1.1 Introduction

This chapter tries to address two sets of issues, which are the following:

Capitalism in its classical form is a demand constrained system. The recognition of
this aspect of capitalism leads to the formulation of the characteristics and problems
under capitalism in a completely different perspective as compared to the neo-classical
theory, (which assumes full employment of resources or a supply constrained system).
So much so that Keynes at the time of writing General Theory, highlighting the
problem of demand constraint, himself thought that, his book will revolutionize
economics.\(^2\)

---

\(^1\) Kornai (1979)

\(^2\) I believe myself to be writing a book on economic theory which will largely revolutionize-not, I suppose at once,
but in the course of the next ten years-the way the world thinks about economic problems. --Keynes in a letter
written to Barnard Shaw in January 1935, Quoted from Kalecki and Keynes, printed in Robinson (1978)
The present chapter tries to examine the properties of capitalism being a demand constrained system. In this context both short run as well as long run problems are considered and it is observed that the problem of unemployment will exist in a demand constrained system.

Secondly, it must be noted that capitalism as an economic system has been "the carrier of the greatest economic progress ever witnessed in the history of the human race ...". The cornerstone of this economic progress has been the immense technological progress that capitalism entails compared to any earlier mode of production, a point which Marx and Engels noted in the Communist Manifesto. The question is: why does capitalism entail such improvements in the techniques of production? Is it the case that technological progress is incidental to the progress of capitalism, and is based entirely on scientific knowledge which has nothing to do with capitalism per se? Or is it the case that technological progress is essential for the development of the capitalist system? Does the fact of capitalism being a demand constrained system have any bearing on the issue of technological progress? What is the relation between technological progress and the question of unemployment? The various theories of technological progress will be discussed in trying to address these questions.

It is the purpose of this chapter to show that in a demand constrained system, involuntary unemployment must exist and theoretically there is no tendency under capitalism to spontaneously remove any growing unemployment. Secondly,
Chapter 1

it will be shown that technological progress under capitalism is essentially labour saving. Various theories will be discussed to arrive at these conclusions.

The chapter is arranged in the following manner. Section 1.2 discusses the existence of unemployment in a demand constrained system as a condition for the stability of capitalism. Section 1.3 examines the unemployment situation in the context of the long run dynamics of a capitalist economy. Section 1.4 reviews the literature on technological progress, particularly dealing with its impact on the issue of the absorption of labour reserves. Section 1.5 provides the main conclusions.

1.2. Unemployment Under Capitalism

1.2.1 Non-existence Of Unemployment In Neo-Classical Models: A Logical Fallacy

The question of existence of unemployment in the capitalist system is ruled out by the neo-classical models. This is because of the following:

The neo-classical model envisages a world of perfect wage price flexibility with perfect competition prevailing in all the markets with perfect foresight. In such a world, the wage price flexibility ensures that the economy attains full employment at a set of equilibrium prices. Equilibrium in the economy must also
entail an equilibrium in the money market which is ensured if the excess demand curve for money is negatively sloped with respect to its price or value, which is the same as the reciprocal of the price level. In other words, the demand for money must be a positive function of the price level in the economy. In such a world, the role of money as a means of holding wealth is ruled out, where the role of money is seen only as a 'medium of circulation'.

The assuming away of the role of money as a medium of holding wealth is however logically incorrect. This is because of the following. If money is held for circulation purposes then it has to be the case that it is a means of holding wealth. This can be expressed in the Marxian diagram of C-M-C. Here a commodity of value C is converted into money value of M to procure another commodity of value C. Now, the act of changing the first commodity into money and procuring the second commodity is not simultaneous. There is a time period, however short, in which the value is held in money form before the procurement of the second commodity. In this time period then money has to act as a medium of holding wealth.

This argument can be logically extended another step. Let us assume that for some reason, the first commodity is converted into money but is then held in money form without procuring the second commodity. In this case then, the C-M-C chain breaks down with the value being stored in the form of money, giving rise to the possibility of a problem of demand in the economy, with money acting as a medium of holding wealth.
1.2.2 Existence Of Unemployment In A Demand Constrained System

As soon as the role of money as a form of holding wealth is recognized, involuntary unemployment arising from deficient demand under capitalism becomes a possibility. This is because of the following. In a closed demand constrained system, investment is the main determinant of output and employment via the multiplier. The level of investment gets determined by the expectation of the capitalists about the future. With money existing as a means of holding wealth there is no reason a priori as to why the investment level in the economy should match with the level which attains full employment in the system.

It can however be argued that if the spontaneous working of the capitalist system cannot generate the full-employment level of investment, why cannot the state increase its investment expenditure and reach the full-employment level? This is not possible because, the state taking upon itself a social role normally reserved for the capitalists, by way of carrying out investments, is unacceptable to the capitalists, who see this act of intervention by the state as an intrusion into their domain. Moreover, with the attainment of full-employment, the disciplining device of capitalism, in terms of the threat to sack the workers, loses its potency, thereby unsettling the social and political institutions of capitalism. The analysis of Keynes and Kalecki, however, is restricted to the short run. If in every short period capitalism must entail a situation of unemployment, this essentially

---

2 Keynes (1937)
3 This was the essence of the Keynesian theory of unemployment.
4 Kalecki (1943)
implies that in the long run too, which can be thought of as a continuum of short periods, capitalism must have unemployment.

1.2.3 Existence Of Unemployment As A Necessary Condition For The Stability Of Capitalism

From the above discussion it is clear that capitalism being a demand constrained system essentially cannot generate full employment. This however is not the entire story. It can be argued that even if the demand constraint is overcome, capitalism cannot actually function without the existence of unemployment or what Marx called the 'reserve army of labour'. This is because of the following reasons:

(a) The reserve army of labour is essential for sustaining a positive rate of surplus value.

According to Marx, in a capitalist economy, with accumulation of capital, the demand for labour is likely to rise. Now, with the increase in demand for any commodity, the price of the commodity must increase, deviating from its value. This deviation of the price of any commodity from its value brings forth an increase in the production of the commodity in question. This happens because, with a rise in price, the producers of the commodity witness a rise in their profits which induces other capitalists to enter the industry and increase the supply of the commodity, leading to a fall in the price of that commodity until it equals the value of a commodity is derived from the labour theory of value, which is to say that the value of a commodity is the socially necessary labour time required to produce the commodity. For detailed exposition of Marx's labour theory of value, see Marx (1887) and also Sweezy (1942)
value of the commodity.

With constant accumulation of capital under capitalism, there is a constant increase in the demand for labour. If the supply of labour does not adjust to this rising demand, then the price of labour, i.e., the wage rate will rise. Now, according to Marx, capitalism in order to survive must produce surplus value which is appropriated by the capitalists. The surplus value under capitalism is the difference between the value of labour power and the value added by the use of that labour power. Thus, with the rise in the price of labour power, the surplus value gets reduced. If there is no mechanism to ensure that the price of labour power comes back to its value, (or in other words, the supply of labour does not adjust to the rise in its demand) then capitalism cannot survive, since with accumulation of capital, wages will rise to a point that will eliminate the entire surplus value. Then the question is: what ensures that the supply of labour adjusts to the rise in demand to ensure that there is a positive surplus value under capitalism?

