PUBLIC POLICY AND THE DYNAMICS OF DEVELOPMENT
A Macroeconomic Theory For Developing Economies

B.K.PRADHAN

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Indian Statistical Institute
7, S.J.S. Sansanwal Marg
New Delhi - 110 016

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To those
who work more
and get less

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CHAPTER - 1

INTRODUCTION

If I am given the choice to define "Development Economics", I would do so in such a way that the work reported here must eminently belong to the realm of that discipline. Before proceeding further one must remember what Hirschman said nearly 28 years ago - "...probably that economists have not been able to construct, much less agree on, a single and unbroken chain of causes and effects that would neatly explain the transition from "Underdevelopment" to development. While this "failure" is of course only to the credit of economists, it cannot be denied that in comparison with the elaborate constructs of static partial and general equilibrium theory, our dynamics, particularly those dealing with underdeveloped countries, have themselves an "underdeveloped" look. Challenging generalisations and theoretical insights are conspicuously rare in the writings on economic development..." Probably the statement still holds though may be to a lesser extent. Through the years, the research response, though overwhelming, could not be enough insofar as the enormity of the problem is concerned. While much descriptive, very useful in their own right, literature exists in development economics, a few attempts have been directed towards abstraction, and so, understanding the subtlety of the interplay of forces that work along the path of development dynamics.

As far as I can assure you, having said all this, here is an attempt in the right direction which is obviously not to claim that it really adds to or subtracts anything substantial from the state of development theory. Of course, the focus here is on growth and distribution, the two questions which are as old as the science of economics itself. And not surprisingly it has become the most basic question to the policy planners, at least, in developing countries.

The "balanced growth" theorists like Nurkse and Lewis perhaps may not entirely agree with our approach that at each period of time the macro balancing conditions must hold; for example, the demand for a particular commodity must equal its supply, or else there will be rationing in that market. But there is no reason why they should not. Markets are clearing either by endogenous forces like prices or income, or by exogenous rationing assumptions. However, we are not assuming the same rate of growth for each economic variable in general. Nevertheless, this does not take this model anywhere near the "unbalanced growth" theory developed by Hirschman. Actually, it is far from that. To my mind, expost, the markets must clear by rationing or otherwise.

Just by imposing the balancing conditions we could see the intricate inter-relationships among growth, distribution and prices. It lays bare the mechanisms that work to settle down the economic variables to rest in each period.

Inasmuch as our principle is to keep the approach simple, we have tried to raise as many relevant questions as possible in the one consumption good model with one technique of production. Nevertheless , later on, we introduce two sectors producing consumer goods and one of them i.e. the industrial sector has two techniques of production. This is obviously due to analyse the choice of techniques on the one hand and to study the agricultural industrial sectors interaction on the other. Towards the end,land has been brought in as an explicit input in the production of food, and also as a constraint on the expansion of the economy. Here, each sector has two techniques and it seems to be interesting to explore the pattern of modernisation in agriculture vis-a-vis industry along the growth path. The introduction of land makes the inherent dynamics explicit and edogenous fluctuations become discernible. And the characteristics of the model change between the two stages of development:before the full modernisation of land and after that.

Our model says we are biased towards modernisation of the over – all economy. It is only when we compare among sectors we are bothered to notice questions like which sector gets modernised faster than the other.

Next distinguishing feature of the work,presented here, is that the role of monetary and fiscal policies have been given their due accolade while performing their roles. Besides taxation, money printing and borrowing by the government enter here as effective instruments of policy. An active public sector produces that critical input called capital with assumed technical efficiency.

Since we assume through out, excess supply of labour,the case of ensuring availability of a fixed amount of basic necessity like food is considered to be more realistic, and therefore, analysed in great detail.

Some of the policy questions, raised here, dates back even to Kautilya, the great ancient Indian statesman and social philosopher. In fourth century B.C., it seems, Kautilya advised against public loans, raising commodity taxes or dabasement of currency. Most of the measures that he recommended are against the traders and the rich. On the other hand, the Dutch writer Pinto argued that public debt augments the riches of the country. Berkley called public debt a mine of gold. Ricardo told that public borrowing and taxation do not have any differential effect on the economy. However, to Keynes' mind it makes all the difference when an individual's consumption is being curtailed by means of tax or government loan. To him, government loan is an addition to the private individual's wealth while taxation is not. True to himself, Marx was more radical in his views as to public debt: "..The public debt becomes one of the most powerful levers of primitive accumulation. As with the stroke of an enchanter's wand, it endows barren money with the power of breeding and thus turns it into capital, without the necessity of its exposing itself to the troubles and risks inseparable from its employment in industry or even in usury."

The main purposes are to analyse the impact on growth and distribution in planned economic development, of (a) financing the plan through different sources like tax, borrowing, deficit financing (defined as borrowing from the central bank) administered prices etc., (b) industrial policies like deliberate discrimination against some techniques in production, allocating capital and credit to priority sectors etc and (c) to observe how the impact varies at different stages of development so that strategies can be chosen accordingly.

We have tried to make it plausible as far as possible, though it may not seem to be entirely persuasive insofar as it bears unconventional policy prescriptions because a balance has to be struck between excessive generalisation and realistic explanations.

By and large, we are addressing ourselves to the problems of developing countries. Some results, however, transcend the assumptions distinguishing the developing economies. Harrod's well known growth equation and the famous Pasinetti paradox turn out to be very special cases of our model. Fortunately enough, we have many more degrees of freedom to manoeuvre than the above mentioned distinguished authors had in their respective models.

We have listed, for anybody to take a cursory glance, all our results in the concluding chapter.

CHAPTER - 2

PUBLIC POLICY - GROWTH AND DISTRIBUTION

2.1.1 Introduction

Even though we are restricting ourselves, here, to only one sector producing consumption good, the framework turns out to have ample scope to explore questions not only pertaining to growth, distribution and prices but also the impact of public policy on them. To confess, the identification of three major theoretical approaches i.e. neoclassical, neo-Keynsian and neo-Marxian in mainstream economics has been borrowed from Marglin (1984). In the first three cases to be discussed, we have tried our best to be closer to these approaches insofar as the basic assumptions are concerned. Nevertheless, our model has its own difficulties and distinguishing features to be exactly equivalent to the assumptions and follow ups of his taxonomy. We think it is interesting to explore few more cases inasmuch as they have their own usefulness though it seems difficult to identify them, even broadly, with any of the mainstream theoretical assumption sets.

A consistent definition of income, solely derived from the usual maintenance of accounts, and hence, definition of saving, investment, consumption, depreciation etc, are presented in the section to follow. Money and bonds are also precisely defined in order to facilitate analysis. A brief account of why money is demanded in the economy is given here for the sake of completeness. Concepts of prices and profits, their definitions and derivations are thought to be in order. Due to the aformentioned reasons the first half of the present chapter seems to be crucial to make out the subsequent pages.

In this supposedly simplest model there are three goods: one consumption good, one capital good and labour; two financial assets: fiat money and government bonds; and three classes: the labouring class, the capitalists, and the government. Capital good requires only labour as input and takes one period to be produced. As to consumption good two different situations are conceived: in one, the production is instantaneous, so profit is assumed to be zero, and in the other, the prodcution takes one period so that enough room is created for the generation of profit. Public sector produces capital good leaving the production of consumption good to private enterprise. In general, the excess supply of labour assumption is crucial except in certain variants of the model where growth rate of the economy is exogenous to the economic system. Invariably, the growth rate refers to the accumulation of capital irrespective of whether it is different from or similar to the growth rates of the other sectors, physical or financial. A word of justification for excess labour supply assumption is duly in order. Many writers, Nurkse and Lewis being prominent among them, have justified the assumption in more than one way. To start with, it is a fact to observe that all over-populated developing countries in south-east Asia are having acute problem of persistent unemployment which, by no means, can be identified as cyclical or frictional unemployment of an advanced capitalist economy. A lot of disguised unemployment in the primary sector of the economy is also clearly visible. In countries like India women may come out in large numbers to work in the modern sector if situation so demands. One may legitimately ask why the children are employed while so many young adults are moving around in the streets. We do not have any plan to go into the debate except believing the fact that the children are being exploited with more work, and much less pay, which an adult will not do.

Money and Governmnet bonds are the only financial assets which are singled out to be included in the model, and to my mind, rightly so. Both are government liabilities. A bond is a promise to pay one rupee plus the rate of interest next period in exchange for one rupee in this period. On the other hand, the money does not give any return for the holder who carries it from one period to the next. It is the medium of exchange backed by the legislation of the government which can issue any amount of money and bonds. Money assumes the function of numeraire for any type of calculations in the model.

2.1.2 Prices and Profit

In general, the price of labour is fixed at w rupees per period per unit of labour. Not unusual since the market is under constant pressure by dint of excess supply of labour. The upward pressure on wages is mounted because of worker's insistence not to work at less wages. Strange as it seems, he is not at all irrational inasmuch as a day's (and hence, a period's) work is socially standardised and optimisation over his preferences of his perceived benefits lands him in a place where he feels hesitant to work for less. Of course, all of us must agree that leisure has some value.

Wage rate is given and prices may increase, at least when investment is pushed up. How far one can go? One can go till full employment is achieved if one is ready to buy a Nurksian assumption that disguised unemployment means the unemployed is supported by his family and friends, so the wages earned by the employed ones are divided among all. And he called this potential savings. Hence, decrease in the wage rate may not decrease the consumption of individual labourers and so their welfare if the total consumption of labourers does not go down.

Since it is universally known how much heat and dust was created in the debates over the pricing of capital through the histroy of economic thought, we will not recapitulate them here. However, we believe that it is not mean a task to bring people from all shades of thought to an agreement over the pricing principles and measurement of the capital good, and it would remain so till a long time to come. Besides all the problems, our capital good belongs to the public sector so that we are not in a position to take the help of market forces or, in other words, Adam smith's invisible hand. We have attempted to base the pricing on some reasonable principles notwithstanding.

The rate of interest i is either market-determined or simply be administered by the government. In the latter case it becomes a policy variable to be fixed at a level to maximize social welfare. One basic principle for determining the rent on capital could be in the long run, at least, that the public sector must balance its current account, i.e. the revenue from selling the services must be equal to the expenditure including maintenance. Let us say if one unit of capital is created at any point of time, then μ of it was financed through taxes; of the left over, d fraction of it was financed by issuing bonds and the rest by printing money. Putting in other way, to finance one unit of new capital, μ rupees is raised from taxes, $(1-\mu)d$ by issuing bonds and $(1-\mu)(1-d)$ by printing money. If one unit of capital is used for one period, δ unit of capital depreciates. Then the current cost of an unit of capital to the public sector is $(\delta + id)(1-\mu)$ per period. The portion of depreciation also is financed by taxes. Not unreasonable an assumption when public sector capital may include building of infrastructure in the economy and otherwise also public sector is not interested in profit per se. Preceisely this is the reason, again for not recovering what has been sunk into capital formation from taxes and money creation. We need γ units of labour to produce one unit of capital next period. So present cost is γw. Thus a rental charge $r = (\delta + id)(1-\mu)\gamma w$ is enough to meet the interest and non-tax portion of depreciation.

To our comfort, we find that the discounted values of the stream of revenues is becoming equal to r. Production of capital costs γw rupees. At t^{th} period the capital reduces to $(1-\delta)^{t-1}$ units from one unit. The portion financed by bonds, and in a way belonging to them, is $d(1-\mu)\gamma w$. Their opportunity cost, and hence, the discount factor is i per period. Here charge can be $(\delta + i)$. Then the present value of the revenues works out to be

$$d(1-\mu)\gamma w \sum_{t=1}^{\infty} \frac{(1-\delta)^{t-1}(\delta + i)}{(1+i)^t} = d(1-\mu)\gamma w.$$

Government does not discount its revenue i.e. its (nominal) opportunity cost is zero, as long as it can create money. This is as far as the portion financed by money is concerned. Government does not care to collect anything on tax portion. It just goes as sinking fund. Therefore, the government collects δ on the money-financed portion. Hence the present value is

$$(1-d)(1-\mu)\gamma w \sum_{t=1}^{\infty} (1-\delta)^{t-1}\delta = (1-d)(1-\mu)\gamma w$$

The sum of the two present values is $(1-\mu)rw$. And the rental, obviously is equal to

$$(\delta+i)d(1-\mu)\gamma w + \delta(1-d)(1-\mu)\gamma w = (\delta+id)(1-\mu)\gamma w.$$

To warn the reader, there is nothing sacrosanct about this formula. One may choose any other technical formula to work with. Nevertheless, as has been noted, this keeps with the spirit of reasonableness.

The formula holds as such as long as we are in the steady state where the interest rate and the wage rate do not change through time though they may change when we shift the steady-state.

Let α and β be the amount of labour and capital respectively, needed for the production of one unit of the consumer good Q. And if the tax is τ per unit of output and the production is instantaneous, the price of Q is defined as

$$q = \alpha w + \beta r + \tau \quad \text{and} \quad P = \alpha w + \beta r.$$

When production takes time, we assume profits to be generated. Let us say the market price q here includes the profit. Then profit π is defined as follows.

$$\Pi = \frac{q-\tau}{\alpha w + \beta r} - 1 .$$

Implicit here is the fact that τ is a sales tax, more importantly, it is being paid next period when the good is in the market. If we assume that the tax is paid as soon as the production process starts then the profit formula can be changed suitably and easily.

The capital, which generates profit, here is synonymous with the concept of working capital or variable capital in the literature. Like the production of capital, the production here requires waiting which obviously has to be working capital since it is needed for somebody to finance in one period and wait for the next.

In the profit case, we are required to assume that the rate of profit is at least as high as the rate of interest. This is so because, otherwise, everybody will prefer to invest in government bonds. And therefore, no finance will be available for the production process to carry on in the consumption good sector.

2.1.3 Accounts

Transactions are classified into two accounts; the current revenue account or the account that relates to the transanctions of goods and services, and the capital account i.e. the account that takes care of the transactions relating to financial assets. Let us have no doubt that this capital account has nothing to do with physical capital. To write down the accounts in detail we need the following symbols. We will assume profit to be zero for simplicity. However, in positive profit case, and thereafter, in the many good case or for that matter for any case, the transanction tables, and hence, the income, saving and investment can be defined with little more effort if the basic approach is understood and agreed upon.

Q_t = consumption good at time t

L_{tj} = labour demand at time t by jth class

K_t = capital at time t

d_C = fraction of capital financed by capitalists through debt.

d_L = fraction of capital financed by labourers through debt

d = $d_L + d_C$

I_t = gross investment at time t

B^d_{tj} = stock of bonds with class j at the begining of period t

M^d_{tj} = stock of money with class j at the begining of period t.

Superscripts: 'd' denotes demand and 's' supply

Subscript : 'L' for labour, 'C' for capitalist and 'G' for government

Table 1: Current Revenue Account

Sl. No.	Class	Expenditure	Revenue
1.	Labourers	$(P+\tau)Q^d_{tL}$	$(L^d_{tG} + L^d_{tC})w + id_L(1-\mu)K_t\gamma w$
2.	Capitalists	$(P+\tau)Q^d_{tC} + wL^d_{tC} + rK^d_t$	$PQ^s_t + id_C(1-\mu)K_t\gamma w$
3.	Public Firm	$wL^d_{tG} + id(1-\mu)K_t\gamma w$	$\tau(Q^d_{tL} + Q^d_{tC}) + rK^s_t$

Table 2: Capital Account

Sl. No.	Class	Disbursements	Receipts
1.	Labourers	$B^d_{tL} - B^d_{(t-1)L} + M^d_{tL} - M^d_{(t-1)L}$	0
2.	Capitalists	$B^d_{tC} - B^d_{(t-1)C} + M^d_{tC} - M^d_{(t-1)C}$	0
3.	Public Firm	0	$B^s_t - B^s_{(t-1)} + M^s_t - M^s_{t-1}$

The current revenue amount in Table 1 is self-explanatory. However the capital account may look strange at the first sight. Under the Disbursement head the accumulation and under Receipts, the release of bonds and money are listed. Government issues $B_t^s - B_{t-1}^s$ of bonds and $M_t^s - M_{t-1}^s$ amount of money in the t th period and the private sector i.e the labourers and the capitalists put together add this additional amount to their already existing holdings of the assets. Implicit in these transanctions is that the private sector transfers real resources to the government in exchange for the paper assets.

One might feel free to think that the inclusion of the banking sector would have made the accounts more realistic. But that is not to be the case, at least at this level of abstraction. If the banking sector is totally under government control it does not make any difference, whatsoever, to the account. If not, then the private controlled banking sector would assume power over the real resources to the extent it can expand the credit. The argument goes through after abstracting from the usefulness of banks in its efficiency of mopping up of the savings and diverting it to the right sectors, monetising the economy etc. In other words, the banking sector's organisational effort has been abstracted from.

2.1.4. Income, Savings and Investment

For every class, the income will be defined as the balance from current revenue account (BCR) plus the expenditure on consumption and (current) investment.

Sl No.	Class	Income
1.	Labourers	$Y_L = L^d_{tw} + id_L(1-\mu)K_t\gamma w$
2.	Capitalists	$Y_C = id_C(1-\mu)K_t\gamma w$
3.	Public Firm	$Y_G = \tau(Q^d_{tL} + Q^d_{tC}) + rK^s_t - id(1-\mu)K_t\gamma w.$

One must notice that these are gross income concepts because the depreciation is not being deducted. It is sitting inside 'r' so that it is being counted as government's income.

Addition of currency and bonds are vanishing from the income calculations. To our mind, like Joan Robinson's and others', currency creation is a loan from the private sector to the government, but at zero rate of interest. In some growth models with money, government bonds and currency liabilities are treated as private wealth, where the government does not create any physical asset but just provides benefits like social security. (See e.g. Tobin(1965), Solow(1968)). This has been questioned by several authors also (see e.g. Barro (1974)). If at all we include money in income then it must be in government's account, not in any private account. But we have our own reasons not to include additional paper assets to National Income. Tobin (1983) turns our attention to a dilemma that when one includes money in individual's wealth how it cancels out at economy wide aggregate level when added up. He argues that there is enough reason to believe that private individuals perceive their paper asset holdings as their wealth and on the other hand it is difficult to justify the same at the aggregate level. Seen in another way the dilemma is resolved. Everybody's money holding is backed by the goods and services, both real and potential, belonging to all other individuals in the society. If the assumption is acceptable then there is hardly any reason not to see that there is a double counting while adding up individual income to get the total income. What is the alternative then? Inasmuch as we prefer to have the aggregation of individual income to total income, it is logical for us to exclude money and bonds from individual incomes. Secondly, government can go on printing money and creating income in the society. The immediate response from the defenders would be that the real income may not increase at all because the expansion of money income would be taken care of by the price rise. But the question remains as long as it does not match exactly - if the price rise is not adequate or if the price rise is more. There are enough theories to support the second possibility. Money facilitates transaction. So as it performs some real function, it must have value, and hence, it must be counted as income. It should have value - we completely throw our weight behind that. But the point at issue is whether to count it as income. To the best of our knowledge, the transactions could not be affected as long as the proper denominations are available, of course, distribution of money assumed to be constant, whatever the quantity of money in the economy. Besides, if we assume the relationship between transanction and income to be constant, the exclusion of money from income will hardly create any trouble for the analysis.

