulation in an agrarian economy. Bhaduri considers two kinds of accumulation - first, productive accumulation having the result of increasing agricultural output directly, and typically conducted by a class of rich and 'progressive' farmers, and second, what he calls 'unproductive accumulation' which simply changes the distribution of output in favour of the investing class at a more or less constant (or even declining) level of output, and is typically conducted by a distinct class of 'unprogressive' elements in rural areas such as merchants and moneylenders, whose relation with poor peasants is of a semi-feudal nature in the sense of being forced and involuntary. Bhaduri then uses concepts used in mathematical biology to examine the relationship between the two classes of accumulators to provide a classificatory discussion of different kinds of dynamic relationships between these two classes: one in which there is strict complementarity between the classes, implying a stable long run equilibrium with both classes flourishing side by side; one in which there is strict competitiveness yielding an epistic relation of competitive extinction; and yet others of a partly complementary and competitive nature. However, the analysis does not develop a theory of the agrarian structure, and thus does

not determine under what conditions what kinds of interrelations become more likely.

Our model presents a specific theory of income distribution in an agrarian system. While this makes the analysis less general, it takes its role beyond mere classification, and allows us to make some concrete predictions regarding the interaction between two classes - capitalist farmers and landlords - who may be roughly equated to Bhaduri's two classes (although, strictly, our landlords are not really unproductive accumulators in the sense of their accumulation not increasing output). Our model implies that the outcome of the interaction between the two classes is ultimately one of competitive extinction, in Bhaduri's terminology. While our model admittedly makes some fairly strong and special assumptions to get this result, it does seem that this kind of result can emerge from a fairly wide class of models addressed to the question of the relation between capitalist and pre-capitalist classes. For instance, it emerges also from Darity's (1980) formalization of Polanyi's (1944) insights on the transition to a new social structure embodied in the change-over from feudalism to capitalism in Europe. The result also fits in well with Lenin's (1899) ideas that the peasant farm, as a mode of production, cannot coexist in the long run with the capitalist mode of production.

Given that the model predicts the eventual competitive extinction of one class, the question arises as to whether capitalism will triumph in a particular economy. Our model has two implications on issues raised by this

question. First, given that the dynamic paths shown by the phase diagram are not necessarily monotonic, one can conclude that it is not possible to say by observing what has been going on in a given time span what will happen eventually. Our result suggests that it is wrong to argue that capitalism in agriculture will develop in an economy by showing that, for say 10 years, the amount of land operated by large capitalist farmers has increased, and goes well with Lenin's (1899) idea that capitalist development in agriculture follows an uneven path. The second implication is that what determines whether or not a particular economy described by our model will experience capitalist development depends on which side of the separatrix it is on, and this will depend on the relative sizes of the regions of capitalist triumph and decline, and on the initial values of K_a and T_1. What the latter suggests is that for two economies with identical structure, capitalism is more likely to develop in the economy in which capitalists are already more important. What the former suggests is that capitalist development is more likely, ceteris paribus, if the economy has (for instance) a higher level of peasant (subsistence) consumption, a higher population, a higher productivity of labour in capitalist farms, and a lower land productivity on peasant farms. This last comment also shows what kinds of changes in an economy make capitalist development more likely.

5.INTERSECTORAL COMPLICATIONS

In the previous section we argued that an expansion in employment outside agriculture, leading to migration away from that sector, may actually create problems for capitalist development in agriculture. The result seems to be at variance with the suggestion that the capitalist growth of the industrial sector causes capitalist growth in agriculture. One can argue, however, that our model did not provide a suitable basis for discussing the question. The major mechanism by which the growth of the industrial sector is supposed to promote the capitalist development of agriculture is by increasing the demand for food, which raises the relative price of food and makes farming more profitable for capitalists. By assuming that the agricultural product was the only product, we in fact fixed its price to be unity in our model. In this section we will examine a model which can allow us to discuss this question by taking into account intersectoral price changes explicity. However, we shall confine our attention to the short run in which capital stocks are given in both sectors, and so is population and the amount of land.

The model is an extension of the simple model of the agrarian economy we have already considered to explicitly include a non-agricultural sector also. As pointed out before, this extended model adds to the literature on agriculture-industry interaction by discussing the structure of the agricultural sector in more detail than is usually done.