According to Ricardo, when the price of labour (or the wage rate) exceeds the 'natural price' (which in the Ricardian theory is the subsistence wage), in consequence of the accumulation of capital, then the conditions of the labourers improve, whereby their population increases. This brings down the wage rate, since the supply of labour increases compared to the demand for it. This fall in the wage, if it continues, results in a decline of the population. The lower wage rate however also leads to more accumulation of capital, which increases the
demand for labour. This in turn gives rise to a situation where the higher capital accumulation and the concomitant demand for labour outstrips the supply of labour (population), which again results in higher wages and the circle continues. Thus, in the long run, wages are kept at the subsistence level by the change in population, where movements are governed in a manner conforming to the Malthusian theory of population. According to Ricardo then, the supply of labour adjusts to demand through a change in the population of the labourers, which keeps the wage at a level which is commensurate with a positive surplus value.

Marx however rejected this theory of population on the following grounds. According to him, the above mentioned theory of population essentially entails a situation where the capital accumulation has to basically adjust, in the short run, to the population of the workers. Moreover, the time taken for any adjustment in total population to change the wages as envisaged by Ricardo would be too long for the capitalists to remain in operation. In Marx's words “Before, in consequence of the rise of wages, any positive increase of the population really fit for work could occur, the time would have been passed again and again, during which the industrial campaign must have been carried through, the battle fought and won.”

Thus, according to Marx, the capitalists cannot depend on the natural movement of the population for carrying out their production plans. They have to have their

---

1 [it] pretends to make the action of capital dependent on the absolute variation of the population... Marx (1887) page: 637
2 Marx (1887) Page: 637
Chapter I

own reserve army of labour, which consists of primarily the unemployed, underemployed, semi-employed people and those engaged in the environs of capital who are willing to move over to capitalist employment in response to demand. With capital accumulation at a fast rate, the capitalists can recruit labour from the reserve army who are waiting to get employment even at the prevalent wage rate. If capital accumulation reaches a stage where the reserve army diminishes, wages would rise, creating a fall in the rate of capital accumulation and thereby recreating the reserve army. Hence the movement of the wages is determined by the size of the reserve army which is again dependent on the rate of capital accumulation. Therefore we see that it is not the absolute number of workers that determine the wage rate but the proportion of workers divided between the active and the reserve army which ensures that the wage level is maintained strictly within limits where the capitalists can obtain a positive rate of surplus value. Thus reserve army then is "the lever of capitalistic accumulation, nay, a condition of existence of the capitalist mode of production." 

(b) The reserve army brings in flexibility in the capitalist system enabling investment decisions to be directed anywhere without facing labour shortage.

(c) It ensures a minimum discipline of the workers in the production process.

---

10 The general movement of wages are exclusively regulated by the expansion and contraction of the industrial reserve army, and these again correspond to the periodic changes of the industrial cycle. Marx (1887), page: 637
11 Marx (1887), page: 632
necessary for capitalism's functioning.

(d) The existence of the reserve army ensures the stability of the wage unit, which in turn stabilizes the value of money in a fiat money world.

According to Keynes, the stability of the value of money depends on the fixity of the money wage. In the absence of this fixity of the money wage, there cannot be any stability in the capitalist system.\textsuperscript{12} In order to ensure this fixity of money wage, the existence of unemployment is required. In other words, the existence of unemployment is essential for the stability of capitalism.

To see this, let us take the realistic case and suppose that the workers are organized in trade unions demanding higher wages and the capitalists are oligopolists who are "price makers". In this case, the workers and capitalists bargain for a share of the total output produced in the economy. Now, the share of output that the workers succeed in getting is a positive function of the employment rate in the economy. Therefore, higher the employment rate, higher is the share of the workers. Given this, if the share of the capitalists does not match their ex-ante claim then they will increase the price, consequent to which the workers will increase their wage claim, thereby resulting in inflation. The inflation will be accelerating once the workers begin to anticipate it, jeopardising the stability of the capitalist system. There exists an unemployment rate at which the ex-ante claims of the workers and the capitalists add up to one, which

\textsuperscript{12} Keynes (1936), Chapter 17
Chapter 1

Corresponds to the so-called Non-Accelerating Inflation Rate of Unemployment (NAIRU). At this rate, the capitalist economy will witness steady inflation and unemployment.\textsuperscript{13} Thus in order to ensure steady inflation or a steady share of profit in output, there has to be some unemployment in the system. Moreover, it is not even the case that the capitalist economy will actually reach the NAIRU spontaneously\textsuperscript{14} in which case there will be accelerating inflation together with unemployment, provided the unemployment is below NAIRU. Hence, the reserve army must be sufficiently large to ensure a degree of price stability (in the sense of steady inflation) in the system.

From the above discussion it is clear that capitalism as a demand constrained system must witness unemployment. Moreover, the existence of unemployment under capitalism is essential for the stability of the system. Let us see how the different "mainstream" traditions in economics have approached this question of the existence of unemployment under capitalism in a dynamic context.

1.3 Unemployment In A Dynamic Context

1.3.1 Instability In A Demand Constrained System: The Harrod Model

In the last section we have seen that typically capitalism is a demand constrained system. In such a system, the output at any period is determined by

\textsuperscript{13} Patnaik, P (1997a)

\textsuperscript{14} Patnaik, P (1997a)
the autonomous investment through the multiplier. If we however consider the capitalist economy in the long run, then investment has another role, which is of adding to the capacity of the productive system.

Harrod’s model takes this dual role of investment into account and shows that the equilibrium growth path of a capitalist economy is inherently unstable.

In Harrod’s model, the equilibrium growth path is such that planned investment must equal planned savings.\[ I=S \]

Therefore, in all periods,\[ I=S \]

\[ I=S \]

Now,\[ I=S \]

\[ \Rightarrow \frac{I}{K} = \frac{S}{K} \]

\[ \Rightarrow \frac{S}{Y^{C}} \cdot \frac{Y^{P}}{K} = S \beta \theta_{0} \]

where, \( K \) = capital stock, \( Y^{C} \) = output at the desired level of capacity utilization, \( Y^{P} \) = full capacity output

\[ S = \frac{S}{Y} \] is the constant savings ratio in the economy.

\[ \beta = \frac{Y^{P}}{K} \] , is the engineering output capital ratio. In other words, this is the technologically possible output capital ratio that can be obtained in the economy.

\[ \text{Hahn & Matthews (1964)} \]
That is to say the full capacity output that can be obtained with the capital stock \( K \) is \( Y^p \).

\[ u_0 = \frac{Y^c}{Y^p} \]

denotes the desired level of capacity utilisation. This desired level of capacity utilisation on the part of the capitalists, has the following logic. The capitalists may not sustain full capacity output, which is technologically feasible but have some un-utilized capacity to meet a sudden change in demand.

If the rate of growth of capital stock planned by the capitalists happens to be equal to \( s \beta u_0 \) then the economy will be in equilibrium in any period. Since, when the economy is in equilibrium, the rate of growth planned for the next period will be the same as in the current period, it follows that if the growth rate is \( s \beta u_0 \), it will persist. This is the warranted rate of growth \( g_w \) equal to \( s \beta u_0 \), which has the property that if the economy is growing at the rate of \( g_w \) then it continues to do so.\(^{16}\) This is because at this growth rate of output, planned savings and investment equalise for the economy. At the same time, the capitalists' plan in terms of a desired level of capacity utilisation is also fulfilled.

While \( g_w \) gives the equilibrium growth rate, the actual growth rate may differ from it. This is because, the economy need not be on the warranted growth path, ie, the warranted growth path has no stability property which is shown in the following.

\(^{16}\) This is one way of representing the warranted growth rate of the Harrod's model. For alternative representations of it, see A.K. Sen's Introduction and Harrod's article in Sen (1970) and also see Hahn and Matthews (1964).
Let $g_t$ be the actual growth rate in the economy at the period $t$.