Savings is defined to be the difference between income and consumption i.e. $S = Y - C$

where Y = income, S = saving and C = consumption

In our judgement, a good definition of income must satisfy these additional conditions:

(i) The total income must equal the value of final goods and goods in process at market prices.

(ii) Y − tax revenue = the total factor income.

(iii) $Y = C + I$ and $Y = C+S$

So ex post $I = S$

It will not be difficult to see that our definition of income i.e. Gross National Product (We do not have an external sector) satisfies these three conditions. We assume that budget constraints of everybody are satisfied i.e. $BCR_j + BC_j = 0$ where BCR_j is the Balance on current Revenue account of j-th class and BC_j is the Balance on Capital account of the j th class.

Hence for each sector, $S_j = Y_j - C_j = BCR_j + I_j = - BC_j + I_j$. If the capital account balances (in equilibrium it must, and in the case when the classical dichotomy holds without equilibrium also), we have

$BC_L + BC_C + BC_G = 0$. Therefore, $S_L + S_C + S_G = I_L + I_C + I_G$.

Thus we see that investment equals savings whenever financial markets balance

The value of final goods and goods in process

$=(P + \tau)Q^s_t + L^d_{tG}w$

$$= Q^s_t q + L^d_{tG} w + \tau(Q^d_{tL} + Q^d_{tC}) \qquad \text{(when } Q^d = Q^s \text{)}$$
$$= Q^s_t(\alpha w + \beta r) + L^d_{tG} w + \tau(Q^d_{tL} + Q^d_{tC})$$
$$= L^d_{tw} + id(1-\mu)K_t \gamma w + \tau(Q^d_{tL} + Q^d_{tC})$$
$$+ rK^s_t - id(1-\mu)K^d_t \gamma w \qquad \text{(where } K^s_t = K^d_t \text{)}$$

= labourers' income + capitalist's income + government's income

Now, if we deduct the tax part of the government income from the total income, we get the total factor income i.e. the sum of labour income, interest income and the return on capital.

External sector is being excluded from the concepts defined above. Conceptually it should not create any problem to take care of that. Since we have confined ourselves to a closed economy through out, it is natural for us to think that it is unnecessary to include the external sector while defining the income and other variables. However, we do believe that not to include external sector in the analysis is to explain away the problem associated with the sector. Still we are deliberately excluding the sector because our focus, as has been seen, is different.

2.1.5 Demand For Money

We see from our transaction tables that the private individuals demand money. Their exact demand functions of money, the ones in our opinion, satisfy the conditions that they are to be simple to handle and at the same time must be reasonable, will be specified later on as we proceed. That we assume money is demanded, appears to be reason enough for demand for money to deserve a few comments. It is not to say that we are going to build a model to justify endogenously the demand for money. Nevertheless, a few remarks are in order.

What is money? Money is what people believe to be money, not separately, but the group as a whole. Its intrinsic value must be strictly less than its face value. Everybody must be ready to accept it in exchange for any other good. It must reduce the cost of its transaction and transportation to a negligible sum. We can go on listing its qualities. But the basic point is that the demand for money only gives life to money itself. Unlike any other good, money loses its usefulness as soon as its demand goes to zero. And, as we know, any rational economic agent demands something only if it has usefulness.

At this point we enter a beneficial circle. Any agent demands money if it is useful i.e. its value is positive (positive to somebody else as well) and its value is positive if anybody demands it. To vary the jargon, an agent demands money if he believes that at least one other person in the economy will exchange goods for money. As Tobin (1980) has rightly put it money is like a language. One's speaking English is useful insofar as the other does also: just so, money is acceptable to one provided it is acceptable to the other. If one believes that more and more persons are interested in his money, then the money gets more and more social acceptability. Once the confidence is created the process snowballs.

In every country, the government either directly or indirectly via the central bank's link with the banking system creates the confidence. Besides all other reasons that could be put forward in favour of the government to have the exclusive right to create the seed money or what is called in the literature the high-powered money, the confidence generating role must be one. Actually, any discussion on money must involve its creation by the government. It is not that government provides the right quantity of liquidity free of charge, it rather gives money only to transfer real resources from private sector to itself. It does promise to pay back the face value of paper when demanded but it so happens that it is never demanded, and hence, in practice, it need not pay back. When it has to pay back, in common terminology it has to be called a 'crisis'.

We described only the first part of the story. Now the question is money is useful in which sense even when its value is positive. People say money acts as a medium of exchange, store of value and a unit of account. Any number of models have been constructed, assuming money is store of value and medium of exchange, to show the existence of monetary equilibrium. However, we do not have the inclination now to discuss them elaborately here. Though these models have helped the theory to improve to a large extent, a lot of work is necessary to conclude anything definite. For example, the Clower constraint models that take only the medium of exchange role of money into account, assume infinite cost to transaction except via money. People transact in money because it is cheaper to do it that way.

What is the actual social value of money? It is difficult to calculate, may be unnecessary also.

Money demand has a credit aspect also. In Indian towns and villages the small timers, I heard, lend money at very high rate of interest for a very short period, even for a day, and they hold the money for the rest of the time when they do not have anybody to lend to. For instance in the morning they lend money to the small shopkeepers, in the evening they collect with interest, and hold it in the night to carry over to the next day.

For our purpose, it is enough if we observe that people hold money. Nevertheless, it is worth exploring the reasons. And there are enough of them both proximate and ultimate. For *instance*, I can never imagine a situation where I go to a barber shop for a hair-cut and offer him a few pages of my research papers in exchange. Poor barber and me!

2.1.6 Behavioural Assumptions

Both labourers and capitalists save a fixed fraction of their income. The fractions are denoted by s_L and s_C respectively with $s_L < s_C$. Mostly we assume that s_L and s_C are constants, but, at times, we take them to be strictly increasing functions of the interest rate i and in that case $s_L(i) < s_C(i)$ for all i ; z_L and z_C are fixed fractions by which labourers and capitalists split their savings into bonds and money.

The expenditures on consumption good is then given by $(1-s_L)Y_L$ and $(1-s_C)Y_C$. Therefore the real consumption distribution (the only thing that matters when we consider a steady-state) is given by

$$\frac{Y_L(1-s_L)}{Y_C(1-s_C)}$$

The labbourers are ever ready to offer their services for a wage rate w, less than that they do not work. When the production is instantaneous, let us assume that the producers get un-bounded pleasure just in producing as long as it is costless. In the other case, when production takes time and so profit generation is a possibility, the capitalists are assumed to choose their production plan in such a way as to maximize the total profit, given the prices and the supply of the capital good. Inasmuch as we are assuming fixed proportion technology, the supply must adjust to demand at a price more than the cost of production, or to the available supply of capital whichever is minimum.

In our model, the government and the public sector are synonymous for obvious reasons. The government prints money, issues bonds and collects taxes according to its need. The purpose is to use these resources in capital formation. Let us say g is the rate of growth or the rate of net investment and $g > 0$. Then the government's investment behaviour is described by the following equation:

$$I_t = (g+\delta)K_t = (K_{t+1} - K_t) + \delta Kt$$

Where I_t = the gross investment at time 't'

K_t = the capital stock at time 't'

Hence, at time 't' the government needs $I_t \gamma w$ rupees as its investment requirements.

2.2 Allocative Mechanism and Equilibrium

Five markets, three for physical goods and services, viz., consumption good, capital good and labour, and two for financial assets, viz., bonds and money constitute the model. Production and distribution must be organised in such a manner that availability of each commodity or asset is equal to its requirement in each period. Next natural question is: what are the mechanisms that bring balance in each of the markets?

By the way, with financial assets with the properties we have mentioned, it is difficult for the equilibrium to exist with nice neoclassical assumptions. In fact, we have shown a counter example in Appendix-1 that equilibrium may not exist. Hence we have taken care to put the additional conditions, in the text, so that equilibrium exists.

Capital good being produced by the public sector, the price is administered. Time is involved in its production. Hence the quantity of capital is given at the beginning of each period. When there is excess demand, demand is rationed, and when there is lack of demand, actual supply is restricted to demand.

Infinite supply of labour allows the only possibility of actual supply adjusting to the demand. The equilibrium value of labour is determined by the quantity of capital because of fixed coefficient technology.

As to money and bonds, inasmuch as the agents demand them in fixed proportion, the demand for one immediately specifies the demand for the other and the goverenment also issues money and bonds in a fixed proportion. The jth agent holds z_j portion of his savings in bonds. In effect, one mechanism is enough to clear the financial markets.

Out of five markets, we are essentially left with two markets, the consumption good market and the market for the composite financial assets. Because of Walras law, if one market clears, the other does so automatically leaving us with only one independent condition.

Mostly, we will be concerned with the long run, i.e the steady states. This will impose some restrictions on the macro variables. It turns out here that the condition for a steady state yields an additional independent relation.

Government's gross investment expenditure is $(g + \delta)K_t \ \gamma W$ since g and δ are growth rate and depreciation respectively. It cannot escape the balancing of its own budget. From the definition, public sector's income is given by

$$\tau(Q^d_{tL} + Q^d_{tC}) + (\delta + id)(1-\mu)K_t\gamma w - id(1-\mu)K_t\gamma w$$

$$= \tau(Q^d_{tL} + Q^d_{tC}) + \delta(1-\mu)K_t\gamma w$$

= tax revenue + depreciation on non-tax financed capital

As has been mentioned, a fraction of gross investment expenditure is collected via taxes. Hence,

$$\mu(g+\delta)K_t\gamma w = \tau(Q^d_{tL} + Q^d_{tC})$$

Therefore the public sector income which is equal to saving becomes

$$\mu(g+\delta)K_t\gamma w + \delta(1-\mu)K_t\gamma w.$$

Where does the government get resources to finance the rest of the investment expenditure? The labourers and the capitalists save a part of their income, and it is crucial for the public sector to tap these savings. It issues bonds and resorts to deficit-financing. The private agents are eagerly waiting to buy the bonds and money in exchange for real resources and the government does not mind to issue as much paper to collect the whole savings. Now it is obvious that the government does its budget balancing. And the household saving fills in the gap between government saving and investment.

We need not be unrealistic by not assuming the full capacity utilisation of capital in steady-state. Hence the level of employment in consumption good sector is $\frac{\alpha K_t}{\beta}$. Public Sector employment is $(g + \delta)K_t\gamma$. The total wage bill is $[\frac{\alpha}{\beta} + (g+\delta)\gamma]K_t\gamma w$. The saving out of this is equal to $s_L[\frac{\alpha}{\beta} + (g+\delta)\gamma]K_t\gamma w$.

The interest income is from the debt portion of the capital stock, $id(1-\mu)K_t\gamma w$. The amount $id(1-\mu)K_t\gamma w$ is distributed according to their share d_L and d_C. So the labourers get $id_L(1-\mu)K_t\gamma w$ and the capitalists $id_c(1-\mu)K_t\gamma w$ of interest income.

The savings out of interest income is

$$s_L id_L(1-\mu)K_t\gamma w + s_C id_c(1-\mu)K_t\gamma w = ids(1-\mu)K_t\gamma w$$

$$\text{where} \quad s = \frac{d_L}{d}s_L + \frac{d_c}{d}s_C .$$

Since investment equals total savings, we have the following equation.

$$(g+\delta)K_t\gamma w = \mu(g+\delta)K_t\gamma w + \delta(1-\mu)K_t\gamma w + s_L[\frac{\alpha}{\beta}+(g+\delta)\gamma]K_t\gamma w + ids(1-\mu)K_t\gamma w.$$

Dividing both sides by $K_t\ \gamma w$ and collecting the terms, we get,

$$g(1-\mu) = ids(1-\mu) + s_L(\frac{\alpha}{\beta\gamma} + g + \delta) \tag{1}$$

The equation above is the fundamental saving investment equality per rupee of capital. In a steadily growing economy, it is enough to study the relations at one point of time. Hence we choose the point of time, at which the value of capital stock is one rupee (assuming the rate of interest to be zero).

Notice that equation (1) is the market clearing condition for the financial markets. (The budget balancing condition of the government determines redsidually the tax rate). By Walras law this is true if and only if the consumption good market clears. And this is not difficult to check.

We shall refer to equation (1) as 'IS' relation.

In the steady-state, one has to save in the same proportion in bonds, as it is the only interest-bearing asset, as the proportion of capital from which it gets the interest income. In other words, for each rupee of net investment the labourers must provide d_L and capitalist d_C rupee by buying government bonds. Then the two relations follow.

$$z_L s_L[\frac{\alpha}{\beta\gamma} + g + \delta + id_L(1-\mu)] = d_L\ g(1-\mu) \tag{2}$$

$$z_C s_C[id_C(1-\mu)] = d_C\ g(1-\mu) \tag{3}$$

Note that equations (1),(2) and (3) are linearly dependent. So we have two independent equations. Equations (2) or (3) will be referred to as 'LM' equations depending upon which one we use, which in turn, depends upon the convenience of our analysis.

Using the two independent equations, we can determine two endogenous variables. The possible endogenous variables are i, g, d_L, d_C, μ

We will consider only the following three pairs as endogenous (i, d_L), (g, d_L) and (i, g). For each case we will study the existence of a solution and analyse the effect on it of the changes in exogenous variables and parameters.

2.3 Flexible Interest Rate and Income Distribution

This is the case which Marglin might have liked to call Neo-classical given the specificity of our model. The growth rate is assumed to be given here. In that case one is not constrained to say that the full employment prevails, the growth rate is being equal to the rate of growth of population. Absolutely nothing changes in the model. In other words, the case at point is independent of the assumption of prevalent unemployment in the economy. Besides, it is not difficult to imagine that our labourers and capitalists are simply households and maximize their utilities and profits subject to the constraints. Of course, we have more constraints than a pure neo-classical would prefer to allow us. Production is instantaneous, wherefore it is not unreasonable to say that the competition among capitalists drives the profits to zero level. And underlying the assumed demand functions for the consumer good and financial assets there is a utility function for each individual.

Enough about the exegesis of similarity with the neo-classical school. It is time to turn to the equation (1). Assuming, as Harrod did for the moment that there is no tax, no borrowing or lending and no depreciation, i.e. $\mu = o$, $d = o$ and $\delta = o$, we get

$$g = s_L \left(\frac{\alpha}{\beta\gamma} + g \right)$$

which imply

$$g = \frac{s_L}{1-s_L} \; \frac{1}{\beta} \; \frac{\alpha}{\gamma} \qquad (1.A)$$

Equation (1.A) is the same as the famous Harrod-Domar growth equation. Why? Harrod assumed the total saving metamorphose to capital without changing its value. To vary the jargon, to him, one unit of saving becomes one unit of capital whereas ours is a round about process. That with the savings labour is hired and γ unit of labour when employed produce one unit of capital next period. And, as we know, α unit of labour is used to produce one unit of consumer good. Hence, the labour equivalent of – only direct labour requirement is considered, and rightly so – one unit of capital good is $\frac{\alpha}{\gamma}$ unit of consumption good. So implicit in Harrod-Domar equation is that $\frac{\alpha}{\gamma}$ is equal to unity. If there is one class, then our s_L is their s. We get $\frac{s_L}{1-s_L}$ because the process of income generation via Keynesian multiplier has been made explicit whereas they have jumped steps to the final output level. The multiplier, obviously is $\frac{1}{1-s_L}$. This is proof enough to claim that Harrod-Domar growth equation is a special case of ours. While they have only the savings rate, the capital-output ratio of the consumption good and the growth of population plus technical change to vary, we have a host of technical coefficients, policy parameters and market determined variables to restore the required balance in the economy.

Equation (3) also deserves a close look. If we assume $z_C = 1$, what is implicit in Pasinetti's Model (Pasinetti, 1962), then we are left with

$$s_C\ i = g \tag{2A}$$

Since i is the rate of return on capital, equation (2A) is same as Pasinetti's paradox. That both labourers and the capitalists invest their money so that they get the same rate of return on their investment, but the rate of return, given the growth rate, entirely depends upon the propensity to save of capitalists. Our chain of reasoning is also same as his. Mechanistically speaking, inasmuch as the share of income earning asset is constant for both the classes so that each of them has to contribute in that proportion in the current period and the capitalists' only source of income is from the interest receipts, the rate of return has to adjust enabling the capitalist to contribiute his share of saving, given his saving propensity. It does not happen for the labourers because they have one additional source of income i.e. the wage income.

This hurts the general belief that to increase the overall savings in the economy more income must be transferred to the capitalists' class insofar as they save more than the labourers. That is not to be.

From Equation (2) and (3) we get

$$i d_L (1-\mu)(z_C s_C - z_L s_L) = z_L s_L \left(\frac{\alpha}{\beta\gamma} + g + \delta \right)$$

Assuming $z_C = z_L = 1$ (and d=1), we have

$$id_L(1-\mu)[(1-s_L)-(1-s_C)] = s_L\left(\frac{\alpha}{\beta\gamma} + g + \delta\right)$$

This shows that the excess consumption expenditure of labourers due to their interest income is matched by their saving from their labour income. So transfering interest income between classes does not increase the total savings. That is because the income distribution parameters have been fixed.

The growth rate is assumed to be given exogenously, so, at best, what can we do is to study the impact of public policy on distribution.

Using equations (2) and (3) we get,

$$d_L = \frac{\left(\frac{\alpha}{\beta\gamma} + g + \delta\right)}{g(1-\mu)\left[\frac{1}{z_L s_L} - \frac{1}{z_C s_C}\right]} \qquad (2B)$$

Let us call σ_Y the income distribution parameter .

$$\sigma_Y = \frac{\text{Income of the labourers}}{\text{Income of the capitalists}}$$

$$= \frac{\frac{d_L}{z_L s_L} g(1-\mu)}{\frac{d_C}{z_C s_C} g(1-\mu)} \qquad \text{from equations (2) and (3)}$$

$$= \frac{1}{\dfrac{d(1-\mu)\left[\frac{1}{z_C s_L} - \frac{1}{z_C s_C}\right]}{\alpha/\beta\gamma g + \delta/g + 1} - 1} \quad \frac{z_C s_C}{z_L s_L} \qquad (2C)$$

As it is clear, as g increases, σ_Y decreases and otherwise. Growth worsens income distribution. Increase in g not only adds to the labour income but also augments the interest earnings of both the classes by increase in i. Why then they lose? Since, as has been noted, the capitalists have claim to a greater share of the debt capital, they have to contribute accordingly to the increased investment i.e. increase in g. Their income must increase more than proportionately through proper adjustment in the interest rate. And that is what exactly happens.

The consumption expenditure ratio also goes against the labourers in that the saving propensities are constant. Since supply of consumption good is fixed, the share of labourers' consumption decreases. Simultaneously employment increases, and hence, the real wage must go down. It is not difficult to observe this phenomenon from another angle. Rise in interest rate increases the rental on capital and hence the unit cost of the consumption good. The tax rate also goes up as the growth rate goes up. The price of consumption good increases as a result, whereas the wage rate is given at a constant level w.

Next consider an increase in the tax financed portion of the investment μ. The equation (2c) says the distribution parameter σ_Y shows a healthy sign of increase. It must be noticed that, since we have only one consumption good and the propensities to save are not affected by prices, the commodity tax here is equivalent to a proportional income tax. Then our hypothesis follows that a proportional income tax - and certianly a progressive one also - improves income distribution. A change in μ does neither affect the labour income nor even the interest rate. However, d_L responds positively to μ. As μ goes up, labourers' income from interest sources goes up and that of the capitalists goes down the reason being, first, the proportion of bond (and also money) financing of investment decreases; and secondly and subsequently, since the labour income remains unchanged, the savings of labourers increase proportionately requiring the reward to their savings to increase. One must notice that the brunt of the total adjustment is borne by the income in that the interest rate is unaffected.