5.1 THE MODEL

The agricultural sector of the model is identical to the economy depicted in the previous model, with the exception that 'subsistence' is now defined in terms of a vector of the physical quantities of the two goods - the agricultural good, and a non-agricultural industrial good. Suppose that the subsistence requirement of a peasant or worker in the economy is given by the vector (c_a,c_n), where c_i gives the requirement of good i, and where the subscript n from now on will denote the non-agricultural sector. Then the subsistence money income is given by $p_ac_a+p_nc_n$, where p_i denotes the price of the two goods produced by the two sectors. Given this, the equations representing the agricultural sector are given by

(5.1) $r = p_aa_p - (p_ac_a+p_nc_n)L_p/T_p$

(5.2) $w_a = p_ac_a + p_nc_n$

(5.3) $Q_p = a_pT_p$

(5.4) $Q_c = k_aK_a$

(5.5) $T_c = Q_c/a_c$

(5.6) $L_c = b_cQ_c$

(5.7) $T_c = T_o + T_r$

(5.8) $T_1 = T_p + T_r$

(5.9) $Y_1 = rT_1$

(5.10) $Y_c = p_aQ_c - w_aL_c - rT_r$

(5.11) $\rho = Y_c/(p_nK_a)$

(5.12) $I_a/K_a = g(\rho)$ $\quad g'>0$

(5.13) $Q_a = Q_p + Q_c$

These equations are identical to the ones of section 2 and no more than three comments need be made about them. First, the rent per unit of land, as well as all income variables, are now measured in terms of money and not in terms of the agricultural good as in the earlier section. Second, some of the parameters now have a subscript a to differentiate them from similar parameters for the non-agricultural sector. Third, the rate of profit ρ measures money profit relative to the value of the stock of capital in agriculture which is produced in the non-agricultural sector so that the price p_n is used for valuing it.

The non-agricultural sector is assumed to produce a single product which can either be consumed or invested in either the agricultural or the non-agricultural sector, being the capital good in both sectors. Production in the sector requires labour and capital in fixed proportions, Leontief-like. The structure of the market is oligopolistic: producers set prices as a markup over prime costs and operate with an excess capacity of capital.[22] The money wage is fixed in this sector at the level w_n which is

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[22] These assumptions are meant to reflect the reality of Indian industry. See the first essay in this thesis for the empirical justification for this.

[23] We could alternatively allow for unemployment in the non-agricultural sector and consider a migration story along Harris and Todaro (1970) lines, but that would complicate our model unnecessarily, giving it an additional dynamic equation for migration.

higher than w_a for all possible levels of p_a, so that the actual employment of labour in the sector is always determined by the demand for it, labour being in perfectly elastic supply from the agricultural sector.[22] Investment in the non-agricultural sector is taken to be given exogenously (by animal spirits) for simplicity. Hence we have

$$L_n = b_n Q_n \tag{5.14}$$

$$p_n = w_n b_n (1+\tau) \tag{5.15}$$

where τ is the given markup rate in the non-agricultural sector and the other variables and parameters have the same meanings that they had for the agricultural sector.

The total supply of labour, L, must be employed, so that we have

$$L = L_c + L_p + L_n \tag{5.16}$$

Regarding consumption expenditure, we assume that workers above subsistence (that is, non-agricultural workers only) spend a fraction a of their income above subsistence requirements on the agricultural good, and a fraction $1-a$ on the non-agricultural good, there being no saving by workers. None of the other agents in the economy consume food, the agricultural product, but only the non-agricultural product. We assume constant average propensities

to save, s_1, s_c and s_n out of income from rent, profit on capitalist farms, and non-agricultural profits. Thus we have

$$(5.17)\quad p_a C_a = p_a c_a(L_n+L_c+L_p)+a(w_n-p_a c_a-p_n c_n)L_n$$

and

$$(5.18)\quad p_n C_n = (1-s_1)Y_1+(1-s_c)Y_c+(1-s_n)\tau w_n b_n Q_n + p_n c_n(L_c+L_p+L_n)+(1-a)(w_n-p_a c_a-p_n c_n)L_n$$

where C_i denotes the level of physical consumption of the two goods.