If $g_t < g_w$ then the capitalists will see that the actual capacity utilisation is less than the desired level. This they will perceive as being symptomatic of a lack of effective demand in the economy and hence will cut back on investment compared to what was essential for maintaining $u_0$. This will however result in a reduction of the output through the multiplier, which will lower $g_t$ still further and lower $u_0$ even below what it was earlier. The economy in subsequent periods therefore will continuously move away downwards from the warranted growth path. Hence, if $g_t < g_w$ then $g_{t+1} < g_t$.

If $g_t > g_w$ then the capitalists will find that the actual capacity utilisation is more than the desired level. This they will perceive as a higher level of demand in the economy than what they expected. Hence the capitalists will invest more to install more capacity. This will result in an even higher actual growth rate, than what prevailed earlier. Hence if $g_t > g_w$ then $g_{t+1} > g_t$.

Thus it is seen that if there is slight deviation from the warranted growth rate, the economy moves further away from this growth rate. Hence in a demand constrained system the growth path is necessarily unstable. This is Harrod's knife-edge instability problem.

The second major problem focused in Harrod's model is the long run problem of equating the warranted rate of growth, with the natural rate of growth of the
economy determined by the rate of growth of labour supply, which is equal to \( n + m \), where

\[ n = \text{natural rate of growth of labour force}. \]

\[ m = \text{rate of growth of labour productivity}. \]

If \( g_w = g_t = n + m \) then, the economy continues to grow at this rate, with a constant rate of unemployment in the long run. However, if \( g_w = g_t < n + m \), then, the economy experiences persistent increase in unemployment.

If \( g_w = g_t > n + m \), then the economy will hit the full-employment ceiling. Once it does so, the economy cannot continue to grow at the warranted growth rate due to labour shortage. In other words, the actual growth rate of the economy has to come down. In this case then, the economy will cumulatively move away from the warranted growth path\(^{17}\) in a downward direction, resulting in growing unemployment.

Now, in Harrod's model, there are essentially two kinds of instabilities. One is the problem of the actual growth rate equalling the warranted growth rate. If this is not the case, then the economy cumulatively moves away from the warranted growth path, resulting either in an ever increasing growth rate or in the reduction in growth rate to zero. Secondly, even if the actual growth rate in the economy, equals the warranted growth rate, there exists no reason a priori for the equality between Harrod's warranted rate of growth and the growth of labour in efficiency units. Therefore, left to itself, the economy, according to

\(^{17}\) Introduction by A.K. Sen in Sen (1970)
Harrod, has little chance of steady growth with constant unemployment. It must either face growing unemployment or labour shortages, subsequent to which the problem of unemployment will again resurface. Left to itself, therefore, a capitalist economy, as characterised by Harrod, has no inherent spontaneous mechanism to get rid of the problem of growing unemployment.

1.3.2 Models Representing Capitalism As A Stable System Showing Full-Employment And Their Fallacy

As opposed to the basic instability property of capitalism as enumerated in the Harrod Model, many other models were formulated to challenge Harrod's conclusion of instability in a capitalist system. On the one hand, there was a neo-classical response to the Harrod Model, starting with the Solow Model. On the other hand, there were some Marx inspired models which also arrived at the conclusion contrary to what Harrod had argued. In this section we analyse one model each of the above mentioned genre, the Solow Model and the Goodwin Model and show that there are basic logical problems with both these models.

The Solow Model

The Solow model tries to counter both the instability problems of Harrod. The model by assuming full-employment, assumes away the long run problem of Harrod, in terms of growing unemployment or labour shortage. The economy by assumption is always at full-employment with a smooth production function and capital-labour substitution for cost minimizing firms. On the other hand, neo-
classical growth theory starting with Solow, assumes away the problem of knife-edge in Harrod by assuming that full employment savings are always invested. It assumes that there is no autonomous investment function, but there is factor price flexibility and substitution. 18

Under the above mentioned assumptions and the assumption of a CRS production function, the basic result of the Solow model is that the rate of growth of output is determined by the exogenously given rate of growth of labour in efficiency units, thereby overcoming the instability problem of the Harrod model, in terms of a divergence between the warranted rate of growth and the natural rate of growth. This result, in the mainstream literature on growth theory is provided as a conclusive proof that capitalism as a system is essentially stable, where problems of unemployment or labour shortage as envisaged in the Harrod model do not arise. According to this view, the instability property of Harrod is a result of the rigid assumptions of non-substitutability of the factors of production, rather than any inherent instability under capitalism. This however is incorrect because of the following reasons.

Given that the future is uncertain and money can be held as wealth, it cannot be assumed like Solow that the full employment savings will always be invested, and that there exists no autonomous investment function. As soon as it is the case that there exists an autonomous investment function with money as a form of holding wealth, there is no condition which can actually ensure that the

---

18 Dutt (2001)
warranted growth rate is achieved and equal to the natural rate of growth. The Harrodian instability then is not a result of any particular restrictive assumption of Harrod, but a result of the inherent logic of capitalism being a spontaneous anarchic system, where the savings and investment decisions are separately taken in an uncoordinated manner. Secondly, the stability of the Solow model is crucially dependent on the flexibility of factor prices. This is also not a tenable assumption; as has been shown by Keynes, the stability of the capitalist system is crucially dependent on the fixity of the money wage. Moreover, the assumption of the existence of a production function is not logically tenable since a production function postulates a homogeneous capital good which is simply unrealistic.19

**The Goodwin Model**

The same result of the capitalist economy's growth rate getting tethered to the natural rate of growth of labour force is also obtained in the Goodwin model.20 Goodwin discussed the relationship between the size of the reserve army and accumulation. When accumulation increases at a fast rate, the reserve army of labour gets used up. This results in an upward movement of the real wage rate, which decreases the profit rate and hence the rate of accumulation. With the decrease in accumulation, the reserve army increases pushing down the real wage rate and increasing accumulation. Thus in the long run, the economy according to the Goodwin model settles down at the natural rate of growth of

---

19 Sen (1970)
20 Goodwin (1969)
labour force with constant unemployment.

However, there are a number of problems in this model. Firstly, like the Solow model there is no autonomous investment function in Goodwin, thereby assuming away the existence of any demand constraint which is a characteristic feature of capitalism. Secondly, in Goodwin, the wage bargains are in real terms and not in money terms, which is unrealistic. In a paper money world there is no reason why a movement in the money wage must necessarily imply a movement of the real wage in the same direction. Thus, even with a higher money wage claim of the workers, the real wage might not increase; and likewise with lower money wages, real wages may not come down, in which case the mechanism of adjustment of the Goodwin model breaks down.

Thus it is seen that since the capitalist economy is demand constrained, there is no mechanism in capitalism which can ensure that the system can reach full-employment or arrest any tendency of experiencing growing unemployment. The neo-classical theories postulating full employment or models akin to the Goodwin model postulating a constant unemployment rate in the capitalist economy assume away the demand constraint which is a characteristic feature of a capitalist economy.21

1.3.3 Explaining Sustained Growth In a Demand Constrained System

The problem of demand constraint characterising capitalism not only precludes

---

21 Kornai (1979)
any possibility of ensuring a constant unemployment rate, but also gives rise to other sets of problems. Kalecki (1962) proved that in a system characterized by demand constraint, there is no explanation of sustained growth only through endogenous factors.