Therefore, in as much as the quantity of the consumption good is given, the consumption expenditure ratio moves in favour of the labourers, they as a class and also individually get to consume more. The result remains unaffected when the saving propensities are made to depend upon the interest rate. We know the consumer price increases to the extent tax rate increases minus the decrease in the cost.

It is a question, what happens when the administered price of capital changes, of utmost importance. Suppose the rental changes are increased by ε per rupee of capital. Then the financial structure of the public firm changes to ε, $d(1-\mu-\varepsilon)$ and $(1-d)(1-\mu-\varepsilon)$ according to their sources of funding. The rental is given by

$$r = [\varepsilon + (\delta + id)(1-\mu-\varepsilon)]\gamma w$$

The public sector surplus is ε. Therefore, the investment saving relation is modified as

$$g(1-\mu-\varepsilon) = ids(1-\mu-\varepsilon) + s_L(\frac{\alpha}{\beta\gamma} + g + \delta).$$

Similarly the steady state conditions are given by

$$z_L s_L[\frac{\alpha}{\beta\gamma} + g + \delta + id_L(1-\mu-\varepsilon)] = d_L\, g(1-\mu-\varepsilon)$$

and $z_C s_C\, id_C(1-\mu-\varepsilon) = d_C\, g(1-\mu-\varepsilon)$.

These conditions are same as the earlier equations(1),(2) and (3) if we replace by $\mu + \varepsilon$. This makes clear that increasing the administered price is equivalent to raising the commodity tax. That it is not surprising since, when technology is in fixed proportions, input tax and commodity tax are equivalent.

Now, suppose the deficit financing i.e. money creation is increased. Then d decreases. Since d_L is endogenous, let us say d_C decreases by the same amount as d. From (2C) we see, σ_Y increases. In effect, for an decrease in d and increase in μ, both reasons and results are same, atleast qualitatively except that consumer price decreases in the former case while it may increase in the latter case. This result that deficit financing is better than market borrowing is also insensitive to whether we make the saving propensities to depend upon i or not.

2.4 Growth and Distribution

We do not have a proper investment demand function in the sense that investment is not a positive function of the profitability of investment. However, as we will see later, the rate of return i affects the investment positively though due to entirely different reasons. Nevertheless, we would like to call this case as Neo-Keynesian because the growth rate g and the distribution of income d_L are endogenously (and simultaneously) determined; and the consumer preferences determine the composition of the output and not the structure of prices. On the other hand the prices are given. Unlike neo-classicals, neo-Keynesians assume unemployment though to a smaller extent and so allow a limited upward variation of growth rate without population expansion. To that extent we have a generalised assumption of unlimited supply of labour. By solving explicitly for g and d from equations (2) and (3), we get

$$g = z_C s_C i \tag{2D}$$

$$\text{and } d_L = \frac{\left(\frac{\alpha}{\beta\gamma} + z_C s_C i + \delta\right)}{i(1-\mu)\left[\frac{z_C s_C}{z_L s_L} - 1\right]} \tag{2E}$$

And the distribution parameter is given by

$$\sigma_Y = \frac{1}{\dfrac{d(1-\mu)\left[\frac{z_C s_C}{z_L s_L} - 1\right]}{\alpha/\beta\gamma i + \delta/i + z_C s_C} - 1} \qquad \frac{z_C s_C}{z_L s_L}$$

For existence of the solution (it is unique since the system of equations is linear) we must have, $z_C \geq 0$, $s_C \geq 0$ and $z_C s_C > z_L s_L$. (So, in effect, $z_C > 0$ and $s_C > 0$). The last condition, already being hinted at earlier, if does not hold, then the capitalists will be wiped out of their existence because the labourers have an additional source of income, that is, wage earnings. If so, then the second and the third conditions immediately follow.

Because $z_L s_L$ cannot be negative, z_C and s_C must be greater than zero again for the existence of the capitalists as a class. Capitalists must save and atleast some portion in bonds because interest earnings is their only source of income. And otherwise also s_L, and s_C must not be negative as the origin of growth lies in the savings and therefore investment.

To substantiate our argument we can take $z_L s_L = z_C s_C$ as a special case and observe that d_L tends to infinity implying the non-existence of the capitalists class.

The growth rate entirely depends upon the saving behaviour of the capitalist. We do not need to repeat the reasons which have already been specified. A rise in i pushes up the growth rate, and pulls down d_L. Whatever is happening is not unlikely because with a rise in i, the income of the capitalists increases, so also their savings in bonds.

Simultaneously the income of the labourers increases but not proportionately, because though their interest earnings and labour income from investment sector go up, the wage earnings from consumption good sector remains stagnated. Hence their contribution to savings in bonds goes down relative to that of the capitalists resulting in the diminution of d_L.

For the reasons described above σ_Y also diminishes. Number of persons employed has gone up and consumer price goes up due to increase in i. Hence the labourers as a group and individually get to consume less than before the interest rate was hiked even though the income of the labourers increases. It is, now, not easy to comment on welfare changes. Per capita consumption (and also total consumption) of the labourers goes down but employment goes up so that the intra-distribution of consumption good among labourers improves. And also, since growth rate goes up, it may be better in absolute terms in future for everybody.

The effect of changes, in μ and d on d_L (and therefore since g is not affected by these parameters) are the same as in the last section. To our relief, the chains of reasoning are also the same.

Changes in z_L and s_L do not affect the growth rate (correspondingly the rate of return in the last section); but they favourably affect d_L and σ_Y. An increase in either z_L or s_L increases the relative income of the labourers. This is obvious because they are investing more on income earning assets, so their income must increase relative to that of the capitalists.

If only z_L increases then the relative consumption position (let us call it σ_Q henceforth) of the labourer improves outright. If s_L increases, instead, what happens to σ_Q is not clear. From equations (2) and (3) we get,

$$\sigma_Q = \frac{\text{Consumption expenditures of the labourers}}{\text{Consumption expenditure of the capitalists}}$$

$$= \frac{d_L}{s_L} \; \frac{1-s_L}{d_C} \; \frac{z_C s_C}{z_L(1-s_C)}$$

From (2E) it is clear that $\frac{d_L}{s_L}$ increases with an increase in s_L. And $\frac{z_C s_C}{z_L(1-s_C)}$ is constant. Let us turn our attention to $(1-s_L)/d_C$.

Again, differentiating equation (2E), we get,

$$\frac{\partial(d_L)}{\partial s_L} = \frac{z_C s_C z_L [\frac{\alpha}{\beta\gamma} + z_C s_C i + \delta]}{i(1-\mu)(z_C s_C - z_L s_L)^2}$$

which increases as s_L goes up.

If we differentiate $\frac{1-s_L}{d_C}$ with respect to s_L we get,

$$\frac{\partial}{\partial s_L}\left(\frac{1-s_L}{d_C}\right) = -\frac{1}{d_C} + \left(\frac{1-s_L}{d_C^2}\right)\frac{\partial (d_L)}{\partial s_L}$$

which is positive if the second term is large; and as we have observed $\frac{\partial (d_L)}{ds_L}$ can be made large by increasing s_L. Therefore, there may exist a s_L, for all values of s_L less than $\bar{s}_L$, $\frac{1-s_L}{d_C}$ increases with an increase in s_L. If the saving propensity of the workers is very large to start with, a rise in that improves their relative consumption expenditure. In other words when s_L increases, the income of the labourers increases so much that it offsets the increase in their saving enabling them to consume relatively more.

If we increase either z_C or s_C, g increases whereas d_L goes down. Hence it becomes difficult to conclude anything about σ_Y and σ_Q. However, let us look at σ_Q when we increase z_C. We get,

$$\frac{\partial (z_C d_L)}{\partial z_C} = \frac{z_C s_C i\left(\frac{z_C s_C}{z_L s_L} - 2\right) - \left(\frac{\alpha}{\beta\gamma} + \delta\right)}{i(1-\mu)\left(\frac{z_C s_C}{z_L s_L} - 1\right)^2}$$

So if $\left(\frac{z_C s_C}{z_L s_L} - 2\right) < \left(\frac{\alpha}{\beta\gamma} + \delta\right)\frac{1}{z_C s_C i} < 0$

then $\frac{\partial (z_C d_L)}{\partial z_C}$ is negative. Therefore, σ_Q goes down, and the capitalists relative consumption expenditure improves. So σ_Y must go down for this case.

2.5. Flexible Interest Rate and Endogenous Growth

Capitalists' saving propensity is assumed to be greater than that of the labourers. The rate of return, once it is determined, along with the saving propensity of the capitalists determine the rate of growth g. So, even though w is given from outside the system, and consumer preferences affect i, and hence, the consumer prices, this case can be called neo-Marxian in character.

Here, i and g are taken as endogenous variables. From equations (2) and (3) we can calculate these two variables and the relevant parameters as follows:

$$i = \frac{(\frac{\alpha}{\beta\gamma} + \delta)}{d_L(1-\mu)(z_C s_C / z_L s_L - 1) - z_C s_C} \qquad (2.5.1)$$

$$g = z_C s_C i \qquad (2.5.2)$$

$$\sigma_Y = \frac{d_L}{d_C} \frac{z_C s_C}{z_L s_L} \qquad (2.5.3)$$

$$\sigma_Q = \sigma_Y \frac{(1-s_L)}{(1-s_C)} \qquad (2.5.4)$$

Unlike earlier regimes, here, growth rate g and interest rate i depend upon both the capitalists' and labourers' saving propensities. In fact, an increase in z_L or s_L implies a rise in g whereas when z_C or s_C goes up, g goes down.

As z_L or s_L increases, the contribution of labourers to income earning assets increases, but d_L and d_C are given constants. So, as z_C and s_C are given, the income of the capitalists must increase to make him able to pay for his share. Thus the only way is that i has to increase. This increased saving from both the classes forces the g to go up. So employment increases, and therefore, the savings of labourers increases (and total savings also) leading to an increase in i. This process continues and when it converges we get higher g and i.

From (2.5.3) and (2.5.4) we see that the relative consumption and income of the labourers go down with increase in z_L and s_L. Since they are saving more, then the balancing requires that the capitalists have more income than previously when z_C and s_C were undisturbed. In addition to deterioration of their relative income, the labourers save more, so their relative consumption obviously goes down.

The results are diametrically opposite, though the reason is the same, when we increase s_C or z_C.

Now, we are able to say that Pasinetti's Paradox that only capitalists' characteristic matters to determine the rate of return, crucially depends upon the assumption that the growth rate is given to the model from outside.

In the present regime, as in every other, we conclude that a rise in μ helps growth to increase. It does not affect the distribution parameters.

The interest rate i and the growth rate g are not affected by d_C (if we assume d_L and d_C are independent). However, d effectuates a negative change both in i and g. If we assume as we do, that change in d_L means change in d, keeping d_C constant, then we are again forced to say that money printing is better than market borrowing for growth, whereas it is worse for distribution (as both σ_Y and σ_Q decrease).

2.6. Inflation and Growth

Till now, production was instantaneous and profit was zero in consumer good sector leaving very little flexibility for the prices to vary by the market forces. By introducing time in production of the consumer good we are serving a dual purpose of injecting some doses of realism into the model on one hand, and enabling ourselves to analyse inflation vis-a-vis growth on the other.

Introduction of time as an input in the production of the consumer good necessitates some changes in the original model. The problem of financing appears for the consumption good sector as well. For the sake of simplicity an assumption is made that the capitalists (producers of the consumer good) are not allowed to enter the capital market (bonds market) to borrow. They can invest whatever funds they generate internally. The rate of profit π is assumed to be greater than the rate of interest. So as maximizers of rate of return they invest all the funds available to them in production instead of lending to the government. Assuming that they consume $(1-s_C)$ fraction and save $s_C(1-z_C)$ fraction in money, out of the total profit income, the funds available to them for investment is the sum of the balance from profit and the working capital they invested last year. They get the profit this year for the investment they made last year as they made all the factor payments last year for production, and the receipts from sale they are getting this year. So the saving-investment equality for the consumption good sector is written as follows:

$$\left(\frac{\alpha}{\beta} K_{t-1} w + rK_{t-1} \right) (1 + z_C s_C \pi) = \frac{\alpha}{\beta} K_t w + rK_t \ .$$

Implicit in the equation is that the capital is fully utilised every period. Since the growth rate is g, the equation reduces to

$$z_C s_C \pi = g \qquad (2)$$

The labourers' behaviour carries over from the last section. The only change is that the whole debt capital with the government is held by the labourers. So $d_L = d$.

So the steady-state condition for the labourers modified as follows.

$$z_L s_L \left[\frac{\alpha}{\beta\gamma} + g + \delta + id(1-\mu) \right] = dg(1-\mu) \qquad (1)$$

Equations (1) and (2) when added up implies the saving investment equality in the whole economy as the savings via money and the resources collected via taxes and the pricing of capital are implicit in them. The resource requirement equation through taxes will determine the tax rate and through money will determine the money supply.

By Walras law we can drop the demand supply equality in the commodity market. In fact, it can be easily shown that when equation (1) and (2) hold, the commodity market also clears, of course, the necessary substitutions are done for the tax rates by μ. Solving for g, π, σ_Y and σ_Q from equations (1) and (2), we get,

$$g = \frac{\frac{\alpha}{\beta\gamma} + \delta + id(1-\mu)}{\frac{d(1-\mu)}{z_L s_L} - 1} \qquad (3)$$

$$z_C s_C \pi = g$$

$$\sigma_Y = \frac{z_C s_C [(\alpha/\beta\gamma)+\delta+id(i-\mu)]+[(d(1-\mu)/z_L s_L)-1]}{(\alpha/\beta\gamma)+(\delta+id)(1-\mu)[1-(z_L s_L/d(1-\mu))]} \quad (4)$$

$$\sigma_Q = [(1-s_L)/(1-s_C)]\sigma_Y \quad (5)$$

Tax equation $\tau = \mu(1+g)g\beta\gamma w$ where τ is the tax per unit of output (6)

Equation (1) makes it evident that the growth rate g does not depend upon the characteristics of the capitalists; rather it is influenced by the labourers' saving propensity. Once the growth rate is determined, the rate of return is determined only by the capitalists characteristics. In effect, though both classes influence the rate of return π, the labourers influence it indirectly, only via the growth rate. In neo-classical growth models the growth rate depends upon the growth of the labour force which is generally taken as exogenous.

Admittedly, under the present regime, any increase in growth generally brings with it, a steep price rise. Both profit rate π and tax rate τ increase which is clear from equations (2) and (6). But inflation per say may not be bad if the distribution parameters behave properly which is what we have to study carefully while doing comparative statics with the parameters.

A rise in μ brings an increase in g and therefore π rises. Two effects, a rise in μ and g, simultaneously pulls up

τ. So the consumer price must increase. However, the price rise is offset to whatever extent due to a fall in the cost of production as r falls because of the rise in μ. At this point it is wiser to write the consumer price explicitly.

$$q = (\alpha w + \beta r)(1+\pi) + \tau$$
$$= [\alpha w + \beta(\delta + id)(1-\mu)\gamma w](1 + \frac{g}{z_C s_C}) + \mu g^2 \beta\gamma w.$$

If $g^2 \geq (\delta+id)(1+\frac{g}{z_C s_C})$ to start with, then the price rises that the depressing effect of μ on prices is being offset by the effects which push up the price. In other words, when growth rate is very high, if μ is increased to bring further increase in growth, then the price may explode. If g is low enough such that π is almost equal to i then a rise in μ brings down the price.

However, the previously employed labourers lose in the bargain as the per capita income and so consumption of the labourers go down. Let us look at the following expression.

$$\sigma_L = \frac{\text{Income of the Labour Class}}{\text{Total employment}}$$

$$= \frac{[\frac{\alpha}{\beta\gamma} + (g+\delta) + id(1-\mu)]w}{\frac{\alpha}{\beta\gamma} + (g+\delta)}$$

$$= \{1 + [id(1-\mu)/(\frac{\alpha}{\beta\gamma} + g + \delta)]\}w \quad (7)$$

Thus, it is clear that as μ increases σ_L decreases, because the total interest income goes down and per capita interest income goes down further due to the increase in employment i.e. increase in g. Since propensity to consume is fixed, the consumption per capita goes down in an obvious manner.

The story, here, is very simple to follow. That due to increase in μ, the interest income of labourers goes down; so also the fund requirement, for net investment from non-tax sources but the latter goes down more than the former [from equation (1)]. The excess fund available, therefore requires the growth rate to go up. A rise in growth rate increases the wage income requiring the growth to go up again. A chain effect is set in motion. But it converges because the fund requirement rises faster than the income of the labourers. Once growth is high, the profit may increase because the capitalists have to employ all the capital which is higher now, of course, at a lower price.

Equation (2) informs us that for one unit increase in g, π increases by $\frac{1}{z_c s_c}$ units. And the interest income goes down. This may mean that the income of the capitalists rises faster than that of the labourers. But this is a non-sequitur because the profit comes with one period lag whereas the employment goes up instantaneously. Besides, with an increase in μ, the profit income is offset by shrinking of the base of working capital.

The argument can be validated by looking into the derivative of σ_Y.

$$\frac{\partial \sigma_Y}{\partial \mu} > 0 \text{ if } \frac{1}{1-\mu} [1 + \{\frac{\alpha}{\beta\gamma} + \delta + id(1-\mu)\} \frac{z_L s_L}{d(1-\mu)}] \geq \frac{d}{z_L s_L}$$

That means if z_L, s_L are not very small and $\frac{\alpha}{\beta\gamma}$, δ, d are larger then the derivative is positive. Since only labourers save in government bonds, when s_L or z_L tends to zero, g does the samething. In plain words, very small s_L and z_L means stagnation in the economy.

The interest rate policy of the government also needs close scrutiny. A rise in i is concomitant with a rise in labourers' income, and hence, in their savings. So growth rate goes up and so the labourers' income. The process converges with a higher growth rate [see equation (3)]. Along with g, the profit rate goes up. Now capitalists income rises due to two effects, the rise in profit rate π and the expansion of the base or working capital by dint of the increase in i. And the rise is more than the increase in labourers' income. So the relative income parameter σ_Y moves against the labourers and therefore they consume less relatively.

The condition for the negativity of $\frac{\partial \sigma_Y}{\partial i}$ is $[1- \frac{d(1-\mu)}{z_L s_L} -\delta\mu]<0$ and it is obviously true because, as we know, $\frac{d(1-\mu)}{z_L s_L} > 1$, from equation (1).

The price q rises due to the triple effect of rise in i, π and τ. But the per capita consumption of labourers increases because, though employment increases and the share of labour class in consumption goes down, the output of consumption goods goes up more. The individual labourer is able to purchase the amount as interest income moves faster than the price [see equations (7) and (3)].

The message from interest rate policy is clear. If the labourers have a source of income from property, then hiking the interest is the best policy as it increases employment, output, growth and per capita consumption though the relative income of the labour class goes down.

A decrease in d or printing more money raises growth-rate g, and hence, π . It is not very clear what happens to σ_Y and σ_Q . Decrease in d decreases the savings of the labourer, but the fund reaquirement through bonds goes down more. So growth rate increases. Profit rate, and the tax rate increase as d goes down. So consumer price may rise. The labour class income goes up further but their per capita income comes down since employment goes up and interest income comes down. Then per capita consumption may come down as price may shoot up. Thus printing more money is almost like increasing the tax portion of the public investment.