Equilibrium in this economy requires that the demand for, and the supply of, the two goods be equal, or that

$$(5.19)\quad Q_a = C_a$$

$$(5.20)\quad Q_n = C_n + I_n + I_a$$

The agricultural price, p_a, varies to clear the flexprice agricultural market, while non-agricultural output, Q_n, varies to clear the fixprice non-agricultural market.

5.2 STABILITY OF EQUILIBRIUM

To examine whether or not the short run equilibrium with given K_a, K_n, and T_1 (along with given values of all the other parameters of the model) is stable we must first make more explicit assumptions about the nature of short run disequilibrium dynamics. We assume simple adjustment equations given by

$$(5.21) \quad dQ_n/dt = \theta\ [p_nC_n+p_nI_n+p_nI_a-p_nQ_n]$$

$$(5.22) \quad dp_a/dt = \mu\ [p_aC_a - p_aQ_a]$$

where θ and μ are positive constants denoting speeds of adjustment in the two markets, and which show that the two equilibriating variables respond positively to the value of excess demand in the two markets.

Substituting in (5.21) and (5.22) from (5.1) through (5.18) we get

$$\begin{aligned}(5.23)\ dQ_n/dt = \theta\ \{ & (1-s_1)T_1\ [p_aa_p-(p_ac_a+p_nc_n)(L-b_nQ_n-b_ck_aK_a)/T_p] \\ & +(1-s_c)\,[p_ak_aK_a-(p_ac_a+p_nc_n)b_ck_aK_a \\ & -T_r[p_aa_p-(p_ac_a+p_nc_n)(L-b_nQ_n-b_ck_aK_a)/T_p]] \\ & +\ (1-s_n)\tau w_nb_nQ_n + p_nc_nL+\ (1-\alpha)(w_n-p_ac_a-p_nc_n)b_nQ_n + p_nI_n \\ & +\ p_ng(\ (1/p_n)\,[p_ak_aK_a-(p_ac_ap_nc_n)b_ck_aK_a \\ & -T_r(p_aa_p-(p_ac_a+p_nc_n)(L-b_nQ_n-b_ck_aK_a)/T_p)]\ ) \\ & -(1+\tau)w_nb_nQ_n\ \}\end{aligned}$$

$$(5.24) \quad dp_a/dt = \mu\ \{p_ac_aL+\alpha(w_n-p_ac_a-p_nc_n)b_nQ_n-p_aa_pT_p-p_ak_aK_a\}$$

To examine the local stability of the system of equations we next examine whether the system satisfies the sufficient conditions for such stability, that is, whether the Jacobian of the system has a negative trace and a positive determinant.[24] To do that let us compute the four partial derivatives entering as elements in the Jacobian, which we denote by a_{ij}. Ignoring the speed of adjustment constants, we therefore have

$$(5.25)\quad a_{11} = -\{[s_n r w_n + (w_n - p_a c_a - p_n c_n)\alpha] + (p_a c_a + p_n c_n) b_n (1/T_p)[s_1 T_1 - (s_c - g')(k_a K_a / a_c - T_o)]\} b_n$$

$$(5.26)\quad a_{12} = -(1-\alpha) c_a b_n \Omega_n + (1 - c_a b_c) k_a K_a (1 - s_c + g') + (a_p - c_a(L - b_n\Omega_n - b_c k_a K_a)/T_p)\{T_p + (s_c - g')(k_a K_a / a_c - T_o) - s_1 T_1\}$$

$$(5.27)\quad a_{21} = \alpha (w_n - p_a c_a - p_n c_n) b_n$$

$$(5.28)\quad a_{22} = -\{a_p T_p + k_a K_a + \alpha c_a b_n \Omega_n - c_a L\}$$

Consider now the saving propensities out of rent and capitalist farm income, s_1 and s_c. It is likely that capitalist farmers interested in capital accumulation will have a higher propensity to save than landlords, implying that we may expect $s_c > s_1$. For accumulation, capitalist farmers buy capital goods from the non-agricultural sector and their marginal propensity to accumulate is given by g'. $(s_c - g')$ therefore shows the leakage from the demand for non-agricultural goods from capitalist farm income

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[24] See, for example, Hirsch and Smale (1974).

while s_1 gives the similar leakage from rent income. The relative sizes of these two leakages determine the effect on non-agricultural demand of income distributional changes between rent and agricultural profit. With no presumption in either direction, we can greatly simplify the algebra by assuming that $s_c-g'=s_1=s$, which embodies the fact that $s_c>s_1$ but assumes that g' just compensates for their difference. Relatively small differences either way from this equality will leave our broad conclusions unchanged.