Let us ignore depreciation for simplicity and postulate the investment function of the capitalists as follows:

$$(\frac{I}{K})_{t+1} = (\frac{I}{K})_t + b(u_t - u_0)(\frac{I}{K})_t, \ b > 0$$

$$i_{t+1} - i_t = b(u_t - u_0)i_t$$

where $i_t, i_{t+1}$ are the aggregate net investment per unit of capital stock at time $t$ and $t+1$

$u_t=$capacity utilisation at the $t^{th}$ period and $b$ is a constant.

Now, $u_t = \frac{O_t}{O_{t'}}, \frac{O_t}{K_t} = \frac{I_t}{sK_t} = \frac{i_t}{s\beta}$,  

$$O_t = \text{output at period } t$$

$$O_{t'} = \text{potential output at period } t.$$ 

Thus from (a) we have,

$$i_{t+1} - i_t = b(\frac{i_t}{s\beta} - u_0)i_t$$

An equilibrium is possible only when,

$$\frac{b_i^2}{s\beta} = b_i u_0$$

This has two solutions:

22 The investment function is taken from Patnaik, P (1997a)
The second solution is the Harrod's warranted growth rate, while the first one is the stationary state. Kalecki showed that if growth is only due to endogenous factors, then while Harrod's warranted growth represents an unstable solution, the zero growth rate point is stable. He then argued that it is most likely that the economy, if sustained by endogenous stimuli alone, will actually settle down at the stationary point. Thus, sustained growth in a capitalist economy cannot be explained by endogenous stimuli alone. Kalecki in order to explain sustained growth in a capitalist economy introduced exogenous stimuli by changing the investment equation to the form:

\[
\left(\frac{I}{K}\right)_{t+1} = \left(\frac{I}{K}\right)_{t} + b(u_{t} - u_{0})\left(\frac{I}{K}\right)_{t} + \varepsilon
\]

\(\varepsilon\) denotes the external stimuli to invest.

There are three kinds of external stimuli that have been mentioned in the literature:

1. **Government expenditure:** The state can step in to the economic arena and undertake investments or public expenditures generally to ensure sustained growth. This was historically evident when during the post war period of the so called Golden Age of capitalism, the developed capitalist countries had to step up government
Chapter 1

expenditure, to follow Keynesian demand management policies.

2. **External Markets:** The second source of external stimuli is the capture of external markets. Rosa Luxemburg emphasised the role of external markets for capitalist economies to maintain growth in the long run. The advanced capitalist economies exploited the colonial markets both for appropriating the surplus of these economies and also as a market for their finished products.

3. **Innovations:** Innovations are said to happen when an invention is put into production process. If there is an innovation then by adopting this a higher profit can be gained. So, capitalists invest in the new innovation over and above their planned investment. In an imperfect market too, this additional investment increases the profit at the going wage rate by reducing the costs, without a change in price. Even if prices are reduced, capitalists who have introduced the innovation earn a higher profit margin. So others will also invest in the new innovations thereby increasing the overall investment in the economy. This external stimulus of innovations in terms of explaining the growth in a capitalist economy was propounded by Schumpeter, who did not see capitalism as a demand constrained system; it was also emphasised by Kalecki.

As a result of introducing this external stimulus in the investment function, a
positive trend rate of growth can be explained.

1.3.4 Reformulating The Problem Of Unemployment Under Capitalism

Being A Demand Constrained System

The above discussion shows that sustained growth under capitalism cannot be explained by endogenous stimuli alone. On the contrary, the growth rate of output is determined by the strength of the exogenous stimuli. Now, growth rate of employment depends on two factors, the growth rate of output and the growth rate of labour productivity. Moreover, the growth rate of labour productivity is a function of the growth rate of output as has been pointed out by Kaldor. Therefore, we can write the growth rate of employment according to the following equation:

\[ g_e = g_y - g_p \]

Now, \[ g_y = g(\epsilon) \], where \( \epsilon \) is the external stimulus

Again from Kaldor we know that

\[ g_p = f(g_y) = f(g(\epsilon)) \]

Therefore, the growth rate of employment can be written as follows:

\[ g_e = g(\epsilon) - f(g(\epsilon)) \]

The growth rate of employment given by the above formula therefore is dependent on the growth rate of output which is dependent on the strength of the external stimuli. If as a result of the external stimuli, the growth rate of output is higher than that of labour productivity then employment growth will be positive. There is however no reason as to why this should necessarily be the
case. In other words, even with external stimuli it might so happen that the growth rate of employment does not increase while that of output increases. Even if the rate of growth of employment is positive there is no reason \textit{a priori} as to why this will equal the natural rate of growth of labour force. If there is no such mechanism to equalize these growth rates, capitalism must be facing secularly rising unemployment or be constrained by labour shortages, in which case the above model will break down. The case of labour shortage is however difficult to imagine since the rate of growth of output also increases the rate of growth of labour productivity, thereby pushing out the labour shortage ceiling. Even so, the general conclusion is that there is no in built mechanism under capitalism which can ensure that the economy does not witness growing unemployment or labour shortage.

As has already been mentioned, the existence of external stimuli is essential for explaining sustained growth in a demand constrained capitalist economy. One of the external stimuli as has been already mentioned is technological progress or innovations. In the next section we look at the different theories of technological progress and derive conclusions regarding the impact of technological progress on the absorption of labour reserves.

1.4 Theories Of Technological Progress: A Review

This section is concerned with the economics of innovations and technological progress, which have been regarded as exogenous stimuli for growth of the
capitalist system. The main thrust of the present section will be two fold. Firstly, the discussion will try to enumerate how different theories of technological progress view the relation between technological progress and the question of absorption of labour reserves. Secondly, the various theorisations of technological progress regarding its role in the functioning of a capitalist economy will also be analysed.

Solow's model postulates that the rate of growth of the economy is tethered to the sum of the natural growth rate and the growth rate of labour productivity, which is exogenously determined, having nothing to do with the growth process of the economy per se. In other words technological progress is like 'manna' falling from heaven.\(^2\)

The treatment of technical progress as 'manna falling from heaven' views technical progress as something unrelated to the economic processes. Karl Marx however underlined the importance of technical progress as intrinsic to capitalism, as essential for it to survive and flourish. At the same time, in the Marxian theory, technological progress played a key role in producing unemployment or the reserve army of labour. We now take a look at the theory of technical progress as proposed by Marx.

1.4.1 Marx's Theory Of Technological Progress

Marx emphasised technical progress as a weapon in the competition amongst

\(^2\)Matthew & Hahn, (1964)
capitalists. In order to survive in the Darwinian struggle in which they are engaged, the capitalists are driven to lower the cost of production or increase the productivity of labour to sell cheaply and reap additional profits. This is achieved according to Marx by employing machinery on a larger and larger scale in the production of commodities. This entails a substitution of living labour by accumulated labour. This according to Marx results in the production of a relative surplus population or the reserve army of labour. This is because of the following reason. In the Marxian scheme, the introduction of machinery essentially means that the value expended by the capitalists on constant capital increases relative to variable capital. This entails a situation where, the organic composition of capital increases. In other words, with technological progress, "the demand for labour lags behind the growth of total capital." 24

The capitalist competition drives the capitalists to cheapen their products through the introduction of machinery. The cheapening of the commodities necessarily entails introduction of machinery on a larger and larger scale. Only the big capitals can function on such large scales. Therefore in the course of capitalist development, the small capitals are driven out of their business, a phenomenon that Marx called centralisation of capital. In this manner, with capitalist accumulation, larger and larger masses of capital, formed through centralisation of capital, employ relatively smaller masses of labourers, perpetuating the reserve army.