A rise in z_C or s_C does not affect g, but raises σ_Y and σ_Q . And π falls. Thus if the capitalists try to save or invest more in their own firm they will end up being worse off. That is to say, the more greedy the capitalists are the less they get to consume. As the growth rate is constant, from equation (2) we see that the rate of profit goes down. So while the labourers' income is constant, on the other hand that of the capitalists' goes down. It is reason enough for the capitalists' relative consumption position to deteriorate. Besides, if s_C goes up, that position will go down further. From equation (7) we notice that the per capita income of the labourers is undisturbed. And employment is constant, and the consumption expenditure of the capitalists goes down. Then, who consumes the left over output? The labourers consume, because though their expenditures is constant, the consumer price goes down as the profit rate comes down. To emphasise, if the capitalists try to accumulate more, they cannot do that even if there is excess supply of labour, because the critical input is controlled by the public sector.

When z_L or s_L increases, g and π goes up, and if s_L or z_L is not very small then σ_Y may go up. The condition for $\frac{\partial \sigma_Y}{\partial (z_L s_L)}$ to be positive is that

$$\frac{1}{z_L s_L}\left[2 - \frac{d(1-\mu)}{z_L s_L}\right] + \frac{1}{(1-\mu)d}\left[\frac{\alpha}{\beta\gamma} + \delta - 1\right] + i > 0.$$

Hence, if $z_L s_L$ is not very small or, more definitely, if $\frac{\alpha}{\beta\gamma} + \delta > 1$ then the derivative is positive. In other words, if the direct and indirect labour requirements to produce one unit of cloth is greater than the labour required to produce β units of capital then the income distribution improves with increase in $z_L s_L$. For a rise in z_L alone, σ_Q rises but it is difficult to conclude about σ_Q when s_L goes up. In either case, however, the per capita income and consumption of labour class go down. From equation (1) when z_L or s_L goes up, the saving in bonds goes up, so the growth rate goes up to clear the excess supply in the bond market. Then the chain effect affects the other variables in the way we have mentioned. Consumer price rises because both the rate of profit and the tax rate go up.

It appears to be interesting to explore how a change in the technological parameters affect the growth and distribution. The reasons for the effects and the effects of a change in β and γ are same whereas α on the one hand, and β and γ on the other are exactly opposite. And δ has the same effect on growth as α. More α means the technique is labour intensive and, in general terminology, inefficient. More δ means the capital good depreciates faster so more labourers are necessary to maintain the capital good. More α or less β or γ imply more g and π, and less σ_Y and σ_Q. And obviously per capita consumption of labour class goes down. The price rises due to simultaneous increase in α, r, and τ. At the first count so much price rise may appear to be untenable. But that is not to be, if we probe a little further. Increase in α (and δ) simply means to give doles to the additional workers- with one difference that price does not get affected as much- since the marginal product of the workers turns out to be zero. So when the employment goes up, the income goes up and so the supply of funds for investment. So g goes up. Since the profit rate and the base increases, the profit income moves faster than the wage income. So the relative income of the capitalists increases. The per capita consumption of employed labourers goes down. The lesson is that inefficient technique in consumer good sector is better if and when it is difficult to effect a desired distribution by direct income transfer. By the way, the technique is inefficient because the same work is done by employing additional labourers who, otherwise, could have enjoyed their leisure.

If we calculate the derivative σ_Y with respect to $\frac{\alpha}{\beta\gamma}$, we get the following condition.

$$\frac{\partial \sigma_Y}{\partial \left(\frac{\alpha}{\beta\gamma}\right)} < 0 \quad \text{if} \quad \left[1 - \frac{d(1-\mu)}{z_L s_L} - \mu\delta\right] < 0.$$

And this condition we have already proved.

CHAPTER - 3

GROWTH AND DISTRIBUTION - CHOICE OF TECHNIQUE WITH LAND ABUNDANCE

3.1. Introduction

As has been implicitly assumed that some of the main characteristic features of developing economies are (1) low per capita availability of basic necessities, (2) highly skewed distribution of assets, (3) abundance of labour and (4) scarcity of capital. Economic policies in such countries are designed to supply the essential goods and services, reduce unemployment, accumulate capital and improve the income distribution.

In this context, a policy planner always faces the problem of choosing the best among the available alternative techniques. Other differences apart, the techniques vary in terms of their capital and labour intensities. It is easy to identify a modern technique, but more often than not, it is difficult to locate the efficient technique. If a technique produces more output using the same amounts of inputs then the technique is clearly technically efficient. Plants and equipments are different; so it is difficult to compare the capital used since we do not have a proper unit as a measure of capital. Again some technique may use more labour and less capital than the other. So how to compare the labour and capital? The difficulty is that the past rate of return and the expected rate of return in future may differ.

Suppose we assume we are free of all the difficulties mentioned above. Then we will be able to identify the technique which is efficient in the technical sense that it produces more output given equal quantities of inputs. But it would be too naive to assume that it would be the most efficient technique. A technique which promotes growth may very well affect distribution. Even a technically efficient technique may hamper growth, because it may negatively affect distribution which in turn may affect growth. It is not for nothing that Mahatma Gandhi wrote, "An improved plough is a good thing. But if, by some chance, one man could plough up, by some mechanical invention of his, whole of the land of India and control all the agricultural produce and if the millions had no other occupation, they would starve and, being idle, they would become dunces, as many have already become".

We will take up the second question as to the choice of technique problem, namely how to choose a technique which promotes overall growth in the economy as it affects the employment and income distribution; and if possible to see which technique improves the income distribution. We will also hint at the effects of monetary and fiscal policies on growth and distribution, and at times on the choice of technique itself.

As it has been pointed out, our model is biased towards modernisation. As per our assumption the traditional technique is such that it does not need any capital equipment for production. And all the capital in the economy has to be used. Therefore one need two sectors, otherewise given only one sector, the choice is obvious: the modern technique would be used to the extent demand is forthcoming; only the excess demand, if any, is met by the production through the traditional technique.

We are having two sectors to produce two consumption goods: food, the necessity and cloth, the luxury. One of our important assumptions is that land is abundant in supply. Inasmuch as land and labour are in excess supply, the food production will be unbounded given these two are the only inputs needed to produce food. Let us say capital is a necessary input in the production of food. Only one technique is avialable for cloth production whereas there are two techniques to produce cloth. The modern technique uses labour and capital to produce food whereas the traditional technique uses only labour for its production process. We call the production in the modern sector as mill production and in the traditional sector as handloom production.

We prefer to distinguish between two types of capitalists: one producing food and the other producing cloth by the modern techniques. A labourer may get work in public sector which produces investment goods or in the food sector or in modern cloth sector or set up his own handloom and produce cloth at home.

We will be discussing three regimes and obviously the assumptions would differ. In the first case we would assume instantaneous production period for both the consumption goods, and money wage rate is given. All the three classes i.e. the labourers, food-capitalists and cloth-capitalists consume both cloth and food, and save in money and bonds in fixed fractions. Section-3.3.2 keeps the instantaneous production and the consumer behaviour assumption as it is in section-3.3.1 . It further assumes that each labourer consumes a fixed amount of food and the rest of the expenditure allocated to consumption goes for purchasing cloth. And his consumption expenditure is enough to purchase the right amount of food. Section —3.3.3 says the production in food and modern cloth sectors take one period for production. However, the instantaneous production assumption is retained for the handloom sector. The consumer behaviour, as in sec -3.3.2, is different from the case in sec 3.3.1. That only labourers consume food and each of them consume a fixed amount and only they purchase government bonds. The capitalists naturally invest only in their production process, implicitly assuming there is excess demand for funds and the private entrepreneurs are not allowed to enter the bond market to sell bonds. Nevertheless, they also hold money. They consume only cloth. This is obviously a simplifying assumption.

3.2.1 Set up of the Model

To start with we will define the symbols which we are going to use through out the paper.

Technological symbols:

α, ν, a, γ = amounts of labour required to produce one unit of output of food, mill cloth, handloom and capital good respectively.

β, η = amounts of capital needed to produce one unit of output of food and mill cloth respectively.

δ = depreciation per unit of capital used per period.

Behavioural symbols:

s_j = the average and marginal rate of savings by j-th category of agents.

z_j = the average and marginal rate of bond holdings out of total savings by j-th category of agents.

ρ_j = fraction of total expenditure spent on food by j-th category of agents.

General symbols:

F - agricultral sector

T - mill cloth sector

K - capital stock

H - handloom output

L - labour sector

G - government sector

I - amount of gross investment made

Price variables:

q_F = market price of food when tax is included

q_T = market price of cloth when tax is included

Policy and other parameters and the variables:

d_j = share of j-th category of agents in the total capital in terms of bond holding in steady-state

x = fraction of K going to F sector

g = Growth rate of K

h = cloth produced in the handloom sector per unit K

μ = fraction of investment covered by taxes.

i = rate of interest given by the government to the bond holders.

τ_F = producer's tax on food.

τ_T = producer's tax on cloth

r = rental rate on the service of K = $(\delta+id)(1-\mu)\gamma w$

w = money wage rate

π_F, π_T = profit per unit of working capital employed in F & T sectors respectively

Y_j = income for rupee of capital for the j-th class

Subscripts:

L : labourers

F : Food producing capitalists

T : Mill cloth producing capitalists

j : Common symbol for L,F,T

d : total debt portion of the capital stock net of taxes.

If some symbols are not defined here and we are using them in the text then we are ascribing the same meaning to them as in last chapter.

3.3.2 Balancing conditions

There are six goods and assets in the model: Food,cloth, capital, labour, money and bonds. The capital stock is given at a point of time. Generally, the equilibrium values of the capital should be equal to the demand or the supply whichever is less at the given rental r . We will assume that in steady-state the supply of capital does not exceed the demand. Labour is in excess supply always or it is there as long as we believe that the model works. So we say that whatever is demanded, only that amount is supplied at the given wage rate w. The agents demand money and bonds in fixed proportions and the government issues them in fixed proportion, and therefore, if one financial market clears, then the other does so automatically.

So we are left with three markets. By Walras'law we can drop one market. We will drop either food or the cloth sector depending upon the convenience in the analysis. Besides, we also have to take the bond market i.e. the funds market into account.

Now, we have to impose the steady-state conditions also. The three categories of agents, the labourers, the food sector capitalists and the mill cloth sector capitalists will have to contribute to the savings in bonds in the same proportion as they derive interest income from the accumulated bonds saving which forms portion of the total capital stock minus tax-portion. These three steady-state conditions add up to the funds market condition. Instead of the funds market condition we will take only these three balancing conditions.

Government has to raise a fixed fraction of total investment by raising commodity taxes. This requirement itself will impose one more independent condition. So, totally there will be five independent equilibrium conditions. Let us begin to write them down precisely.

We will write them down per rupee of capital (defined when $i=0$). As we have already assumed, α is the amount of labour required for the production of one unit of F. Since capital stock is given at K at the point of time, x of it goes for the production of F and β is the amount of capital per unit of F, $\frac{xK}{\beta}$ is the maximum that can be produced. Therefore $\frac{\alpha xk}{\beta}$ is the amount of labour to be engaged for this scale of production. The requirement of labour for one unit of capital good to be produced is γ and w is the wage rate in money terms. So $\frac{\alpha x\ Kw}{\beta}$ is the amount of rupees to be spent to hire the required quantity of labour which will produce the output F. By dividing the term $\frac{\alpha xkw}{\beta}$ by $K\gamma w$ we get $\frac{\alpha x}{\beta\gamma}$ which is the labour requirement for production of F per one rupee of capital good avialable in the economy as $k\gamma w$ is the value of capital in rupee term. One point to be noted here is that the production length of capital good is one period. So to discuss everything in terms of per unit rupee of capital may be a misnomer as we have not taken the interest rate effect into account. But, since the earlier concept facilitates our analysis and does not distort the results in any manner we may still stick to our concept and keep the above shortcoming of the definition at the back of our mind.

In the similar manner if we calculate the expenditure on labour per rupee of capital in other sectors it will turn out to be $\frac{\nu(1-x)}{\eta\gamma}$ in T-sector, $\frac{ha}{\gamma}$ in H-sector and $g + \delta$ in investment good sector. This is because $(1 - x)$ fraction of capital goes into T-sector, H sector does not need any capital but its production is tied to the existing level of the capital in the economy in the sense that h amount of cloth is being produced in the H-sector per unit of K existing in the economy, and g is the rate of growth of K and so $(g + \delta)K\gamma w$ is the amount of investment required in rupee terms for achieving this particular growth rate since δ is the rate of depreciation of capital per period per unit of capital used. Now we are free to deduce that $[\frac{\alpha}{\beta\gamma}x+\frac{\nu}{\eta\gamma}(1-x)+\frac{ha}{\gamma}+g+\delta]$ is the labour income in the economy per rupee of capital. If we multiply this number with γ then what we get is the quantity of employment or the labour demand per unit of capital (in physical terms) in the economy.

The other source of generation of income is through interest earnings and profits from private production. Government can produce surplus. If it is not mentioned otherwise, we assume no surplus originates in public sector.

Let us come to the interest income. Government has to pay the interest charges at a rate i every year on the outstanding debt. The amount of capital accumulated till the date has been financed through three sources, taxes, money and bonds. As we have earlier pointed out, the portion financed through bonds is d per unit rupee of capital net of taxes. In simpler terminology, it means, if one rupee of investment is to be made then $d(1-\mu)$ rupee must come through bonds. So the government has to pay interest on this part i.e. it has to pay $id(1-\mu)$ rupees to the bond holders per one rupee of capital. This amount is to be divided among the three classes according to their bond holdings. As we have defined earlier d_L, d_F and d_T are the fraction of bond holdings by labourers, food-capitalists and mill-sector capitalists respectively and they add up to d, i.e., $d_L + d_F + d_T = d$. So their interest incomes are $id_L(1-\mu)$, $id_F(1-\mu)$ and $id_T(1-\mu)$ respectively.

Let us define π_F and π_T as profits per unit of working capital in F-sector and M-sector respectively. We have defined profit in a similar manner in section-2.5 . And let us assume the whole profits generated in the above two sectors accrue to the respective capitalists. Then the incomes of the three classes will be as follows.

Labour income = $Y_L = \frac{\alpha x}{\beta\gamma} + \frac{\nu(1-x)}{\eta\gamma} + \frac{ha}{\gamma} + g + id_L(1-\mu)$

Food capitalist income = $Y_F = id_F(1-\mu) + \frac{\pi_F x}{(1+g)} \left[\frac{\alpha}{\beta\gamma} + id(1-\mu)\right]$

M-sector capitalist income = $Y_T = id_M(1-\mu) + \frac{\pi_T x}{(1+g)} \left[\frac{\nu}{\eta\gamma} + id(1-\mu)\right]$

These incomes are given per rupee of capital. To get the absolute incomes we can multiply them by $K\gamma w$. Before proceeding further, it behoves us to make one point. That the consumption good takes one period to be produced and hence, the capitalists put their funds and wait for one period to get profit. When they themselves need funds which gives more return (It is rightly assumed that $\pi_F, \pi_T \geq i$) why then they invest in government bonds ? So the general assumption is that they invest in government bonds only when production is instantaneous and profits are zero in consumption good sectors. Now we can write the steady-state conditions for the three classes of agents by assuming profits are zero.

For labour (1) $z_L\, s_L\, Y_L = d_L\, g(1-\mu)$

For F-capitalists (2) $z_F\, s_F\, Y_F = d_F\, g(1-\mu)$

For M-capitalist (3) $z_T\, s_T\, Y_T = d_T\, g(1-\mu)$

The underlying logic of the above three equations needs clarification. The income of the j-th class is Y_j. A fractrion s_j of it goes for saving (both in money and bonds), out of which z_j portion takes the form of bonds. So $z_j s_j Y_j$ is the amount of income of j-th class which finds its way into the investment in bonds. The net investment of public sector is g and μg is being financed by taxes. So $(1-\mu)g$ is the amount being financed by money and bonds; d of it i.e. $d(1-\mu)g$ is financed by borrowing. We know, the j-th class has claim on d_j portion of the bond-financed portion of the capital. So to maintain his share in the long run he has to contribute d_j of g net of taxes via purchasing bonds from the government, and that is equal to $d_j(1-\mu)g$. Basically, what it means is that a particular class of agents has to contribute in same proportion to net investment (i.e. new capital formation) by lending money via bonds to the government, as the proportion of the capital they have claim for deriving interest income, to make themselves able to be in the steady-state.

We assume that the price of cloth is equal to its cost of production in the handloom sector plus the tax rate on cloth. And that is $aw(1+\tau_T)$. The price of food is $q_F = (\alpha w + \beta r)(1+\pi_F) + \tau_F$

=(labour cost + capital cost + profit + tax per unit of output).

The output levels in F and T-sectors are $\frac{x}{\beta\gamma w}$ and $\frac{(1-x)}{\eta\gamma w}$ respectively per unit of capital since capital is allocated in x : (1-x) proportion to the sectors. The expenditure by j-th class of agents in both food and clothing is $(1 - s_j)Y_j$ and ρ_j of it i.e. $\rho_j(1 - s_j)Y_j$ goes into the expenditure on food; therefore $(1 - \rho_j)(1 - s_j)Y_j$ is spent on clothing. Now, we can specify the market clearing conditions for both sectors by writing the total expenditure on the commodity by all classes on right hand side and the price multiplied by total supply on the left hand side. We must note, here, that the total cloth supply constitute the supply from mill sector and the supply from the handloom sector. Handloom produced per unit of K is h. So $\frac{h}{\gamma w}$ is the cloth produced per unit rupee of K. So total cloth supply is $\frac{1-x}{\eta\gamma w} + \frac{h}{\gamma w}$. So our two market clearing conditions are

Food market clearance (4a) $\frac{x}{\beta\gamma w}(\alpha w + \beta r + \tau_F) = \sum_j \rho_j(1-s_j)Y_j$

Cloth market clearance (4b) $(\frac{1-x}{\eta\gamma} + \frac{h}{\gamma})(1+\tau_T)aw = \sum_j (1-\rho_j)(1-s_j)Y_j$

Let us come down to the govenment's budget. The government's investment expenditure is $(g + \delta)$, its interest payment is $id(1-\mu)$. We have already specified how $(1-\mu)(g+\delta)$ is being financed which may be repeated for the sake of continuity in the argument. The amount $(\delta + id)(1 - \mu)$ i.e. both depreciation and interest charges are being taken care by pricing formula. Actually the private sector producers pay

$r/\gamma w = (\delta + id)(1 - \mu)$ to the government if they use one unit of capital for one period. And $d(1 - \mu)g$ is financed by borowing and $(1 - d)(1 - \mu)g$ is financed by printing money. So what is left is μg which is to be financed by imposing taxes. This would come from the taxes in both the consumer good sectors. Since τ_F is the tax on food and $\frac{x}{\beta\gamma w}$ is the production of food the collection from F-sector turns out to be $\frac{x\tau_F}{\beta\gamma w}$. Let us say cloth sector does not make any profit (the assumption will be dropped when required) and the difference in cost of production in H-sector and T-sector is taken away by the government by imposing a tax. The cost in H-sector is aw and in T-sector is

$$\nu w + \eta r = \nu w + (\delta + id)(1-\mu)\eta\gamma w$$

So difference is $(a-\nu)w - (\delta+id)(1-\mu)\gamma w$

Dividing the whole expression by γw, we get

$$\frac{a-\nu}{\gamma} - (\delta+id)(1-\mu)$$

which is the difference in two costs per rupee of capital. We may impose a tax at a rate of τ_T on the total cloth production. So we can write the government budget constraint (actually residual constraint) by equalising μg with the total collection of taxes.

$$(5) \qquad \mu(g+\delta) = \frac{\tau_F x}{\beta\gamma w} + \left[\frac{a-\nu}{\gamma} - \eta(\delta+id)(1-\mu)\right](1-x) + \left[\frac{(1-x)}{\eta\gamma w} + \frac{h}{\gamma w}\right](1+\tau_T)\,aw$$

This equation will be modified later in the relevant sections when we consider special cases.