If we make the above simplifying assumption we can rewrite (5.25) and (5.26) as

$$(5.29)\quad a_{11} = -\{[s_{nr}w_n+\alpha(w_n-p_ac_a-p_nc_n)]+(p_ac_a+p_nc_n)s\}b_n$$

$$(5.30)\quad a_{12} = (\alpha-s)c_ab_nQ_n+(1-s)(Q_p+Q_c-c_aL)$$

We can then show that the trace of the Jacobian is given by

$$tr = -\{Q_p+Q_c+\alpha c_ab_nQ_n-c_aL+[s_{nr}w_n+(w_n-p_ac_a-p_nc_n)\alpha]+(p_ac_a+p_nc_n)b_ns\}$$

which is seen to be negative, and the determinant of the Jacobian is given by

$$\Delta = b_n\{(Q_p+Q_c-c_aL)[(s_{nr}+\alpha s)w_n+(1-\alpha)(p_ac_a+p_nc_n)s]+(s+s_{nr})\alpha c_aw_nb_nQ_n\}$$

which is seen to be positive, proving the local stability of equilibrium.

5.3 EFFECT OF AN EXPANSION OF THE NON-AGRICULTURAL SECTOR

An expansion of the non-agricultural sector can be represented by an autonomous rise in I_n. To examine the effects of this on the variables of the model, particularly on the distribution of income between landlords and capitalist farmers, we can first examine the effect of the change on Q_n and p_a and then consider the effects on the other variables.

Totally differentiating the equilibrium conditions with respect to I_n we can show that

$$dQ_n/dI_n = (p_n/\Delta)\ (Q_p+Q_c+\alpha c_a b_n Q_n - c_a L) > 0$$

$$dp_a/dI_n = (p_n b_n/\Delta)\ \alpha(w_n - p_a c_a - p_n c_n) > 0$$

which show that the rise in I_n raises both non-agricultural sector output and agricultural price, the former because it raises aggregate demand for the product, and the latter since non-agricultural sector employment rises, so that the demand for food rises, because non-agricultural workers have a higher wage than the subsistence incomes of peasants and workers in agriculture, from whose ranks the new industrial workers are drawn.

Next we can show that

$$dr/dI_n=\{a_p-c_a(L-b_n\bar{Q}_n-b_c k_a K_a)/T_p\}(dp_a/dI_n)+(p_a c_a+p_n c_n)(b_n/T_p)(d\bar{Q}_n/dI_n)>0$$

which shows that a rise in I_n will raise rent in agriculture in terms of the agricultural good, both because the price of agricultural good rises and because an increase in non-agricultural output and employment implies that less peasants are left on peasant farms so that the peasants have a lower total subsistence requirement, allowing landlords to mop up a large surplus as rent. It immediately follows that landlord income rises. Also, we can show that

$$dY_c/dI_n = (b_n p_n/\Delta)\{\alpha d[(1-c_a bA)k_a-(T_r/T_p)(\bar{Q}_p-c_a L+c_a b_n\bar{Q}_n+c_a b_c k_a K_a)]$$
$$-(T_r/T_p)(p_a c_a+p_n c_n)(\bar{Q}_p+\bar{Q}_c-\alpha c_a b_n\bar{Q}_n-c_a L)\}$$

where $d = w_n-p_a c_a-p_n c_n$ is the industrial-agricultural money wage differential. The first term within the braces is positive, and the next positive term is subtracted from it. It is thus not possible to sign the above derivative definitely. However, one may speculate as to what its sign is likely to be in the Indian context. The magnitude of the first term depends on α and d. α is the marginal propensity of workers in non-agriculture to spend on food. This marginal propensity, reflecting Engel effects, is not likely to be high. Indeed, Ray (1980) estimates that the urban expenditure elasticity of food for India is .340. d, the wage gap, is likely to be small also, especially if we adjust for cost of living