24 Sweezy (1942)
Chapter 1

Ricardo And Marx On Machinery

At this point it is worthwhile comparing the Ricardian theory of machinery with that of Marx. It was pointed out by Ricardo that with the introduction of machinery some workers will become redundant in the industry where the machinery is introduced. For the society, the introduction of machinery will release purchasing power through a lowering of the prices of the commodities. Moreover, with the introduction of machinery, the fund that was earmarked for the workers, who were thrown out of jobs, will be "in no degree impaired"25 thus ultimately re-employing the displaced workers.

Contrary to Ricardo, Marx pointed out the following26: Firstly, machines are not only introduced only in sectors where the capitalist mode of production is dominant. It is also introduced in those where this is not the case. For example the introduction of power looms destroyed the hand loom and weaving industry, where the capital "employed by the hand-loom weaver, hand spinner etc. has ceased to exist."27 Secondly, even assuming that the machinery is introduced in the capitalist sector, it is not necessarily the case that the fund released as a result of the redundancy of the erstwhile employed workers will employ them. This is because the fund thus released will not be necessarily employed by the capitalist as wages. Rather it will get converted into constant capital, in the form of machines again or in the form of raw materials thus increasing the demand for machines and raw materials. This increased demand for machines and raw materials. This increased demand for machines and raw materials.

25 Quoted in Marx (1978) page: 553
26 This discussion is based on Marx (1978), Chapter XXVIII
27 Marx (1978) page: 556
materials does not necessarily translate into employment because of the following: since 1840 the production of machines themselves became highly dependent on machines and therefore became capital intensive, thereby precluding the employment of the redundant labour from other branches of industry into the machine building sector.\textsuperscript{28} Again, the raw material producing sectors' increased demand need not employ the displaced people since here too, introduction of machines takes place which reduces the demand for labour or the raw materials can be imported from another country, in which case it will have no impact on the demand for labour in the country where the machine has been originally introduced. Thirdly, if it is the case that as a result of the decrease in prices, (resulting from the introduction of machinery), the demand for the existent commodities increase or the released purchasing power is expended on some new branches of industry, (provided that it is not expended in imports), the demand for labour will rise. However, it is highly improbable that the same set of workers will get the jobs. At the same time the jobs that will be available must be of lower wages.\textsuperscript{29}

Ricardo, however realized the mistakes in his formulations regarding the question of machinery, particularly the fact that the capital released as a result of the redundancy of labour (resulting from the introduction of machinery), will not necessarily be forwarded as wages. However, as long as a part of the surplus value is re-invested the demand for labour will increase. But this demand for labour will be relatively diminished, with the capital accumulation being at a

\textsuperscript{28} Marx (1847)

\textsuperscript{29} Marx (1847)
faster rate than the demand for labour. However, Ricardo assumes that with sufficient capital accumulation, the problem of redundancy of labour will be solved. To quote Ricardo,

"a portion of the people thrown out of work in the first instance, would be subsequently employed; and if the increased production, in consequence of the employment of the machine, was so great as to afford, in the shape of net produce, as great a quantity of food and necessaries as existed before in the form of gross produce, there would be the same ability to employ the whole population, and, therefore, there would not necessarily be any redundancy of people."\(^{n30}\)

This however will be the case only if the introduction of machinery is a one shot affair, assuming away any problem of demand. If however, it is the case that technological progress under capitalism is a continuous process with continuous introduction of machinery (which according to Marx is the case), then in every period, a portion of the labour force becomes redundant, which cannot be completely absorbed through a higher rate of accumulation of capital since, even before that process is completed another round of technological progress is introduced which makes another set of workers redundant. Thus according to Marx, the reserve army of labour is perpetually existent under capitalism, which is reproduced in every period through the spontaneous working of the capitalist system.

---

\(^{n30}\) Ricardo, On Machinery. Quoted in Marx (1978) page: 553
Chapter 1

The concept of technological progress in Marx is not only confined to the production of the reserve army. It also points to a deeper issue which is the following:

According to Sweezy's interpretation of Marx,\(^{31}\)

\[
p = \frac{s}{c+v} \\
q = \frac{c}{c+v}
\]

where, \(p\) = rate of profit
\(s\) = surplus value
\(c\) = constant capital
\(v\) = variable capital
\(q\) = organic composition of capital

From the above two equations the following can be deduced:

\[
p = \frac{s}{v} \cdot \frac{v}{c+v} \\
\Rightarrow p = \frac{s}{v} \cdot (1 - \frac{c}{c+v}) \\
\Rightarrow p = s'(1 - q)
\]

where \(s' = \frac{s}{v}\) is the rate of surplus value.

Now, we have seen that with technological progress, the organic composition of capital \(q\) rises. Thus from the above formula, it can be said that for a given rate of surplus value, technological progress leads to a falling tendency of the rate of

\(^{31}\) Sweezy (1942)
profit. Marx however mentioned a number of counteracting forces which resist the falling tendency of the rate of profit.\(^{32}\)

Thus from the above discussion it is observed that according to Marx, with technological progress the reserve army of labour is continually reproduced which at the same time results in centralisation of capital and a tendency for the rate of profit to fall.

Schumpeter's theory of technological progress and innovations takes the idea of the entrepreneurial function of the capitalists from Marx\(^{33}\), so much so that Schumpeter has been christened as 'bourgeois Marx'.\(^{34}\) Even then, Schumpeter's understanding of capitalism and technological progress was in some respects diametrically opposite to that of Marx, as will be evident from the discussion below.

1.4.2 Schumpeter's Theory Of Innovations

Schumpeter starts from a stationary state describing the circular flow.\(^{55}\) Starting from there, Schumpeter visualizes the development of the economic system as a "rupture of the circular flow."\(^{36}\) This rupture from the circular flow is brought

\(^{32}\) For an exposition of these counteracting forces see Sweezy (1942)

\(^{31}\) Bagchi (1989a)

\(^{34}\) Alternative Approaches to a Theory of Economic Growth: Marx, Marshall and Schumpeter, in Chakravarty (1993)

\(^{36}\) Schumpeter (1961)

\(^{56}\) Alternative Approaches to a Theory of Economic Growth: Marx, Marshall and Schumpeter, in Chakravarty (1993)
about by the introduction of innovations or what Schumpeter calls “new combinations” in the economic system. The question is who carries out these “new combinations”? According to Schumpeter, the innovations are carried out exclusively by new firms, where entrepreneurs foresee a positive profit by introducing innovations and hence innovate in order to reap those profits. With the introduction of the innovations, positive profit is gained. Other entrepreneurs similarly invest in the new process and gain profit, thus taking the economy to a higher level of output, under the assumption of full-employment. Once the profits from the new innovation become zero with the innovations getting generally adopted by other entrepreneurs, the economy again returns to the stationary state, but at a higher level of output. In order for the economy to come out of this, a fresh round of innovations needs to be introduced. This theory essentially postulates innovations as the main engine of growth in a capitalist economy. Since, entrepreneurs are the ones, who innovate, Schumpeter regards this class as essential for the growth and development of a capitalist economy.

Both Marx and Schumpeter emphasise the role of technological progress in the capitalist economy. However, there are immense differences between the two theories, which are enumerated below: as has been pointed out by Sweezy (1943), in order to introduce innovations it is not necessary that there must exist the sociological category of an entrepreneur; what is needed is a society with capitalist relations of production. Sweezy argues that profits exist in a capitalist society even without innovations where the urge to accumulate results in...

---Schumpeter (1961), Chapter 2
innovations; while in Schumpeter, profit results from innovations due to the activity of the entrepreneurs. In other words, profits for Schumpeter is a category not dependent on the property relations existing in the society. Rather profit is generated in Schumpeter's theory as a return for the innovativeness of the entrepreneurs who identify an opportunity for carrying out an innovation, and introduce it. On the other hand, Schumpeter's argument lacks a theory of class as anybody having the talent to innovate can do so and become an entrepreneur.