3.3 Existence and Analysis of Equilibrium

3.3.1 Fixed money wage, zero-profit and flexible interest

We can begin by examining equation (1) which states the steady-state requirement of the labour class. If we divide the whole equation by $z_L s_L g$, we get,

$$\{ \frac{\alpha}{\beta\gamma} x + \frac{\nu}{\eta\gamma} (1-x) + \frac{ha}{\gamma} + id_L(1-\mu)\} \frac{1}{g} + \frac{(g+\delta)}{g} = \frac{d_L(1-\mu)}{z_L s_L}$$

It follows $\frac{d_L(1-\mu)}{z_L s_L} > 1$ which is condition to be used later. And $\frac{d_L(1-\mu)}{z_L s_L}$ moves closer to 1 as labour income from investment sector increases or from other sources decreases and vice versa, and it is almost equal to $(1 + \frac{\delta}{g})$ when labour income is zero. But the last case does not arise because, then there will not be any labour class and so production will be at zero level.

Next point is that $g \geq 0$ is necessary for viability. And if $z_L s_L > 0$ then $g > 0$ at equilibrium.

Since we are assuming $\pi_F = \pi_T = 0$ equations (2) and (3) imply $z_F s_F i = g$ and $z_T s_T i = g$

Putting this value in equation (1), we get

$$\frac{\alpha}{\beta\gamma} x + \frac{\nu}{\eta\gamma} (1-x) + \frac{ha}{\gamma} + (g+\delta) = d_L(1-\mu)g\left(\frac{1}{z_L s_L} - \frac{1}{z_F s_F}\right). \qquad (1.2)$$

What the last condition says is as follows. If $z_L s_L$ becomes larger, then d_L has to be larger, but there is a limit that in no case $z_L s_L$ should exceed $z_F s_F$. This result is crucial and needs further explanation. The result has been noticed by Pasinetti and we also have already pointed out earlier. The capitalists have only one source of income i.e. interest income which comes via savings in bonds. The labourers, on the other hand, have an additional source i.e. the labour income itself. So if the labourers put proportionately more saving in bonds then their interest income itself will go on increasing along with their claim on interest portion of the capital. At one stage it will exceed that of the capitalist and in the long run capitalist's existence will be insignificant. So in plain terms, in the steady-state, the capitalists will cease to exist.

Let us complete the specification for this section by making the endogenous variables explicit. They are, for this case, i, g, τ_F and x. Though there are five equations we will be able to solve only four variables because equation (2) and (3) are same in the particular case we are discussing (i.e. zero profits). This condition again is being enforced by the steady-state. Both the capitalists groups has only same source of income. They earn only from their bond holdings where rate of return is same for both i.e. i. So if one saves more in bonds than the other, then the first one will eliminate the second in the longrun. And, mathematically there will be no solution, if both the equations are not the same.

We are fixing τ_T at zero level, i.e. $\tau_T = 0$. We must tell a word why we are choosing i, g, τ_F and x as endogenous variables.

It is a stylised fact that the distribution of income between capital and labour remained unchanged through a long period of modern history. Rate of return, growth rate and a price are obvious choices. Since producer price is cost-based, τ_F has to vary to ensure flexibility in that price. And it is not unreasonable to say that the distribution of capital along sectors is dictated by the macro-economic consistency conditions.

Let us try to solve for the endogenous variables. That will be enough proof to say the solution exists. As it is clear from the system of equations, τ_F is being residually determined by the equation (5) (of course we are dropping equation (4a) and using (4b) instead) when values of other variables are determined outside of the equation. So let us drop that equation, for the moment, from our analysis. Now, let us denote $A = \frac{\alpha}{\beta\gamma} - \frac{\nu}{\eta\gamma}$ and rewrite equation (1.2)

$$(1.2') \qquad Ax = gB - C - \frac{ha}{\gamma}$$

$$\text{where} \qquad B = d_L(1-\mu)\left(\frac{1}{z_L s_L} - \frac{1}{z_F s_F}\right) - 1$$

$$\text{and} \qquad C = \delta + \frac{\nu}{\eta\gamma}$$

We will call equation (1.2') as L.M. equation because this condition is given to us by the savings-investment condition.

If we rearrange equation (4b), we get,

$$(3') \qquad Dx = -Eg + F + Gh$$

$$\text{where} \qquad D = A(1-\rho_L)(1-s_L) + \frac{a}{\eta\gamma}$$

$$E = \frac{b(1-\mu)}{z_F s_F} + (1-\rho_L)(1-s_L)$$

$$F = \frac{a}{\eta\gamma} - \left(\delta + \frac{\nu}{\eta\gamma}\right)(1-\rho_2)(1-s_L)$$

$$G = \{1 - (1-\rho_L)(1-s_L)\}\frac{a}{\gamma}$$

$$\text{and} \quad b = \sum_j (1-\rho_j)(1-s_j)d_j$$

We will call equation (3') as IS curve since it relates to the commodity market. Now we can solve for g and x from LM and IS curves.

$$(D + \frac{EA}{B})x = F - \frac{EC}{B} + h(G - \frac{Ea}{B\gamma})$$

$$(1 + \frac{AE}{BD})g = h(\frac{AG}{BD} + \frac{a}{B\gamma}) + \frac{AF}{BD} + \frac{C}{B}$$

As we can see from the solutions of x and g, it is not very clear whether x and g are positive or not. In addition to ensuring that x is non-negative and g is strictly positive, we also have to show that x is less than or equal to unity, since x is a fraction. So existence of solutions means strict-positivity of g and to keep the value of x within 0 and 1.

Actually A is the difference of labour-capital intensities of agricultural sector and mill sector. Safely, we can take it to be positive but our analysis, at times, covers all the values of A. We have already noted that steady-state conditions forces $d(1-\mu)(\frac{1}{z_L s_L} - \frac{1}{z_F s_F})$ to be greater than 1. So B is positive. So also C. It is natural to assume $a > \nu$ that per unit labour requirement for cloth production in handloom to be greater than that in mill sector. We know that $(1 - \rho_L)(1-s_L) < 1$. So $\frac{a}{\eta\gamma}$ dominates the negative term that is sitting inside A and makes D to take positive value always. The fact that the direct labour requirement in mill sector is greater than the direct and indirect requirement in handloom sector makes sure that F is positive and it is obvious to note E and G are positive.

As long as A is positive, g remains positive. Let us call this as normal-technology case because it is natural to believe that mill sector is more mechanised than agricultrual sector, at least, in a developing economy.

When we examine the solution to x, we find that when s_L is very small, x lies between zero and unity.

We will christen s_L-small case as nomal-saving behaviour case. When there are both normal technology and normal-saving behaviour, we would say that the system is in normal case. To show the positivity of x, the arguments will take the following course.

If s_L is small,

$$d_L(1-\mu)\left(\frac{1}{z_L s_L} - \frac{1}{z_F s_F}\right) > \frac{1}{1-(1-s_L)(1-\rho_2)}\left[1 + \frac{b(1-\mu)}{z_F s_F}\right]$$

$$\Longrightarrow G - \frac{Ea}{B\gamma} > 0$$

As x is positively related to h, by increasing h we can increase x and otherwise. One may say that by properly fixing h one can make x to lie between 0 and 1. This is the right approach provided two more conditions are satisfied: (i) when h=0, x should be less than 1; (ii) when x=1, h should be positive. Then one can confidently say that for some positive values of h, x lies within its right boundaries. These two conditions can be easily shown to hold. When h=0 from the value of x, we get,

$$(D + \frac{EA}{B})x = F - \frac{EC}{B} \qquad \text{i.e.} \quad x = (F - \frac{EC}{B}) / (D + \frac{EA}{B})$$

Now $x \leq 1$ if $F - D \leq \frac{E(A+C)}{B}$

[Actually, one can see directly that $x < 0$ if $h = 0$ and s_L is very small].

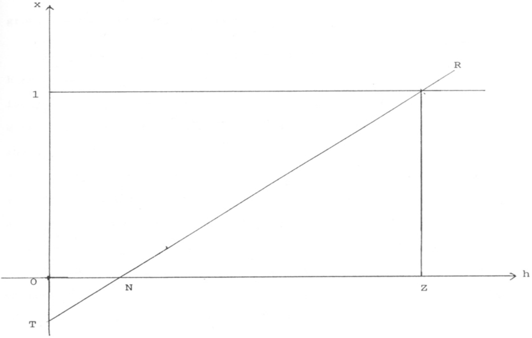
By substituting their respective values, we can easily show that this condition holds even with strict inequality. When x=1, from the value of x, we get,

$$D + \frac{EA}{B} = F - \frac{EC}{B} + h(G - \frac{Ea}{B\gamma})$$

$$\Longrightarrow \quad h > 0 \quad \text{if} \quad D - F + \frac{E}{B}(A+C) > 0.$$

This inequality is same as the one we showed to be true above. So it follows that there will exist solutions for some values of h for the normal-saving case.

We can illustrate it by the following diagram.



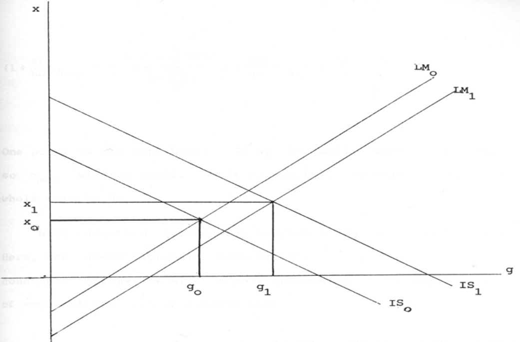
In the diagram the symbols are self -explanatory. When h=0, we know $x < 1$. Let us say, at the worst, x is negative; secondly, when x=1, h is positive. And x increases with increase in h and this relationship is continuous and represented by the line TR. So it is clear from the diagram that x lies between 0 and 1, whenever h takes the value in the whole range of NZ. We may note that TR is a straight line. The rate of change of x with respect to h depends upon the slope of TR. The slope is $(G - \frac{Ea}{B\gamma}) / (D + \frac{EA}{B})$ and it is positively related to the value of s_L. If s_L is small then the rate will be less.

Since both x and g are increasing functions of h, they take the minimum possible value when h=0. That is if only mill operates in the cloth-sector then the economy suffers both in terms of growth and employment to the maximum. So to maximise growth we must keep on increasing h.

The question arises, first, why both g and x increase when h increases. Increase in h implies increase in employment which induces more savings and so, more investment; more investment means more growth. So we need more food to support so many labourers. So more x. More x implies again more employment as $A > 0$. Hence with more g and x, there is second round effect. But it tends to a limit. One may argue that more g means increased i and so increased food price. But we are clear that food price does not increase so much to curtail the demand for food so that extra number of labourers which is unleashed due to increase in employment, can be sustained with earlier level of food production. This is no denying the fact that increase in i do help in growth. First, higher price of food and by that decreasing the demand for food, and secondly, by increasing the income to all clases via interest earnings. While making the above argument, we assume i increases with increase in g. How?.

We know that once g is determined, i is given as $i = \frac{g}{z_F s_F} = \frac{g}{z_F s_T}$ from equations (2) and (3) which are, of course, same equation. So g, z_F and s_F completely determine i. Why? Because i is the return to capital invested by different classes. The answer was already given by Pasinetti through in a different set up. (Pasinetti, 1962). That z_F s_F only, not the characteristic of labour determines i when g is given, the investment through bond sources must come proportionately from all classes. Interest receipts is the only source of income for capitalists. So i must rise to make them pay their share of investment through bonds since z_F, s_F, z_T, and s_T ($z_F s_F = z_T s_T$) are given. Labourers' characteristics do not enter because they have an additional source of income i.e. labour income which adjusts accordingly so that the labourers can contribute their share of savings to maintain their share of interest income. So when i goes up, labour income will go up less than proportionately.

So it is clear that when we shift for more handlooms both growth and employment increse. We can see this by drawing IS and LM curves.



Here we have drawn equation (1.2') as LM curve and equation (3') as IS curve. LM curve has a slope of B/A and it intercepts g-axis at $\frac{C + ha/\gamma}{B}$ and x-axis at $-\frac{C + ha/\gamma}{A}$. Since B/A is positive, the curve is upward sloping; and it is a straight line. IS curve has a slope of $-E/D$, it is a straight line, and it inctercepts g-axis at $\frac{F + Gh}{E}$ and x-axis at $\frac{F + Gh}{D}$. The slope of either of the lines does not involve h. So the lines shift parallelly when we change h. Both the curves shift in the same direction when we change h e.g. when we increase h, both IS and LM curves shift rightwards. So when h increases g must increase. Both shifts rightwards when we increase h but IS shifts more so x also increases.

Now if we want to maximise growth, then we can go on increasing h. But how long? Until we reach x=1. So the maximum value of g is calculated by substituting x = 1 in both IS and LM curves.

$$(1+\frac{AE}{BD})\,g_{max} = \left[\frac{D-F+\frac{E}{B}(A+C)}{G-\frac{Ea}{B\gamma}}\right]\left[\frac{AG}{BD}+\frac{a}{B\gamma}\right]+\frac{AF}{BD}+\frac{c}{B}$$

One point we may note here. If s_L is small, then B is large, so g_{max} will be small. This we can see, by multiplying the whole term by B.

Next question arises what happens to income distribution. Here, the distributional characteristics d_L, d_F and d_T are constant. Anyway, we will be more interested in the distribution of expenditure. Let us analyse that.

$$\sigma_Q = \frac{\text{Labourer's expenditure}}{\text{Capitalists' expenditure}} = \frac{(1-s_L)Y_L}{(1-s_F)Y_F + (1-s_T)Y_T}$$

$$= \frac{(1-s_L)\dfrac{d_L}{z_L\, s_L}}{(1-s_F)\dfrac{d_F}{z_F s_F} + (1-s_T)\dfrac{d_T}{z_T s_T}} \quad \text{[From equations (1),(2) and (3)].}$$

This expression is independent of h, so when h changes, expenditure ratio remains constant between labourers and capitalists. Actually, a closer look will show that the expenditure ratio of one class vis-a-vis any other class remains constant. This is in nominal terms. What happens in real terms? We know that q_F increases when h increases and q_T is constant at aw. And we can safely say that the proportion of income that labourers spend on food is more than that of the capitalists.

Therefore, in real terms the labourers lose as a class. If we come down to individual labourers, then those who were employed before the experiment with h are much worse now, since per head consumption expenditure, even in money terms decreases. But some more people get employment. So from the equity point of view it is not clear wether increase in g is welfare improving. Most of the benefits of growth (in relative terms) is going to capitalists. The *ex ante* employed labourers are losing individually both in money and real terms. But total income of *ex post* labourers is increasing though to a lesser extent in real terms (since food price is going up). So it is not exactly like distributing poverty among the labour class. It is distributing poverty plus some extra income.

For the above reasoning, perhaps, the increase in h is welfare improving. So, what one concludes, in effect, is that with relative de-modernisation of industrial sector, growth increases and welfare improves because if h increases, both g and x increase, implying proportionately less capital employed in the industry sector. And the proportion of mill production to the total cloth production also goes down. One point need to be emphasised that x and g are positively correlated. That means the less the relative modernisation of industry sector, the more the growth rate. This brings up the essentiality of the fact that food can not be produced without capital. As we know, when g goes up, the income must have gone up simultaneously. Since the price of cloth is fixed at aw, the cloth consumption is higher and so the prduction must have been higher. Therefore, an increase in h implies more cloth, more food, more employment and, nevertheless, relatively more capital for food production.

We may take note of the fact that a change in the administered price of capital r does not affect either g or x, whereas μ affects both g and x. This shows that in more than one consumption good model, the tax portion μ and r are not same insofar as their effect on growth is concerned. The price of cloth is given at aw. It is not affected by change in r or μ . Whereas a rise in r decreases the government revenue from cloth sector. However, we know that the income, and so the demand for food, and the supply of food are constant. So the price of food also remains unchanged. The cost is increasing in Mill sector, so the tax collection decreases. So how the government makes up for the lost revenue. That loss must be exactly matching with the gain in revenue due to the hike in the administered price r. In effect, what we conclude is that r is ineffective as a policy variable. To a large extent the result depends upon the price fixation rule in the cloth sector. The price is given by the marginal technique which is comparable to Ricardo's price fixation for corn by the marginal land.

A change in d does not directly affect g or x, and that is so because r does not affect g or x. However, with an increase in d, d_L ,d_F or d_T increases and hence, b increases. As a result, E increases. Thus x and g decrease with an increase in d.

Therefore with increase in d i.e with relatively less money printing, the growth, food production and employment go down. This confirms to the general pattern of our results that in the long run borrowing is not good for growth and employment.

3.3.2 Fixed Real Wage, Zero Profit and Flexible Interest Rate

Here, we will give a significant twist to the model developed in the last section. We will assume that each labourer needs a fixed amount of food f for his consumption each period. His need is exactly f units in physical terms; not more, not less. The labourer must be able to buy his food requirement. Since the underlying logic of the above assumption is that food is a basic necessity, it is wiser to impose a tax only on cloth, not on food. The production of cloth and food are instantaneous, so, profit is assumed away. Keeping these changes in mind, we can write the modified balancing conditions as follows.

Labourer (1) $$z_L s_L [Ax + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + g + \delta + id_L(1-\mu)] = d_L\, g(1-\mu)$$

Food-capitalist (2) $$z_F\, s_F\, id_F(1-\mu) = d_F(1-\mu)g$$

Mill-capitalist (3) $$z_T\, s_T\, id_T(1-\mu) = d_T(1-\mu)g$$

Food-market (4a) $$\frac{x}{\beta\gamma} = (Ax + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + g + \delta)f$$

Cloth-market (4b) $$[\frac{1-x}{\eta\gamma} + \frac{h}{\gamma}]a(1+\tau_T) = (Ax + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + g + \delta)(1-s_L - \frac{fp_F}{w})$$
$$+ id_L(1-\mu)(1-s_L) + (1-s_F)id_F(1-\mu) + (1-s_T)id_T(1-\mu)$$

tax-equation (5)

$$(g+\delta)\mu = \tau_T \; a[\frac{1-x}{\eta\gamma} + \frac{h}{\gamma}] + [\frac{a-\nu}{\eta\gamma} - (\delta+id)(1-\mu)](1-x)$$

The first three equations are the steady-state savings (in bonds) requirements of the three classes, the labourers, the food-capitalists and the cloth-capitalists; and they are similar, letter by letter to the first three equations of the earlier section.