differences in the two sectors, given the poverty of both urban and rural working classes. Chatterjee and Bhattacharya (1974) look at differences in per capita consumption expenditures for urban and rural areas and show that the per capita expenditures for the lower income groups - which is relevant for our purposes - are merely 15 per cent higher in urban than in rural areas. Consequently, especially if capitalist farmers rent a large part of landlord land, that is, T_r/T_p is high, one would expect the second term to dominate so that dY_c/dI_n would be negative. The expansion in the non-agricultural sector will indeed raise the agricultural price faced by capitalist sellers, but will also raise the rent paid by them. If the rise in price is not very large - and that happens when the wage gap is not too large and the non-agricultural workers' marginal propensity to spend on food is not too high - the rent increasing effect will dominate and capitalist income will fall. In this case, from (5.11) and (5.12) it would follow that agricultural investment would fall, and hence the rate of growth of (capitalist) agriculture would fall.

Two comments can be made about this result.

First, the growth of the non-agricultural sector need not necessarily imply the growth of capitalism in agriculture. Capitalist progress in non-agriculture is clearly not sufficient for agricultural growth: one ought to carefully examine the agrarian structure of the economy before making a blanket statement on the issue for a particular economy.

Second, if our analysis were valid for a particular economy, time series data on the agricultural terms of trade and the rate of agricultural growth would reveal an inverse relation for that economy. This result is relevant for the discussion on agricultural price policy concerning the effect of changes in agricultural price on agricultural production and marketed surplus.[25] Our result is a warning to those who believe that somehow raising agricultural prices would trigger off higher growth in agriculture by raising its rate of profit. Our finding has a flavor similar to that of Gibson and McLeod (1982) who show that in economies in which non-produced means of production such as land exist and where all land is of the same quality (so that rent in intensive and not extensive in Ricardian terminology), an autonomous change in the terms of trade in favour of agriculture could depress the rate of profit in agriculture and hence the rate of growth. However, their model has several differences compared to ours: they take relative prices to be autonomously fixed and implicitly assume all production to be capitalistically organized. Rent is therefore determined in a different manner in their model. Since in our model, prices are not autonomously fixed, we are not saying that a lower rate of agricultural growth is caused by the change in the relative price; the two occur together, both caused by non-agricultural growth.

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[25] See Mitra (1977), for example.

6.CONCLUSION

In this paper we have constructed a simple model of rent determination in an agrarian economy in a situation in which both poor peasants and rich capitalist farmers rent in land in the same market. Rent is determined in our model with landlords charging a rent high enough to squeeze the entire surplus production above subsistence needs from the peasants; capitalist farmers, renting land in the same market, pay the same rent. The implications of this kind of rent determination have been explored in the paper.

First, the model shows the growth and income distributional impacts of different kinds of exogenous changes in the agrarian economy. The analysis illustrates Myrdal's (1968) analysis of the criss-crossing of class interests, suggests explanations for a low rate of technological change, and shows that the main source of conflict in agrarian areas which can be described by the model exists between capitalist farmers and precapitalist elements.

Second, the model sheds some light on the question of the development of capitalism in underdeveloped agrarian areas, and shows under what kinds of conditions the triumph of capitalism is more likely. It should be pointed out, however, that the model developed is a model which focuses only on some important aspects of agrarian structures while ignoring many other important issues. In particular, it stresses on the relation between capi-

talist farmers and pre-capitalist landlords through the land market, but ignores entirely rural credit markets, and hence does not consider the relationship between capitalist farmers and pre-capitalist moneylenders, a relationship which may also be relevant to the question of capitalist development in agriculture.

Finally, the model, extended to include also a capitalist non-agricultural sector, shows that the expansion of the non-agricultural sector may not always foster capitalist development in agriculture following the Lenin-Kautsky laws of capitalist growth in agriculture.[26] It also implies that a shift in the intersectoral terms of trade towards agriculture may not imply the growth in agriculture. These two results illustrate the by now well understood fact that in underdeveloped areas with large agricultural sectors it is bad policy to foster the growth of the industrial sector alone and expect the agricultural sector to follow obediently behind.

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[26] Lenin (1899a) observes that 'it is the development of capitalism in the manufacturing industry that is the main force which gives rise to, and develops, capitalism in agriculture'. In all fairness to Lenin, we should note that this is not the same as saying that capitalist growth in manufacturing is sufficient for capitalist growth of agriculture, a proposition we have shown to be wanting.

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