Marx had emphasised that in order to introduce an innovation the capitalist must possess a minimum amount of capital. Schumpeter however does not believe so. Instead he assumes that the banks will give credit to the entrepreneurs to undertake the innovations. But the banks do not give credit to anybody who lacks a minimum amount of prior capital, a point which Schumpeter does not take into account.

Schumpeter's theory was a theory of full-employment with no possibility of unemployment existing in the system. In the Marxian theory, as we have already seen, technological progress recreates the reserve army of labour, which is absolutely essential for maintaining the stability of the capitalist system.

This idea that technological progress can generate unemployment with a rise in the productivity of labour has been elucidated by Kalecki.\textsuperscript{38} Kalecki considers a

\textsuperscript{38} Kalecki (1941)
reference system which is the same as the actual system with technical progress except for the fact that the labour productivity does not rise and the ratio of productive capacity to capital does not fall in the reference system. Kalecki proves that all variables in the reference system will be the same as in the actual system except for the fact that technical progress with rising labour productivity will result in more unemployment in the actual system. At the same time, Kalecki also showed that with technological progress, there is an increase in the degree of monopoly in the system.

Lange however pointed out that the impact of technological progress or innovations on the output or factor use will depend on the structure of the market in which the innovation is introduced. Let us analyse Lange’s theory in details.

1.4.3 Lange’s Theory Of Innovations

According to Lange, “Innovations are such changes in production functions, i.e., in the schedules indicating the relation between the input of factors of production and the output of products, which make it possible for the firm to increase the discounted value of the maximum effective profit obtainable under given market conditions.” With the introduction of the innovations, profits of the innovating firms increase. If there is perfect competition with free entry then this increase in profit of the innovating firm results in entry of other firms in the market. This entry of firms continues until the profits of the firms come to zero. This is

\[97\] Lange (1943)
achieved by an increase in the output of the industry as a result of the entry of the firms in the market. Therefore, under perfect competition and free entry, any innovation results in an augmentation of the total output. The effect of this innovation on the demand for factors cannot be deduced conclusively, it can move in either direction.\footnote{Lange (1943)}

The situation is different in the case of an oligopolistic market. In an oligopolistic market, the market behaviour of a firm depends on a conjecture regarding what its rivals will do in the market. The basic assumption is that if the firm increases the price, then its competitors will not do so, hence it will lose the market. On the other hand, if it decreases the price, then all other firms do so, thereby ensuring that the market share is maintained for all. In this case then, the firms face a kinked demand curve in the market. As a result, the marginal revenue curve becomes discontinuous. This is shown in the following figure:
In the diagram, the kinked demand curve is given by the line MPD. As the price is increased, the firm loses a greater share of the market since no other firm does so. However, when the price is decreased, every other firm does so, thereby the firm gets a lesser share of the market. Thus, the kinked demand curve is elastic in the upper portion and inelastic in the lower. The broken line MM' shows the marginal revenue curve, while the curve MC shows marginal cost curve in the initial position. The equilibrium in this market is reached when the MC curve passes through the discontinuous portion of the MR curve\textsuperscript{41}, at price ON and quantity OQ.

Suppose now an innovation is introduced in the market, whereby the marginal cost curve shifts downwards to MC'. In this case, the output of the firm will not change since the MC curve is still within the broken part of the MR curve and hence the same price and quantity is maintained. Thus, this innovation under oligopoly does not increase the output. However, in this case, the innovation must be factor-saving, since the marginal cost has reduced. Thus, under oligopoly, innovations are generally factor saving and not output-increasing.

\textbf{1.4.4 The Concept Of Neutral Technological Progress}

Let us now revert to the story where technological progress occurs regularly at a steady state. In the simplest version of such technological progress, it is taken as exogenous, like the Solow model. Here technological progress is said to be

\textsuperscript{41} At this point profit is maximised because if output is less than OQ, MR>MC hence output is increased. If output is greater than OQ, then MR<MC and hence output is lowered. Hence, even when $MC \neq MR$, still profit will be maximized at this point.
occurring, if with the same combination of inputs, more output is produced. However, in such models it is assumed that full-employment prevails in the economy. Therefore, the possibility of existence of unemployment as a result of technological progress is simply ruled out. Even so, these theories recognize the fact that with technological progress there occurs some alteration in the balance between labour and capital. The concept of Neutral Technological Progress tries to capture, according to various criteria, if after technological progress the balance between the labour and capital remains unchanged, in some sense.\textsuperscript{42} We briefly present the different criteria mentioned in the literature.\textsuperscript{43}

**Hicks Neutral Technical Progress**

According to this criterion, with technological progress, if for a given capital-labour ratio, the ratio of marginal product of labour to marginal product of capital remains unchanged, then the technological progress is said to be Hicks neutral.

The production function for any exogenous technical progress is written as follows:

\[ Y = f(K, L, t) \]

where, \( K, L, t \) have the usual meanings.

If the technological progress is Hicks neutral then the production function must be of the form:

\textsuperscript{42} Hahn & Matthews (1964)
\textsuperscript{43} The following discussion is based on Hahn & Matthews (1964)
Chapter 1

\[ Y = A(t)f(K, L), \]

where, \( A(t) \), is an increasing function of \( t \).

Hicks neutral technical progress compares two points on the production function, before and after technical progress, given a particular capital-labour ratio. Now, this ratio does not remain constant with technological progress but rather increases, a point also noted by Marx. Therefore, neutrality of the technological progress will always remain an unsolvable phenomenon. Hence another criterion of neutrality was evolved which is the following:

**Harrod Neutral Technical Progress**

According to this criterion, technological progress is neutral if for the same capital-output ratio, the rate of profit remains unchanged before and after the technical progress. Harrod Neutral technical progress therefore is necessarily associated with a reduction in the amount of labour per unit of capital.

The production function for Harrod Neutral Technical Progress is as follows:

\[ Y = f(K, A(t)L), \]

where, \( A(t) \), is an increasing function of \( t \).

Harrod Neutral technical progress is essential for the economy to have steady state growth path (Hicks Neutral technical progress may also be associated with steady state, but only when it also happens to be Harrod Neutral as well, for example in the case of a Cobb-Douglas production function). If the technical
progress is not Harrod neutral, then there is no way that this steady state path can be reached. However, as has been discussed above, this entails an increase in the capital labour ratio, without a rise in the capital-output ratio. Moreover, from the production function it is clear that Harrod Neutral technical progress actually entails an increase in the productivity of labour, where if earlier two persons were required to do a particular job, now one person can do the job of two. In this sense it can be said, even if there is Harrod neutral technical progress, in terms of maintaining a constant rate of profit, the technical progress even in this case is actually labour saving, with the productivity of labour increasing as has been discussed above.

The foregoing discussion on technological progress brings out the following points; Firstly, introduction of technological progress is a result of the competition among the capitalists, as has been mentioned earlier. Secondly, in this competition capitalists employ technological progress which is mainly labour saving in nature. Even in the case of Harrod neutral technological progress it was evident that the technical progress envisioned was essentially labour saving. But in steady state equilibrium under neo-classical economics, with the assumption of full-employment, this increase in labour productivity is not associated with any unemployment, since it is assumed that there is always full-employment in the economy.