Equation (4a) is the market clearing condition for food sector. Since x fraction of capital goes to the food-sector, $\frac{x}{\beta}$ is the amount of food supplied. As we have already noticed, $[Ax\gamma + \frac{\nu}{\eta} + ha + g\gamma + \gamma\delta]$ is the amount of labour per unit of capital. Each labour demands f units of food, and, therefore, the total demand for food is $[Ax\gamma + \frac{\nu}{\eta} + ha + g\gamma + \delta\gamma]f$. Equation (4a) depicts the supply-demand equality in the food sector.

Let us turn our attention to equation(5), then it will be easier to come back to equation (4b). The tax revenue requirement for the public sector net investment is $g\,\mu$.

The difference in the costs of production of handloom and mill cloth is $[\frac{a-\nu}{\eta\gamma} - (\delta+id)(1-\mu)]$. . This part is fully taxed so as not to allow any profit. Since (1-x) fraction of capital goes for mill production, and handloom production is tied to that of mill, government collects the whole surplus i.e. $(1-x)[\frac{a-\nu}{\eta\gamma} - (\delta+id)(1-\mu)]$ which is being generated in mill sector due to cost difference. But this quantity of tax revenue may not be adequate, it may be more than what is required also. So a tax (or subsidy) of τ_T per unit value of cloth is imposed both on handloom and mill sector. The first term of the right side of the equation (5) represents this particular fact. If τ_T is positive, then it is tax; and subsidy if negative. And $\tau_F = 0$.

The equation (4b) is the market clearing condition for cloth sector. The left hand side is the total market value of the cloth in the economy. The incomes of the labour class is $(Ax+\frac{\nu}{\eta\gamma}+\frac{ha}{\gamma}+g+\delta)+id_L(1-\mu)$ and those of the capitalists are $id_F(1-\mu)$ and $id_T(1-\mu)$. Capitalists spend $(1-s_F)$ and $(1-s_T)$ portion of their income in cloth consumption. Labourers spend $(1-s_L)$ amount of their interest income in cloth. Here, it may appear and legitimately so, that they behave almost like capitalists. Of their wage income they save s_L amount on money and bonds. From the rest they buy food first and whatever is left, they spend that on cloth. However, we are assuming the non-saving portion of the wage income is sufficient for his food consumption. In that case the laboourer will not have to distinguish between the two sources of his income as far as his spending pattern is concerned. Note that fP_F is the expenditure on food per labourer; $\frac{fp_F}{w}$ is the expenditure per rupee of wage income; and $[Ax+\frac{\nu}{\eta\gamma}+\frac{ha}{\gamma}+g+\delta]$ is the total food consumption expenditure by labourers. So their expenditure, out of wage income, on cloth is

$$[Ax+\frac{\nu}{\eta\gamma}+\frac{ha}{\gamma}+g+\delta+id_L(1-\mu)]\,(1-s_L)-[Ax+\frac{\nu}{\eta\gamma}+\frac{ha}{\gamma}+g+\delta]\frac{fp_F}{w}$$

Therefore the total expenditure on cloth is equal to

$$[Ax + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + g + \delta](1-s_L - \frac{fp_F}{w}) + id_F(1-s_F)(1-\mu)$$

$$+ id_T(1-s_T)(1-\mu) + id_L(1-s_L)(1-\mu)$$

which is in turn, can be written as

$$(Ax + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + g + \delta)(1-s_L - \frac{p_F f}{w}) + id(1-s)(1-\mu)$$

where

$$d(1-s) = d_L(1-s_L) + d_F(1-s_F) + d_T(1-s_T)$$

This explains why we wrote the cloth market clearing condition as in equation (4b)

Besides the above five equations, we have imposed one more extra condition. Since the labourers consume a fixed amount of food, their income must be sufficient to buy the food at the prevailing market price. They buy food only from labour income. So the maximum income they allocate for the consumption of food is $(1-s\ )w$ per head, the labour income, after saving is taken out. This constraint is

(6) $$f(\alpha + \beta r) \leq (1-s_L)$$

since

$$p_F = \alpha w + \beta r = \alpha w + \beta(1-\mu)(\delta+id)\gamma w$$

By Walras law we can drop equation (4b) from the analysis. Equations (2) and (3) are the same. They imply $z_F\ s_F = z_T s_T$ We are, then, left with four independent equations and one inequality. We can choose any four variables to be endogenous subject to the inequality (6). So, let us take i,g,x and τ_T as endogenous variables. Equation(5) determines the value of τ_T once all other variables are determined and equations (2) and (3) gives i once we know g as $i = \frac{g}{z_F s_F}$. From equations (1) and (4a) we have to determine the value of g and x simultaneously. We will call equation (4a) as IS curve and (1) as LM curve and rewrite them as follows.

<u>IS curve</u> $$x\left(\frac{1}{\beta\gamma f} - A\right) = g + \delta + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma}$$

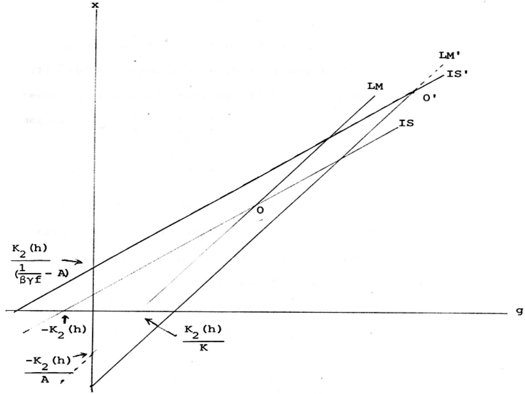
<u>LM curve</u> $$Ax = K_1 g - K_2(h)$$

where $$K_1 = d(1-\mu)\left(\frac{1}{z_L s_L} - \frac{1}{z_F s_F}\right) - 1$$

and $$K_2 = \frac{ha}{\gamma} + \frac{\nu}{\eta\gamma} + \delta$$

Let us have a look at the IS curve. If we assume viability, $(\frac{1}{\beta\gamma f} - A)$ is always positive. If it is negative or zero then $1 \leq A\beta\gamma f$ which implies $1 + \frac{\nu\beta f}{\eta} < \alpha f$ i.e. the direct labour requirement for production of f amount of food is greater than unity which, in simple terms, means that the labourer consumes more labour which goes for food production than he provides. So, naturally the system will not survive. Here, both the slope i.e. the inverse of $(\frac{1}{\beta\gamma f} - A)$ and the intercept $(\frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} +)/(\frac{1}{\beta\gamma f} - A)$ are positive. If we depict the curve in a diagram, then we can see it is a upward sloping straight line and cuts x-axis at $\frac{K_2(h)}{(\frac{1}{\beta\gamma f} - A)}$ and g-axis at $-\ K_2(h)$

The LM curve is also upward sloping straight line if we consider the normal technology case since we know K_1 is positive from the earlier section. The intercept $K_2(h)$ is also always positive. It cut x-axis at $-\frac{K_2(h)}{A}$ and g-axis at $\frac{K_2(h)}{K_1}$. Let us represent these two curves in the following diagram.



The diagram is being drawn assuming a solution exists. The IS and LM lines cross each other at the point O. Both g and x are positive, x is less than or equal to one and g is within the constraint imposed by food availability. The technology is normal. Here the IS curve shifts upward and LM curve downwards when we increase handloom production h. So the solution point O' moves in the north-east direction what means both g and x increases with increase in h. More and more handloom means, here, less and less mill cloth, more and more food, so employment and growth. So h must be increased to maximise growth until food constriant becomes binding.

If we take A = 0, then LM curve will be a vertical line and will shift rightwards with increase in h. If A < 0, LM curve becomes downward sloping with a slope of $\frac{K_1}{A}$ which is negative, and it will cross x-axis above IS curve because $-\frac{K_2(h)}{A} > \frac{K_2(h)}{(\frac{1}{\beta\gamma f} - A)}$. We will show a little later that the shift in LM-curve will be more than IS curve.

The solution may not exist at all if we allow all the parameters to take every possible value. For example if the LM and IS curve cross each other in the non-positive quadrant or if they are parallel. So, first of all, we have to show they cross each other in the positive quardrant. For that the slope of IS-curve must be less than that of the LM curve.

So

If A < 0, then the condition is easily satisfied.

If A > 0, then viability requirement will imply the condition, if s_L is small so that K_1 is large .

Secondly, x is a fraction, it must be less than or equal to unity. Solving for x from IS and LM curves, we get

$$x\left[\frac{1}{\beta\gamma f} - A\left(1 + \frac{1}{K_1}\right)\right] = \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + \frac{K_2(h)}{K_1} + \delta$$

then

$$x < 1 \implies \frac{1}{\beta\gamma f} - A\left(1 + \frac{1}{K_1}\right) \geq \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + \frac{K_2(h)}{K_1} + \delta$$

$$\implies \left(\frac{1}{\beta\gamma f} - \frac{\alpha}{\beta\gamma}\right) \geq \frac{A}{K_1} + \frac{ha}{\gamma} + \delta + \frac{K_2(h)}{K_1}$$

If $s_L \to 0$, and so $K_1 \to \infty$, then the condition reduces to

$$\left(\frac{1}{\beta\gamma f} - \frac{\alpha}{\beta\gamma}\right) \geq \frac{ha}{\gamma} + \delta$$

$$\implies \frac{1}{\beta\gamma f} \geq \frac{\alpha}{\beta\gamma} + \frac{ha}{\gamma} + \delta$$

The viability condition requires, the direct and indirect labour requirement for the production of f units of food must be less than unity, otherwise the system will not survive. The direct labour requirement is αf and $\beta\gamma\delta f$ is the indirect labour requirement since δ units of capital is being used up if one unit of capital is employed for production. The depreciation of capital for one unit of food production is $\beta\delta$. The labour required to produce that amount of capital is $\beta\gamma\delta$. So

$$1 > \alpha f + \beta\gamma f\delta$$

$$\implies \frac{1}{\beta\gamma f} > \frac{\alpha}{\beta\gamma} + \delta$$

$$\implies \frac{1}{\beta\gamma f} > \frac{\alpha}{\beta\gamma} + \delta + \frac{ha}{\gamma} \qquad \text{for small h.}$$

Therefore, for small s_L, there exists a h, such that $x \leq 1$.

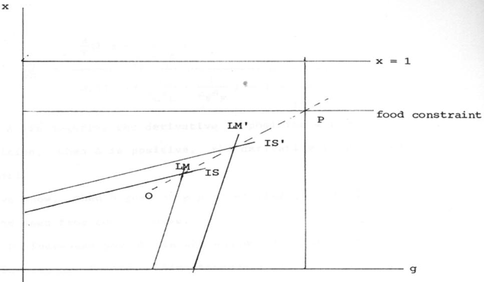
Thirdly, the food constraint condition must hold for equilibrium values of g and x. Let us look at the inequality and substitute x for i. We get,

$$x\left(\frac{1}{\beta\gamma f} - A\right) \leq \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + \delta\left(1 - \frac{z_F s_F}{d}\right) + \left[\left(\frac{1-s_L}{f} - \alpha\right) / \frac{\beta\gamma d(1-\mu)}{z_F\, s_F}\right]$$

This condition also puts an upper bound on x. We would like to note that if h can increase then it would not be difficult to satisfy this condition. But we have lost flexibility with h to ensure x < 1. So, at best, what we can say is that the constraint will be satisfied for very small x. So to maximise growth we may not be able to take x to one. This constraint may put the value of x less than one. The smaller the f, the greater the maximal value x may attain as long as the inequality holds.Given growth, we need less food if f decreases. The following condition says with decrease in f, the growth can be pushed forward. The condition we get by substituting g for i in (5) is

$$g \leq \left\{\left[\frac{1-s_L}{f} - \alpha\right] / \frac{\beta\gamma d(1-\mu)}{z_F s_F}\right\} - \frac{\delta z_F\, s_F}{d}$$

We can show the contraints in the following diagram



The OP line traces the growth path with changes in h. When h increases the growth rate and x moves in OP direction. As h increases the food constraint also shifts upwards but it moves slower than the growth path; and these two curves and the food constraint in terms of g, cross each other at P. That is the maximum growth achievable.

We can derive the expression for growth rate explicitly by solving IS and LM for g.

$$\frac{\left(\frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + \delta\right)\left[1 + \frac{A}{\left(\frac{1}{\beta\gamma f} - A\right)}\right] + \delta\left(1 + \frac{A}{\frac{1}{\beta\gamma f} - A}\right)}{d_L(1-\mu)\left(\frac{1}{z_L s_L} - \frac{1}{z_F s_F}\right) - 1 - \frac{A}{\beta\gamma f} - A}$$

From the expression it is not hard to notice that g is positive in the normal case and also it is positive when $A < 0$ without any restriction on the value of s_L. Let us calculate the per unit changes of g with respect to h.

$$\frac{\partial g}{\partial h} = \frac{\frac{a}{\gamma}\left(1 + \frac{A}{\frac{1}{\beta\gamma f} - A}\right)}{d_L (1-\mu)\left(\frac{1}{z_L s_L} - \frac{1}{z_F s_F}\right) - 1 - \frac{A}{\frac{1}{\beta\gamma f} - A}}$$

When A is negative the derivative is positive without any extra condition, when A is positive, the derivative is positive if s_L is small.

Now we know, when h goes up g goes up whereupon x goes up which can be seen from the IS curve.

When h increases savings in the economy increases due to increase in labour income. Simultaneously food requirement increases. It pushes up x to meet the food requirement and also to reduce excess supply of cloth which has arisen due to increase in handloom. When $A > 0$ we take s_L to be small because food requirement in food-sector itself is relatively larger.

What happens to the distribution parameters σ_Y and σ_Q ?

$$\sigma_Y = \frac{\frac{d_L}{z_L s_L}}{\frac{d_F}{z_F s_F} + \frac{d_T}{z_T s_T}} , \quad \sigma_Q = \frac{(1-s_L)\frac{d_L}{z_L s_L}}{(1-s_F)\frac{d_F}{z_F s_F} + (1-s_T)\frac{d_T}{z_T s_T}}$$

The parameters σ_Y and σ_Q are not affected at all by h. However, the price of food rises because i goes up and so the cost of production of food. The price of cloth may go up because the revenue requirement from taxes goes up as investment rises. The price rise is most likely will be higher for cloth as the tax rate has to increase quite a bit because the cost difference between handloom and mill production falls down as i goes up and the base for this shrinks because x goes up. The total cloth production may go up but that may not be enough to compensate for the resultant requirement from this particular source leading to a rise in the tax rate. If that happens then distributionally it is better if h rises because the capitalists consume only cloth.

Thus the relative de-modernisation of industry sector turns out to be better for growth, employment and distribution.

A change in r is ineffective insofar as g, x, σ_Y and σ_Q are concerned. The price of food goes up since the capital cost rises. But the price of cloth goes down since the tax rate τ_T goes down. So the administered price hike worsens welfare. Because capital is an universal input and its price must affect the cost of production in every sector of the economy including the cost of the essential goods.

If we step up μ ,the tax financed portion of the investment then both g and x go up. When μ goes up excess supply arises in the funds market which forces the investment to go up. That in turn leads to more income for labourers and since the saving ratios and d_L , d_F and d_T are constant, the incomes of other two classes go up. More investment is the result. The process converges and we end up with more g and x also. The distribution characterstics are unaffected. The price of food comes down as r goes down. The price of cloth is likely to increase as the tax rate may increase. So the real consumption distribution moves in favour of the labour class. As expected, a rise in μ helps both the growth to increase and the welfare to improve.

The parameter d does not enter directly in the value of g or

x. If an increase in d means a rise in d_L even to a lesser extent then a change in d affects both g and x negatively. Money printing is better for growth. About distribution we can not say anything unless we know how d_L d_F and d_T change relative to each other.

One point we must take note of is that in response to any change in the policy parameters, g and x, if they change at all then they move in the same direction. So, in general, growth is associated with relative de-modernisation of industrial-sector. That the proportion of output produced by the mill-sector must be less for faster growth and, at times, better distribution.

In this particular regime, the growth rate depends only on the labourers' characteristics. Capitalists' characteristics, whatsoever do not affect the growth rate; however,it affects the determination of the rate of return i. We have already noticed and explained it in sections 2.5 and 2.6 of the first chapter. For emphasis, we want to add that this particular observation is free from the number of sectors or techniques in the production of consumer goods.

We can see from the growth formula that g increases with an increase in α whereas the maximal growth goes down. It is not surprising because when α goes up growth goes up because savings increases. In contrast, maximal growth rate goes down because the surplus from food sector decreases as the labourers directly employed in the F-sector consume more food now for the same amount of output produced.

3.3.3 Positive profit and time as input in production of the Consumer goods

This is the section which is more realistic than all the earlier ones, at least, in one sense. The consumption goods, both food and mill cloth take one period to be produced. The handloom cloth is still assumed to be produced instantaneously. The profits π_F and π_T are being defined as follows. The profit is the surplus per unit of working capital. The cost of production of food is $\alpha w + \beta(\delta+id)(1-\mu)\gamma w$ and the price is q_F. So profit

$$\pi_F = \frac{q_F - [\alpha w + \beta(\delta+id)(1-\mu)\gamma w]}{\alpha w + \beta(\delta+id)(1-\mu)\gamma w}$$

In mill sector the profit is being defined as the difference between the costs of mill and handloom divided by the cost in mill-sector. It is given by

$$\pi_T = \frac{aw}{\alpha w + \eta(\delta+id)(1-\mu)\gamma w} - 1$$

This definition looks all right since the price of cloth should not go beyond the cost in handloom production plus the taxes because handloom does not need any capital and there is unlimited supply of labour. Another reasonable assumption we make is that the capitalists do not lend any money to government. They do not buy government bonds, however they hold some money. Thus d_L is equal to d. They invest their surplus in their own consumer good sector. The meanings of z_F and z_T are different now. These are proportions of their savings invested in their own production units. The rest of the savings they hold in form of money. So the only source of their income is profit. We retain the assumptions that only cloth sector is being taxed and each labourer needs exactly f units of food to be able to work for one period. Now we can write the balancing conditions as follows.

Labourers (1) $$z_L s_L [Ax + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + g + \delta + id(1-\mu)] = dg(1-\mu)$$

Food Capitalists (2) $$z_F \, s_F \, \pi_F = g$$

Mill Capitalists (3) $$z_T \, s_T \, \pi_T = g$$

Food-market (4a) $$\frac{x}{(1+g)\beta\gamma} = [Ax + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + g + \delta]f$$

Cloth market (4b) $$[\frac{(1-x)}{(1+g)\eta\gamma} + \frac{h}{\gamma}]a \; (1+\tau_T) = [Ax + \frac{\nu}{\eta\gamma} + \frac{ha}{\gamma} + g + \delta](1-s_L - \frac{fp_F}{w})$$

$$+ (1-s_L)d\,(1-\mu) + (1-s_F)[\frac{\alpha}{\beta\gamma} + (\delta+id)(1-\mu)]\pi_F x + (1-s_T)[\frac{\nu}{\eta\gamma} + (\delta+id)(1-\mu)]\pi_T(1-x)$$

Tax equation (5)
$$\mu g = \tau a[\frac{(1-x)}{(1+g)\eta\gamma} + \frac{h}{\gamma}]$$

Food constraint (6) $$f[\alpha + \beta\gamma(1-\mu)(\delta+id)](1+\pi_F) \leq 1 - s_L$$

Profit in mill (7) $$\pi_T = \frac{a}{\nu + \eta\gamma(\delta+id)(1-\mu)} - 1$$

The equation (4a) is same as earlier. Since only labour class buys government bonds $d_L = d$ so that the equation (1) is also same as earlier. At each point of time the capitalists have their revenues, $(1+\pi_F)$ per rupee of working capital for food-sector and $(1 + \pi_T)$ for the mill sector. And $(1 + z_F s_F \pi_F)$ and $(1 + z_T s_T \pi_T)$ of these they invest in their own production process of food sector and mill sector respectively. These sector must grow at a rate g also. So equations (2) and (3) follow. In equation (4), the right hand side represents the expenditure on cloth and the left shows the market value of the total cloth production where profit and taxes are included. In equation (5), we are showing that both the handloom and mill cloth are taxed uniformly and the tax is on the total value of cloth. The equation (7) defines the profit for mill sector. The difference in the cost of production of handloom and mill is the surplus for the mill sector. And this surplus per unit of working capital in the mill sector is called the rate of profit. Inequality (6) shows the food constraint as the price of food is given by

$$q_F = [\alpha w + \beta(\delta + id)(1-\mu)\gamma w](1 + \pi_F)$$

Here we have six independent equations as long as π_F is different from π_T . So we can endogenise six variables subject to the constraint (6). The profit rates π_F and π_T are the natural choices. The other endogenous variables are g,x, τ_T and h. As in earlier section, the existence here we can see easily by choosing s_L and f appropriately. Therefore, let us look at the conclusions straight.

Equation (7) gives the value of π_T since i is exogenous.

Then (3) gives the value of g and (2) the value of π_F. By solving the equations (1) and (4a) we get

$$x = [\frac{g}{z_L s_L} - i] d(1-\mu)(1+g)\beta\gamma f$$

and

$$\frac{ha}{\gamma} = [1-A(1+g)\beta\gamma f] d(1-\mu)[\frac{g}{z_L s_L} - i] - \frac{\nu}{\eta\gamma} - g - \delta$$

For solutions to be meaningful, we must have $g > z_L s_L i$ and $[1-A(1+g)\beta\gamma f]d(1-\mu) > 0$. Only in this case x and h may take positive values. We can see that x and g are directly related. The relationship between h and g is not so obvious.

Let us calculate the first and second derivative of h with respect to g.

$$\frac{a}{\gamma}\frac{\partial h}{\partial g} = -A\beta\gamma f\, d(1-\mu)[\frac{g}{z_L s_L} - i] - 1 + [1 - A(1+g)\beta\gamma f]\frac{d(1-\mu)}{z_L s_L}$$

And,

$$\frac{a}{\gamma}\frac{\partial^2 h}{\partial g^2} = -\frac{2A\beta\gamma f\, d(1-\mu)}{z_L s_L}$$

We can see that for solution to be meaningful g must be strictly greater than $z_L s_L i$, otherwise, h will be negative. When g is very near to $z_L s_L i$ fortunately the derivative $\frac{\partial h}{\partial g}$ is positive because we know that $[1-A(1+g)\beta\gamma f]\frac{d}{z_L s_L}(1-\mu)$

is greater than 1, again to ensure the positivity of h. By increasing g we can bring up the value of h. The value of h has to come up to zero. The second derivative is always negative. If h takes some positive value then at least, for the lower values of g, h must increase with g. Therefore, at least, when g is small the relative de-moderisation follows when the growth rate increases .

When growth rate is low, x and g move in the same direction i.e. when mill cloth is reduced the handloom production increases. This is quite intuitive. When growth rate is high it is difficult to produce more cloth by handloom-sector as food is limited and both investment and handloom-sector need labour. So cloth production is curtailed from mill-sector and may be from the handloom-sector. But employment increases, so also income and demand for cloth. In that case this is being taken care of by the price hike. Price can be increased only by increasing taxes which is not unlikely because for the increase in investment, government must collect more taxes which is possible only through increased tax rate as the base has shrunk.

Let us experiment what happens when i increases. It implies π_T goes down from equation (7). Then, from equation (3) g goes down which means both x and h go down if g is low to start with. If g is high then h may go up. This happens in normal-technology case. When A $<$ 0 or A = 0, h decreases with g irrespective of latter's value. From equation (7) we can see that the price of cloth (so the surplus) is being determined by the marginal industry handloom sector [like Ricardo's marginal land determines surplus for the better quality land]. Similar result will follow if we fix the price of food at some level exogenously.

What happens to distribution. Since the saving propensities are fixed, the movements of σ_Y and σ_Q are in the same direction. We may examine only σ_Y. Using equations (1), (2), and (3) and the definitions of profits, we get,

$$\sigma_Y = \frac{Y_L}{Y_F + Y_T} = \frac{\dfrac{d(1-\mu)(1+g)}{z_L s_L}}{\dfrac{x}{z_F s_F}\left[\dfrac{\alpha}{\beta\gamma} + (1-\mu)(\delta+id)\right] + \dfrac{1-x}{z_T s_T}\left[\dfrac{\nu}{\eta\gamma} + (1-\mu)(\delta+id)\right]}$$

With a rise in i we can make one observation. The T-capitalists get better off than the other two classes because x also goes down along with g. This is a pure case of welfare loss as growth goes down, and some rich people get richer and the poorest amomng the population find themselves in a worse position insofar as their income is concerned.

Increase in i decreases π_T, growth rate and π_F. This result is both Pasinetti and anti-Pasinetti. If one interprets i as the Pasinetti's profit, then i and g are negatively related, though $z_T s_T$ alone determines this relations i.e. $z_L s_L$ does not enter the picture; while in Pasinetti's case they are positively related. If we take π_T and π_F as Pasinetti's profit then π_T and g are positively related, as in Pasinetti, and the relationship depends upon $z_T s_T$.

To approach Pasinetti's case more meaningfully, for a moment, let us assume $i = \pi_T = \pi_F$. We are adding two more equations. But equations (2) and (3) reduce to one. And let us assume i is endogeneous to have same number of equations and unknowns. We can solve for i from equation (7)

$$i = \frac{-[\nu+\eta\gamma(1-\mu)(\delta+d)] \pm \sqrt{\{[\nu+\eta\gamma(1-\mu)(\delta+d)]^2+4\eta\gamma d(1-\mu)[a-\nu-\eta\gamma\delta(1-\mu)]\}}}{2\gamma d(1-\mu)\eta}$$

One of the value of i is negative, so meaningless for our purpose. The other value will be non-negative if

$$a \geq \nu + \eta\delta\gamma$$

When this inequality holds i becomes strictly positive if $\mu > 0$. This condition says that the labour requirement for handloom production is greater than the direct and indirect labour requirement of the mill sector for producing one unit of cloth.

Here, i, π_F and π_T are the same, and they are directly related to g through $z_F s_F$ and $z_T s_T$. But i is being determined outside the equation (3) and (2) which has direct resemblance to Pasinetti's famous equation. While Passinetti's equation determines rate of return given the growth rate, ours determines growth rate given the rate of return. The $z_F s_F$ and $z_T s_T$ do not affect i at all. It helps just in the determination of growth rate. This fascinating result follows because our profit rate is being determined by the Ricardian assumption.

When we change α or β, growth does not get affected, however, with increase in α and with increase in β, σ_Y goes down and up respectively. The fact to be noted is that with increase in ν, η and γ the growth rate comes down. Here these parameters are related to a commodity which requires time for production. A close look shows that when a goes up, the growth rate goes up as the profits of T- capitalists go up.

CHAPTER - 4

GROWTH AND DISTRIBUTION - CHOICE OF TECHNIQUE WITH LAND SCARCITY

4.1 Introduction

For many developing countries land is in short supply along with other natural resources and capital. In that case, for a more meaningful exercise, the very fact of the scarcity of land as an input in the production process must be accounted for. It is needless to say that we are twisting the original model in such a way that land as a scarce factor can have a place that it deserves.

We are retaining all asusmptions of section-3.3.3 of Chapter - 3, except, that land is abundant . Here land is an input in the production of food, and there are two techniques of production available in agriculture as well. Unlike the handlooms, we assume the traditional agriculture also takes one period for production. However, the rate of return here is equal to the rate of interest. Hence, agricultural capitalists first look for the opportunities in the modern agriculture and if they fail there then only they turn to traditional agriculture for investment. Modern agriculture gets the first priority in land allocation. We can justify this as there is only one agriculture capitalist who likes to invest in modern agriculture first then on traditional agriculture, because the rate of return is higher in the former case.

The land is non-producible, and the quantity, therefore, is given at a fixed level for ever. No more our system will be in steady-state because land cannot grow at the required rate. Fortunately, we will have a dynamical system, not only in the sense, as previously, that our system moves with time and changes at a constant rate but also in the way that the rate itself changes; for instance, the rate of growth of capital stock changes from one period to the next.

Few of the important questions, answers to which to be explored in this chapter, are being repeated for the sake of continuity. They are,

(1) What should be the level of investment in public sector; and pattern and level of investment in private sector?

(2) What should be the pricing policy of the public sector product?

(3) What should be the method of financing of the public investment?

(4) Most important of the questions is to choose among the techniques where the objective is to optimise growth and reduce the disparities in distribution of income and wealth.

We will try to trace the dynamic path and see how the path shifts when certain parametric changes are effected. For a while, we will concentrate on analysing the behaviour of variables from one point of time to the next, not because it is easier to do so, but it is very useful in its own right.

Mostly the analysis is done till the land is fully modernised. However, a few comments are made as to the post-modernisation period of the agricultural sector.

4.2 Model in Brief

Inasmuch as this chapter is slightly different from the others we need to describe the model briefly even at the pain of repetition. Only briefly because it is needless to add that we have done that earlier in some way or other.

Technology Matrix

	Labour	Land	Capital
Essential Good (food)			
Modern Technique	α	λ	β
Traditional Technique	e	ℓ	o
Luxury Good (cloth)			
Modern Technique	ν	o	η
Traditional Technique	a	o	o

What the entries in the table implies, for instance, is that ℓ is the amount of land used to produce one unit of food if the traditional technique is employed. The other entries are similarly defined. It is natural to assume $\alpha < e$ and $\nu < a$. If the modern technique is assumed to be land-augmenting then $\lambda < \ell$. Supply of labour, at a fixed money wage rate w, is unlimited. Land is privately owned and its supply is fixed. Capital is rented at the rate r to both sectors that use modern techniques of production. Both land and capital are fully utilized in each period.

The labourers save a fixed proportion s_L of their income and demand bonds and money. The fraction of savings invested in bonds is z_L . From the remaining income, a fixed quantity (f) of food is demanded. The remaining amount is spent on the luxury good. The expenditure from wage income is enough to buy food.

Production of food requires one period for both techniques. Production of cloth using the traditional technique does not require time, while the modern technique requires one period. The industrial and agricultural capitalists use all the profits to purchase inputs.

Landlords' income consists only of rent from the land (θ per one unit of land used per period). It is spent only on consumption of the luxury good; they do not save.

The government's receipts are the revenue from the tax on cloth, and rental income through capital good. Its expenditures are on wages for the production of the capital good and interest on borrowed funds. To simplify the analysis, we assume the capitalists are not allowed to enter the funds market.

The private production decisions are based on profit maximization, given input prices, credit and expected output prices. The government has the following instruments: (i) the tax portion of investment μ which affects the tax rate on the luxury good, (ii). the rental on the capital good (iii) the supply of bonds and (iv) currency creation. These are used to influence the variables like the growth rate of capital stock, the level of employment and the composition of output and its distribution.

Market mechanisms are used to balance the demand and supply of consumer goods. For other goods and assets, prices are fixed and rationing mechanisms are used. The macro-balancing conditions are given below.

Let t = the general subscript implying the value of the variable in t-th period.

x_t = fraction of capital allocated for food production in t-th period

A = total amount of land

θ_t = rent on land in the t-th period

L_t = labour employed at time t.

If some symbols are not defined here and still used, then their definitions are taken to be the same as in Chapter – 3 .

Let us say the variables are $g_t, x_t, \theta_t, h_t, \pi_{Ft}, \pi_T, \tau_T$

4.3 Balancing Equations

Labourers :

$$z_L s_L [\frac{Ae}{\ell} - (\frac{\lambda e}{\ell} - \alpha)\frac{x_t K_t}{\beta} + (1-x_t)\frac{\nu}{\eta}K_t + h_t \, aK_t + (g_t+\delta)K_t\gamma + id(1-\mu)K_t\gamma] = d\, g_t(1-\mu)K_t\,\gamma \quad (1)$$

Food capitalists :

$$(1+\pi_{Ft})[\lambda\theta_{t-1}+\alpha w+\beta r]\frac{x_{t-1}K_{t-1}}{\beta} + Sur_t = (\lambda\theta_t+\alpha w+\beta r)\frac{x_t K_t}{\beta} \quad (2)$$

where

$$Sur_t = (\ell\theta_{t-1} + ew)(1+i)\frac{A(t-1)}{\ell} - (\ell\theta_t + ew)\frac{A(t)}{\ell}$$

and $A(t)$ = the quantity of land that goes for food production by the traditional technique in the t-th period.

So, (2) reduces to

$$[(1+\pi_{Ft})(\lambda\theta_{t-1}+\alpha w+\beta r)-(1+i)(\lambda\theta_{t-1} + \frac{\lambda e}{\ell}w)]\frac{x_{t-1}K_{t-1}}{\beta} + A(\theta_{t-1}+\frac{e}{\ell}w)(1+i) = [(\alpha-\frac{\lambda e}{\ell})w + \beta r]\frac{x_t K_t}{\beta} + A(\theta_t+\frac{e}{\ell}w) \quad (2')$$

Mill-capitalists :

$$(1 + \pi_T) = \frac{1-x_t}{1-x_{t-1}} (1 + g_{t-1}) \tag{3}$$

Food-market clearance :

$$\frac{A}{\ell} + (1 - \frac{\lambda}{\ell}) \frac{x_{t-1} K_{t-1}}{\beta} = f L_t \tag{4a}$$

Cloth-market clearance :

$$[\frac{(1-x_{t-1})K_{t-1}}{\eta} + h_t K_t] aw (1+\tau_{Tt})$$

$$= (1-s_L-p_F f) L_t + (1-s_L) id (1-\mu) K_t \gamma w + \theta_t A \tag{4b}$$

Tax equation :

$$\mu g_t K_t = [\frac{(1-x_{t-1})K_{t-1}}{\eta} + h_t K_t] aw (1+\tau_{Ft}) \tag{5}$$

Real wage constraint :

$$p_F f \leq (1-s_L) w \quad \text{where} \quad P_F = (ew + \theta_{t-1} \ell)(1+i) \tag{6}$$

Profit equations :

$$\pi_T = \frac{a}{\nu + \eta \frac{r}{w}} - 1 \tag{7}$$

$$\pi_{Ft} = \frac{(ew + \theta_{t-1}\ell)(1+i)}{\alpha w + \theta_{t-1} \lambda + \frac{\beta r}{w}} - 1 \tag{8}$$

Land constraint :

$$\frac{\lambda x_t K_t}{\beta} \leq 1 \tag{9}$$

Since the balancing conditions are not too obvious to understand, it behoves us to explain them in detail.

Last period K_{t-1} amount of capital was available and x_{t-1} of that was allocated for agricultural sector. Therefore,

$x_{t-1}K_{t-1}$ = capital gone for production of food in the last period

$\frac{x_{t-1}K_{t-1}}{\beta}$ = food produced in the modern sector in the current period.

$\frac{\lambda x_{t-1}K_{t-1}}{\beta}$ = land gone for food production land period by the modern technique.

Similarly,

$\frac{\lambda x_t K_t}{\beta}$ = the land allocated for food production in the current period.

Since, the total land available is A, we get the inequality (9) as

$$\frac{\lambda\ x_t\ K_t}{\beta} \leq A$$

Now,

$\frac{1}{\ell}(A- \frac{\lambda x_{t-1}K_{t-1}}{\beta})$ = food produced by the traditional technique in the last period.

So the total food availability today

$$= \frac{1}{\ell}\left(A - \frac{\lambda x_{t-1} K_{t-1}}{\beta}\right) + \frac{x_{t-1} K_{t-1}}{\beta} = \frac{A}{\ell} + \left(1 - \frac{\lambda}{\ell}\right)\frac{x_{t-1} K_{t-1}}{\beta}$$

The implicit assumption here is that all land is utilised in food production. Not unreasonable, when labour supply is unbounded above. Since, the labourers consume f amount of food per capita and the other classes do not consume any food at all, we get the food market clearance condition as in (4a) where L_t is the total labour employed in the current period. Let us calculate L_t .

$\frac{\alpha x_t K_t}{\beta}$ = labour employed in the current period in food sector where modern technique is used.

$\frac{e}{\ell}\left(A - \frac{\lambda x_t K_t}{\beta}\right)$ = labour employed in the food sector where the traditional technique is used.

$(1-x_t) K_t \frac{\nu}{\eta}$ = labour employed in the mill.

$a h_t K_t$ = labour employed in the handloom

$(g_t+\delta) K_t \gamma$ = labour employed in the investment good sector

The labour employed in the current period,

$$L_t = \frac{Ae}{\ell} - \left(\frac{\lambda e}{\ell} - \alpha\right)\frac{x_t K_t}{\beta} + (1-x_t) K_t \frac{\nu}{\eta} + a h_t K_t + (g_t+\delta) K_t \gamma$$

Since, only labourers save in the government bonds, (hence ($d_L = d$) and they allocate only $z_L s_L$ portion of their income into that, we get the balancing equation (1).

The price of cloth is determined by the principle of marginal cost,that the price is equal to the cost of production in the inefficient technique plus the tax component. Here it is aw,the cost of production in the handloom. Government collects taxes at a rate τ_{Tt} from the cloth sector. And it has the option of increasing the administered price of the capital good. Thus we get the government budget constraint as equation (5).

The labourers save s_L of their icome. The rest of the interest income they spend in purchasing cloth. Out of their labour income after saving they spend $p_F f$ of it in food. The rest they spend in cloth. The only other category who consume cloth are the landlords who, incidentally, spend all their income in the purchase of cloth. They neither save in any form, nor buy food. So, we get the cloth market clearance in the equation (4b).

The production of food by traditional technique also takes one period. However, we assume the rate of profit, there, is equal to the rate of interest i. And there is no tax on the essential commodity food. So, p_F is defined accordingly. We say that the labourers' expenditure from wages is enough to buy the required food stuff. Then the inequality (6) follows.

The profit rates in both the consumer good sectors are defined by the equations (7) and (8). The difference of the cost of production by both the techniques per unit cost in the modern technique is defined as the profit rate.

One simplifying, though important in its own right, assumption we need to mention is that there is only one class of agriculture-capitalists. They invest in both traditional and modern agriculture. Inasmuch as they are profit maximizers, they put all their funds for investment in modern agriculture first. But their demand is frustrated to the extent that they have to invest in the traditional agriculture. This is as far as the rationalisation is concerned. To put the matter straight as to obtaining the equation (2), we have to argue from the other end. The investments in the traditional agriculture in periods (t − 1) and t are $(\ell\theta_{t-1} + ew)\frac{A(t-1)}{\ell}$ and $(\ell\theta_t + ew)\frac{A(t)}{\ell}$ and the rate of return on (t−1)-th period investment is i. Hence, the surplus fund from the traditional agriculture is equal to Sur_t of equation (2). The surplus is directed to the modern agriculture. The investment and the rate of return in modern agriculture on (t−1)-th period are $[\lambda\theta_{t-1} + \alpha w + \beta r]x_{t-1} K_{t-1}$ and π_{Ft} respectively. So, the left hand side of the equation (2) is the funds on t-th period in modern agriculture. The right hand side is obviously the funds required.