The discussion so far has pointed out that technological progress and innovations

---

21 Hahn & Matthews (1964)
are essential for the growth of capitalist economy and a result of the competition among the capitalists, the neo-classical models being an exception in this regard, where technological progress is considered to be exogenous. At the same time, it has been pointed out that with technological progress, the productivity of labour increases. Marx had pointed out that technical progress is a result of the immanent laws of capitalist competition to maintain the market share. In this sense, Marx views technical progress as endogenous to the capitalist growth process. The present day endogenous growth models also try to endogenize the rate of growth and the rate of technical progress. Let us now turn to these models, to understand how technical progress is viewed in the endogenous growth models.

1.4.5 Endogenous Growth Models

The models of endogenous growth start with the so called AK model, in which, $Y=AK$. This function implies that output can be increased indefinitely, without experiencing diminishing returns and output cannot be increased by increasing labour. In its intensive per worker form, this equation can be written as follows:

$$y = A k$$

If it is assumed that a constant fraction 's' of output and income is automatically saved and invested, then, we can write:

$$\frac{\dot{k}}{k} = sA - n \quad \text{with } sA > 0,$$

this gives the constant rate of growth of $k$ and $y$.\(^{45}\)

The AK model assumes away smoothly diminishing marginal productivity of

\(^{45}\) Dutt (2001).
capital. Secondly, the model does not entail full-employment of labour, since labour is not productive in this model.  

Many of the endogenous models are based on this AK model. We will now have a closer look at various endogenous models.

**Rebelo Model:** There are two sectors, one producing capital goods and the other producing consumption goods according to the technology:

\[
K = I = A(1 - \varphi)K \\
C = B(\varphi K)^a L^{1-a}
\]

The first equation denotes the capital good sector and the second one denotes the consumption goods sector. \(\varphi\) is the endogenously determined share of existing capital used in producing \(C\).

As \(\varphi\) is determined endogenously, the growth rate of capital \(\frac{K}{K}\) also gets determined endogenously within the I sector where

\[
\frac{K}{K} = A(1 - \varphi)
\]

If \(\varphi\) is constant, then the rate of growth of capital is a constant.

All other sectors where the capital good enters as an input, with diminishing returns, adjust to this growth rate through the fall in the relative price of capital.
Lucas Model: This model is similar to the above model. Here instead of physical capital, human capital is produced by the technology

\[ H = \delta (1 - u) H \]

\( u \) is the share of human capital time devoted to the production of final good.

Final output is produced by physical and human capital by the technology:

\[ Y = AK^{\beta} (uH)^{1-\beta} H^\gamma \]

\( H^\gamma \) is an Arrow type external effect generated by the aggregate level of human capital in the society.

As in the Rebelo model, \( u \) is endogenously determined due to which the growth rate of \( H \) is endogenously determined.

\[
\frac{K}{K_k} = \frac{1 - \beta + y}{1 - \beta} \frac{H}{H} = \frac{1 - \beta + y}{1 - \beta} g_h
\]

Through this equation, the growth rate of capital gets determined. As \( g_h \) is determined endogenously, \( g_k \) gets determined endogenously too.

Both of the above models do not provide an endogenous theory of technical change as such. They postulate two sectors in the economy and endogenise the rate of growth.

---

\(^{47}\)Das Gupta (1996)
Romer Model: The earlier models stressed upon the accumulation of physical and human capital as the source of growth. Romer (1990) presents a model where growth is an outcome of inventing increasingly productive techniques and not of accumulation as such.

Romer assumes that the stock of human capital is fixed at a constant level $\bar{H}$ over time. Thus growth in this model is not due to accumulation of human capital as in the Lucas model.

The production of final goods is given by:

$$Y = H^a \int_0^A x(i)^{1-a} \, di$$

$H_r$ = Human capital employed in producing $Y$

$x(i)$ = Quantity of the $i^{th}$ variety of special input.

$A$ = cardinality of a continuum of existing varieties.

In the model, the object of research is to have the $i^{th}$ idea embodied in the input $x(i)$. With progress in research $A$ increases, expanding the set of ideas and specialized inputs.

If all $x_i$'s is used at the same level $x$ we have: $Y = H^a_s A x^{1-a}$.

In Romer's model a design has the characteristic of a public good. This acts as disincentive for research as a private activity. Therefore, Romer assumes a monopolistically competitive market structure for $x(i)$ backed by patents. But the total body of knowledge is a free input into new research.
The technology for research is given by $\dot{A} = \delta A H_A$, $H_A$ is the amount of human capital employed in research. In the steady state, $H_A$ and $H_Y$ are constant. Thus $\frac{\dot{A}}{A}$ gets determined which determines the growth rate of output. So growth is sustained endogenously by more research.\footnote{Solow, (2000)}

All the above models have one crucial assumption of a linear technology that generates endogenous growth. As has been argued by Solow (2000), if the technology of $K$, $H$ or $A$ is not linear then there would not be any endogenous growth.

**Grossman and Helpman Model:** This model, like that of Romer is a model of endogenous growth driven by intentional research activity. They assume that resources are invested in order to develop unique goods. Innovations exploit limited monopoly power in the product market. It is shown in the model that endogenous growth results from introduction of newer varieties of goods in the market. Here again, it is seen that the result of endogenous growth depends on the assumption of a linear relationship between stock of knowledge capital and the total number of commodities. This assumption of a linear relationship according to Solow (2000) almost assumes the existence of endogenous growth and brings in artificiality into the model.

The models discussed so far do not take into account the phenomenon of

\footnote{Solow, (2000).}
obsolescence. Aghion and Howitt construct a model where they take into account
the disincentive to research because of obsolescence. They assume that the
arrival time of a new input is not known with certainty. Thus the model
discusses the determination of the expected growth rate in the model. Here again
the assumption of proportionality between the productivity in period \( t+1 \) and
productivity in the period \( t \) is crucial to generate endogenous growth. It is
assumed that \( \frac{A_{t+1}}{A_t} = \gamma \), where \( A \) is the productivity parameter, which leads to the
result of endogenous growth. Solow (2000) shows that without this assumption
the model cannot explain long run growth.

Apart from the problems mentioned earlier, these models assume that labour in
the form of skilled human capital and non-skilled labour are freely mobile
between sectors such that they can be allotted between sectors according to the
need. But this assumption is highly unrealistic. If there is a bottleneck due to
which the firms do not get the required amount of human capital then the
research activities will be stalled by the firms. Secondly, even with research it is
not clear as to why firms will go for better methods of production in terms of
product diversity while the earlier equipments have not given the prospective
return. In fact, Baran and Sweezy (1966) argue that in case of monopoly
capitalism, if new processes displace old, then they will not be employed unless
the cost savings are very substantial, since the returns from the old processes
will not accrue to the firms.
Chapter 1

All these theories are essentially micro theories based on certain behavioural assumptions, which are advanced for a theory of long run growth. The literature has no theory for the macro-economy, and interprets the microeconomic theory as a theory for the economy. Moreover, the theory like the exogenous growth theory relies heavily on the assumption of a production function, which has been criticised severely by the Cambridge school.\(^{49}\)

One of the basic assumptions of all the models has been the assumption of full employment (except the AL model) and the non-existence of an autonomous investment function. In this sense all the models (including AL) are supply constrained. But capitalism has been typically a demand-constrained system with unemployment and the instability problem mentioned by Harrod. All these models assume away the problem posed by Harrod.

Theories of endogenous growth and technical change, postulate technical change taking place due to growth of human capital or research to invent increasingly productive techniques, or to produce unique goods in a monopolistic market to reap monopoly profits. In these models any problem of unemployment is assumed away.