By the same principle we derive the equation (3) which reflects the saving-investment balancing for the modern textiles inasmuch as the production of cloth by handloom does not take any time, and hence, does not need any investment.

4.4 General Observations

We have already prepared the background for the few observations reported below.

(a) From equation (3), we observe that x_t will be never equal to one. Funds are there and they are looking for investment opportunity, and that too in specific sectors.

(b) From equations (1) and (4a), we get,

$$g_t = \frac{z_L s_L}{d(1-\mu)\gamma} \left[\frac{A}{f \ell K_t} + \left(1-\frac{\lambda}{\ell}\right) \frac{x_{t-1}}{f\beta(g_{t-1}+1)} \right] + z_L s_L \, i \tag{10}$$

And from equation (3), we get,

$$x_t = 1 - \frac{(1+\pi_T)(1-x_{t-1})}{(1+g_{t-1})} \tag{11}$$

Thus, g_t is independent of x_t and vice versa. Hence, g_t depends upon x_{t-1} and g_{t-1}, and similarly, x_t depends upon x_{t-1} and g_{t-1}. Last period's capital formation and allocation of capital for food production determines this year's capital formation and this year's allocation. This is because both the capital good and food have one period production lag.

(c) Equation (3) says, when $g_{t-1} > \pi_T$, $x_t - x_{t-1} > 0$ and the higher the g_{t-1} the larger is the difference $x_t - x_{t-1}$. Since the growth rate of capital is more than the growth of investible funds in the cloth sector, proportionately it absorbs less capital on t-th period than the previous period. The reverse result that if $g_{t-1} < \pi_T$, then $x_t - x_{t-1} < 0$, also holds.

(d) By solving the equations (1), (10) and (11), we get the values of g_t and x_t explicitly as follows :

$$g_t = \frac{1}{\prod_{n=0}^{t-1} (1+g_n)} [C_1 - C_2 C_3^{t-1}(1-x_o)] + \frac{C_2}{1+g_{t-1}} + z_L s_L i \tag{12}$$

$$1 - x_t = \frac{C_3^t (1-x_o)}{\prod_{n=0}^{t-1} (1+g_n)} \tag{13}$$

where

$$C_1 = \frac{z_L s_L A}{d(1-\mu)\gamma f \ell K_o} \; ; \; C_2 = \frac{z_L s_L (1-\frac{\lambda}{\ell})}{d(1-\mu)\gamma f \beta} \; ; \; C_3 = 1+\pi_T$$

From equation (12), we can write

$$g_1 = \frac{1}{1+g_o} [C_1 - C_2(1-x_0)] + \frac{C_2}{1+g_0} + z_L s_1 i$$

As we can see, g_1 and g_o are inversely related. And after sometime when $C_2 C_3^{t-1} (1-x_o)$ approaches C_1, the inverse relation between g_t and g_{t-1} becomes prominent. Hence, in the beginning and after sometime we may get fluctuations. This is true, only if C_1 is stirctly greater than $C_2 C_3^{t-1}(1-x_o)$ to start with.

Let us look at the right hand of equation (12) more carefully. The last term is a constant. With time the influence of the first term declines. But, the second term is fluctuating. So it is difficult to conclude about the path of g_t. However, putting some reasonable values of the parameters, we numerically find that g_t goes down with time till the model works. That means till $x_t \leq 1$.

(e) With time, $K_t(1-x_t)$, which is equal to $C_3^t(1-x_o)K_o$ goes on increasing irrespective of the behaviour of x_t which say, in effect, the mill cloth output goes on increasing at a rate π_T whatever the course x_t may take.

But the mill cloth output proportionate to total cloth output goes down with time. As

$$\frac{(1-x_{t-1})K_{t-1}}{h_t K_t + (1-x_{t-1})K_{t-1}} = \frac{1}{\frac{h_t(1+g_{t-1})}{1-x_{t-1}} + 1}$$

$$= \frac{1}{\frac{h_t(1+\pi_T)}{1-x_t} + 1}$$

and h_t and x_t increase with time, of course, with the assumption that π_T is strictly less than g_t for all t. This is is clear from equation (4a) if one is ready to believe that g_t goes down with time.

What happens to the food output? We know

$$x_t K_t = K_o [\prod_{n=0}^{t-1} (1+g_n) - C_3^t(1-x_o)]$$

So as long as $g_n > \pi_T(1-x_o)-x_o$, the food output goes on increasing with time. If g_n is more, then the growth of food output is faster not only in absolute terms but also in relative terms vis-a-vis cloth sector. (g_n, n = 0,...,t-1)

(f) In the model we are biased towards modernisation, implicitly though, by assuming that modern agriculture gets the first priority for land allocation, and the modern industry sells first and the left over demand is met by the handlooms. But we find agriculture gets modernised at a faster rate than industry until agriculture gets fully modernised.

(g) If capitalists are allowed to consume the luxury good cloth then there would be no change in the qualitative results.

(h) If the enterpreneurs are allowed to borrow a limited amount which is what happens in reality; for instnce, the borrowing is tied to the profit, then the qualitative results remain the same.

(i) If we increase w, then the results depend upon the rule we would like to impose. At the moment, we can think of two possible rules. They are (a) to increase w as and when the food constraint for individual labourer becomes binding, and (b) to have a general indexation of w with respect to the price of food. However, here, we are not working out these cases.

(f) The growth rate g_t does not depend upon the characteristics of the capitalists or the landlords. Nevertheless, the labourers' saving behaviour and portfolio choice influence the growth rate.

4.5 Comparative Statics

We have to study the equations (10) and (11) carefully. We have not solved g_t and x_t in exogenous variables which is, of course, difficult to do. However, we can do short run analysis without any hindrance. If we change some parameters at any period t, then we can say, at least, what will happen to g_t and x_t.

The growth rate is positively related with z_L, s_L and μ, and negatively with $\frac{\lambda}{\ell}$, d and γ, where all g_n and x_n $(n = 0,\ldots,t-1)$ are given.

Decrease in $\frac{\lambda}{\ell}$ means the modern technique becomes more land augmenting, that the same quantity of land produces relatively more output in modern than traditional agriculture, now than before. When $\frac{\lambda}{\ell}$ decreases (and the decrease is mainly due to λ) the food output by modern technique in (t+1)-th period remain the same as x_t and K_t are unaffected, but the output by the traditional technique increases because relatively more land is employed there. The employment in food sector and investment sector goes up and the employment in modern mill remains constant in t-th period. Inasmuch as the total employment is constant as the food output is given, the employment in handloom goes down. So cloth production goes down. The price of cloth must increase, to take care of the excess demand situation, which actually happens due to a rise in the tax rate on the cloth because the tax base shrinks and the total tax requirement rises. The food price may increase, though to much lesser extent, as the profit rate π_{Ft} may increase because the surplus Sur_t may decrease. In that case, the labourers, clearly lose in the bargain.

Decrease in γ implies, with the same amount of labour we can increase the production of capital. Therefore, with decrease in γ, it is natural that g_t goes up.

As to the effect of a change in z_L, s_L, μ and d on g_t, the mechanism is same as in section–3.6 of Chapter – 3, the meaning of results differ notwithstanding. With increase in z_L, s_L and μ, and decrease in d an excess supply arises in the bonds market leading to more investment, more growth, more saving and again excess supply in the bonds market. Hence, the second round effect. The process continues and converges.

If i goes up then both g_t and x_t go up (and π_t comes down). Here, g_t and x_t move in the same direction.

4.6 Post-Modernisation

After the whole land is completely modernised, the incremental capital goes for industry-sector only. Food output and hence, employment get stagnated. Nevertheless cloth output goes up. After a while the ultimate stagnation follows when the whole cloth sector gets modernised.

That is not to be, if technical change takes place in the food sector. If after the technical change the food sector requires more capital, as it generally is, then progressively more and more capital may go for agriculture until all the land is brought under the more modern technique. Our pre-modernisation model may start approximating the economy having this particular feature. So the model is in effect, more realistic than it appears at the first sight.

CHAPTER - 5

RESULTS, LIMITATIONS AND EXTENSIONS

5.1 Introduction

As we noticed, this is a macro-theoretic model to analyse the development process of developing countries. Inasmuch as time is involved for development to take place, our model represents a dynamical economic system. Different situations are conceived of, and theoretical insights, into the working of the economy at a disaggregated macro-level, are explored. The effects of policies of government including the choice of technique are studied in great detail.

To sum up, the distinguishing features of the model are:

(i) Labour is in excess supply in quantity and homogeneous in quality.

(ii) The capital good – or to be precise, the machine – is essential in production of consumer goods, it takes one period to be produced, and it is scarce. So, unlike Keynesianism, the present model recognises the potential of investment as the source of capacity creation in future.

(iii) Money and finance have been endogenised in the model to the extent possible and the importance of the creation of money by the government is duly recognised.

(iv) The production of capital good is a public monopoly.

(v) Private investment behaviour has been specified, though in a rudimentary form.

(vi) More than one technique have been introduced to study the choice of technique where the objective is to maximize growth and distributional parameters. For this purpose, two consumption good sectors, agriculture and industry, are introduced in Chapters 3 and 4.

(vi) Land as a scarce input has been introduced in Chapter – 4.

(vii) The government wields enormous power – through printing money, issuing bonds, imposing taxes and deciding about the public investment – to influence growth and distribution.

5.2 Issues Raised

The path of development is traced, given the behavioural, technological and policy parameters. The technological parameters, at times, can be considered as policy parameters if more than one technique of production is available in some sectors. In fact, choosing among the available techniques affects the objective function that reflects growth and distributional considerations in more than one way. Chapters 3 and 4 have been largely devoted to this crucial aspect of the problem. What is a better technique, for instance, the modern mill or the traditional handloom? Chapter-2 also hints at this problem. The government has instruments of the type, commodity taxation, printing currency, borrowing money and directly controlling the production of the crucial input capital. How these instruments affect our objectives? In other words, what are the parameter values that give rise to the desired growth and distribution? Since the production of capital is a public monopoly, the government can fix the price of capital or the quantity of investment. Like a private monopolist the government need not choose them both simultaneously. Hence, the study of public sector pricing policy has attracted our attention.

The taxation, deficit financing (defined as borrowing from the central bank), and raising the administered price (i.e. the pricing of capital) are ways of raising resources for the public sector. What is the best method of financing the public investment — any of the above mentioned instruments to be used or a linear combination of them? If the latter, then what is the combination?

5.3 <u>The Characteristics of the Results</u>

Broadly speaking, we find that the growth rate and the percentage allocation of capital to agriculture vis-a-vis industry, are positively related, that is to say both of them move in the same direction when any external shock is applied through parametric changes. For an increase in growth, the de-modernisation of industry is a better proposition. Precisely, what we mean by de-modernisation is that the output produced by the modern technique proportionate to the total output decreases. In Chapter -4, where we differentiate between two phases of development - before the full modernisation of land and after that -interestingly, we find that de-modernisation in industry takes place in the first phase. However, it is trivial to say that modernisation takes place in the second phase because by the time all land has been modernised, and therefore all the incremental capital goes to the industry sector.

In Chapters 1 and 3, we notice, quite surprisingly, that if a technique producing consumption good is inefficient in labour use, then growth performance of the economy improves. But maximal growth, if there is a real wage constraint, deteriorates. So unemployment, when real wage constraint is not binding, may force the economy to choose technically inefficient method of production, if growth rate maximization is the objective. However, the result is reversed for the capital good sector.

Increase in the tax portion of the public investment, generally speaking, improves growth and distribution. Currency creation also makes the economy to move in the same direction as commodity tax. Whereas, loosely speaking, the market borrowing for public investment worsens the situation. Financing the investment through a hike in the administered price is same as increasing the tax portion of the investment. This is true in the one-consumption-good model of Chapter-2. We find, certain situations might arise where the manipulation of administered price is ineffective as a policy measure.

Lastly, we notice, Harrod-Domar model is a special case of ours and Pasinetti Paradox also appears in our more generalised model.

5.4 Limitations

The demand functions of the private agents, in the economy, who demand goods and financial assets are purely price inelastic. The demand functions depend upon income only, and that too proportionally. Therefore the aggregate demands are also price independent insofar as their direct relationship is concerned. Prices and the interest rate affect only through their effects on generation and distribution of income.

Money wage rate is fixed in our model. It is a reasonable assumption for a short period. But when prices might rise continuously, in a steady-state or long run situation, this assumption seems to be untenable if we want be realistic.

The steady-state has its own limitations, but we are convinced that this is quite an appropriate assumption to examine the long run situation.

5.5 Extensions

The model sets forth a vista of research possibilities. It can be extended in many ways to capture more and more realism. A few possible directions in which some fruitful extensions of the model can be made are:

(i) A differential rental on essential and luxury goods can be imposed. It looks highly probable that this case may turn out to be equivalent to differential commodity taxes.

(ii) Uncertainty in the production of essential goods can be incorporated to caputre the facts of life in monsoon dependent economies like India. Then the question of storage policy can be raised here.

(iii) Strategic behaviour of the agents, for instance, the government in one side and the private agents on the other can be incorporated. The government may choose an optimal strategy as to its policy variable taking into account the optional response from the private agents.

(iv) Indexation of money wages to prices may be studied in detail. At the moment, one can think of two types of indexation.

The wage rate is a continuous function of the price. Or wage rate can be increased only if the real wage rate touches a given floor. Again, there migh be full indexation or partial indexation.

(v) We noticed in Chapter - 4 that the macro-balancing conditions, without any exogenous change, may generate fluctuations. This point need to be further explored and the results may have smilarities with the recently developed endogenous business cycle literature by Grandmont and others.

APPENDIX - 1

We derived a number of relations; equilibrium rate of growth, investment and the financial structure. Due to the simplicity of the model, we did not have difficulty in proving existence of such equilibria. We will now briefly discuss some problems relating to existence in this type of models involving capital goods.

Let us take the form of the model as it is developed in Chapter-2 with necessary modifications which would be pointed out as we proceed.

Two crucial assumptions in a general equilibrium model are: (1) the consumption sets are bounded below and (2) the technology set is bounded above, when non-producible inputs are fixed. Without these assumptions, it is possible to have a situation in which prices, income, demand and supply increase without limit. For example, if consumption set is unbounded from below (unlimited labour supply), as prices rise, labour supply can increase sufficiently to increase income. Similarly, if unlimited output of a good or asset can be produced using bounded inputs, the possibility of generating infinite incomes and suplies cannot be ruled out. An inconsistency will result, if we also insist that the price of the good or asset whose supply is unlimited must be positive.

In temporary general equilibrium models, the supply of money is assumed to be fixed. Production takes time and future prices are expected to be bounded in a stochastic sense (tightness of expectations). Thus, the demand for funds to purchase inputs will be very little, if the input prices (including the cost of borrowing from the bond markets) are sufficiently high. Hence, even when there is no restriction on the supply of bonds, the boundedness of future product prices leads to bounded supplies of other financial assets.

In our model, we cannot restrict the supply of money since one of the main purposes is to study the effects of monetary policies. We also cannot assume that producers expect product prices to be bounded, while input prices are rising. While such an assumption may be reasonable for the short run, it is not quite realistic for studying problems relating to investment and growth, which involves the long run or steady-states.

The difficulty in introducing capital, working capital in particular, in Walrasian general equilibrium models was clearly foreseen by Bohm-Bawerk and Wicksell. "Walras calls 'capital' and treats as 'capital' only durable goods, but not raw materials and half-finished products and not the means of subsistence of workers... It is therefore implicitly assumed by Walras that workers and other producers maintain themselves during production and receive remuneration for their productive services from the proceeds of the product in question only after the completion of the production. ... A necessary consequence of this is the peculiar fact that these equations of production and exchange can give no information at all about the level of the rate of interest".

Suppose there is a consumption good and a capital good. The technology is the same as in Chapter-2. Assume that $\alpha+\beta\gamma>1$. There are labourers and capitalists, but no government and no money. Capitalists supply bonds to raise funds for investment at a rate of interest. We are assuming $\delta = 1$, that means all the capital if used, depreciates in one period. So, here, investment means the spending on the working capital. So, $\beta\gamma$ is the working capital per unit of output. A bond is a promise to pay one rupee in the next period. (Note the difference in the definition here). Hence the price of a bond is $\frac{1}{1+i}$, where i is the rate of interest. Labourers supply a fixed amount $\bar{L}$ of labour services. The budget constraint for the labourers in a steady-state is

$$PQ^d + \frac{B^d}{1+i} = \bar{L} + B^d$$

where $p = \alpha + \beta\gamma(1+i)$ is the price of the consumer good, B^d is the steady-state demand for bonds and the wage rate is assumed to be fixed at one rupee.

The working capital requirement is $Q^s\beta\gamma$ where Q^s is the quantity of consumer good supplied. Hence

$$\frac{B^s}{1+i} = \beta\gamma Q^s$$

Let

$$Q^d = \frac{\bar{L}}{P} + \frac{P^{-(n+1)}i}{(1+B^d)(1+i)}, \quad n > 0$$

This demand function implies that the workers spend their wages and a fraction of the interest income on consumption goods. The rest they invest in producers' bonds. The question is whether $B^d = B^s$ for some p and i. We will show that such a pair (p,i) does not exist for some n. Suppose not. Then, for each n, there exists p and i such that the bond market clears. Then $Q^d = Q^s$ and $B^d = B^s$. Hence

$$\frac{B^d}{1+i} = \frac{P^{-n}}{(1+B^d)(1+i)} = \frac{B^s}{1+i} = Q^s\beta\gamma = Q^d\beta\gamma$$

$$\Longrightarrow \quad \frac{P^{-n}}{(1+B^d)(1+i)} = Q^d\beta\gamma$$

$$\Longrightarrow \quad \frac{P^{-n+1}}{(1+B^d)(1+i)} = PQ^d\,\beta\gamma = (\bar{L} + \frac{P^{-n}}{1+B^d} \times \frac{i}{1+i})\beta\gamma$$

Since $p = \alpha + \beta\gamma(1+i) > 1$, the left hand side of the equation above is arbitrarily small, for large n. But the right hand side is arbitrarily close to $\bar{L}$ for large n. Hence L.H.S. < R.H.S. for large n, a contradiction.

What, in effect, happens is very simple to notice. Excess supply in the bond market or excess demand on the commodity market becomes a permanent feature. That is for large n, irrespective of the value of p [Note p > 1], the markets remain in disequilibrium. When p rises via an increase in i for instance, to take care of the imbalance in the commodity market, demand, of course, comes down but not to the desired extent because income from interest sources goes up which pushes up the demand. This because B^d (= B^s) is not bounded from above.

It appears, at the first glance, that the steady-state is the main culprit here. In short-run situation, it may be worse if the financial assets are unbounded. Since capital is an input and it takes time to be produced, we need a dynamic set up. And, in that case, steady-state is the obvious choice. Time as an input in production, naturally, necessitates the lending-borrowing operation in financial assets. Therefore, the financial assets, the capital as input and the steady-state are rigidly linked in the model. Then one can easily decide what is responsible for the imbalance.

The financial assets, here, are mainly for the presence of capital in the model. Why people demand them is a separate issue. But, supply of them is there, because resources are needed for investment.

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