However, the model by Aghion and Howitt (1994) explicitly take the issue of unemployment into account while postulating an endogenous growth theory. According to this model, growth rate of the economy arises from the introduction

\(^{49}\)Fine (2000) makes this argument in criticising the endogenous growth theories.
Chapter 1

of new technologies that require labour re-allocation for their implementation. The basic argument of the model being that with introduction of technology and increase in the growth rate, a worker who was earlier employed in a machine loses his job because of obsolescence. Given this, and the vacancies in the economy, there exists a search unemployment where, the re-matching of the worker and the machine needs time. Explicitly speaking, the unemployment rate of the economy becomes a decreasing function of the growth rate, given a fixed number of vacancies. On the other hand, the growth rate of the economy results in profits for the firms which in turn induce other firms to enter the market, which under certain conditions leads to an increase in the number of vacancies in the job market, by creating more jobs. Now, with the increase in the number of vacancies, unemployment rate of the economy decreases. At the same time, a faster rate of growth implies a faster introduction of new technologies, which deters prospective entrants from entering into the market, thereby reducing the number of vacancies which otherwise would have been created and therefore increases unemployment. What the actual effect of growth rate will be on the level of unemployment, depends upon the parameters of the model. Specifically, the model, unlike the earlier discussed endogenous growth models, does generate a positive rate of unemployment.

While the Aghion & Howitt (1994) model, does provide for a positive rate of unemployment even in steady state, the unemployment is a result of the problem of matching with machines of appropriate vintages, assuming away the problem of demand. Secondly, the adverse effect of a higher growth rate on unemployment
is dampened by the assumption of free entry. But as has been argued by Kalecki (1941) technical progress through the concentration of capital results in increase in the degree of oligopoly, which will further reinforce the unemployment increasing effect of the growth rate.

Apart from the endogenous models, two other models analysed the causes of technical change in 'learning by doing'. We now turn to a discussion of these models.

1.4.6 Theories Of Learning By Doing

As opposed to the exogenous theory of technical progress, the theories of learning by doing emphasise the point that productivity depends on the economy's capacity to learn.

Arrow's theory of learning is a significant step towards endogenising the rate of technical progress. According to this theory, productivity increases over time depend on learning or accumulation of experience of the labour force. Workers become more adept at their work with time, as they become more used to the machines and gain experience. This stock of experience is not necessarily of one worker but the stock of experiences of workers as a collective. This stock of experience depends on the cumulative capital stock of the economy. The larger the magnitude of capital stock, the greater is the efficiency of the work force.

In the Solow model, the production function was given by, $Y = F(K, A(t)L)$ Arrow
expresses the coefficient of labour augmenting technical progress as being linked to the aggregate capital stock in the economy. Thus,

\[ \Lambda(t) = K(t)^{\alpha} \alpha > 0 \]

Now, in Solow's model, we have,

\[ \frac{k}{k} = \frac{\dot{K}}{K} \frac{\dot{A}}{A} \frac{\dot{L}}{L} \]

Since, \( A = K^\alpha \)

\[ \frac{\dot{A}}{A} = \alpha \frac{\dot{K}}{K} \]

At the steady state the above equation can be written as:

\[ \frac{k}{k} = (1 - \alpha) \frac{\dot{K}}{K} - n = 0 \]

This implies that, \( \frac{\dot{K}}{K} = \frac{n}{(1 - \alpha)} \) under Arrow's assumption of diminishing returns to learning, \( 0 < \alpha < 1 \), this gives the steady state growth rate of capital.

While Arrow also assumes full-employment, the theory throws light on the fact that the accumulation of knowledge through learning is an externality of the increased capital stock. More the capital stock in the economy more is the capacity to learn which is not restricted to one firm but to the economy as a whole.

Arrow's theory treats technical progress as an automatic outcome of the process of accumulation. In another model of similar nature, Kaldor and Mirrlees (1961) treat the rate of growth of productivity as a function of rate of growth of
investment per man. They discard the concept of production function and instead postulate the technical progress function which shows the positive relation between productivity growth and growth of investment per man. Learning is hence made a function of the rate of growth of investment rather than of the integral of gross investment.

According to this model, technical progress has two elements: an autonomous increase in ideas and the adoption of these ideas through learning. Through more investment, currently available ideas are better explored.\(^{50}\)

The model postulates that the growth of labour productivity is a function of the growth rate of investment per man. It is akin to the famous Kaldor Verdoon law, which also postulates the growth rate of manufacturing leading the growth rate of productivity. The model’s focus on growth rate of investment responsible for growth in productivity suggests that the model visualises the growth rate in productivity as a result of expenditure flows, in the form of investment expenditures. The productivity increase is postulated as a function of the investment expenditure. While other expenditures, like R&D, promote innovations, the fact that this model stresses on the expenditure approach stresses the point that the economies which have less potential to undertake innovation promoting expenditures\(^{51}\) will be technologically backward. But it also

\(^{50}\) Hahn & Matthews (1964)

\(^{51}\) Innovations consists of generation of new technologies and its incorporation into the production process. At every stage expenditure needs to be incurred, consisting of R & D, training the workforce etc. All these expenditures are regarded as innovation promoting expenditures. (Patnaik, P, 1997a)
needs to be stressed that two economies having the same growth rate in investment per man may experience different impact on the overall innovations of the two countries. This is because the country which has better infrastructure and more sophisticated production structure will be able to be on a higher innovation trajectory. If we index the infrastructure and the production structure by the aggregate capital stock in the economy, then with identical expenditure, the country with more capital stock will be on a higher plane in terms of innovations.\textsuperscript{52}

1.4.7 Exogenous Stimulus In The Form of Technological Progress: How Strong Is It?

The foregoing discussion on technological progress shows that the growth process of the capitalist economy depends crucially on it. However, the discussion while starting from the issue of technical progress being an exogenous stimulus to invest ultimately boiled down to the fact that technological progress could actually be taken as endogenous as in Marx or the endogenous growth models. So, what is the correct approach in terms of this issue?

It can be fairly assumed that the availability of new technology and its adoption are two different processes. Innovations entail adoption of new technologies for production purposes. The rate of the adoption of new technologies depends on the growth rate of demand, the per capita income of the masses etc. Moreover, with a higher growth and higher profit, the innovation promoting expenditures or the

\textsuperscript{52} Patnaik, P (1997a)
expenditure on research might actually increase thereby affecting the rate of generation and adoption of new technologies.\textsuperscript{53} Therefore, the view that innovations or technological progress are an entirely exogenous stimulus for growth in a capitalist economy does not appear to be a very convincing one, except perhaps in the case of what Baran and Sweezy called "epoch making" innovations. It can rather be argued that the external markets play a much more important role in terms of explaining the growth process in a capitalist economy. The importance of external markets for explaining the growth process of capitalism will be discussed in the next chapter.

1.5 Conclusion

The discussion of the present chapter shows that capitalism being a demand constrained system cannot generate full-employment. Moreover, in the long run, the growth process of capitalism is highly unstable, where no mechanism exists to arrest any tendencies for growing unemployment in the system. All the models, which show that capitalism can function at full-employment with stability assume away the problem of demand constraint which is a characteristic feature of capitalist economies. At the same time, it was also seen that technological progress under capitalism is essentially labour saving. If it is the case that capitalism as a demand constrained system has no theoretical mechanism through which increasing unemployment can be arrested, how is it the case, that capitalism has not witnessed any such increasing unemployment?

\textsuperscript{53} Patnaik, P (1972)
Moreover, in a system characterised by demand constraint, there is no endogenous stimulus to explain sustained growth under capitalism, it needs exogenous stimuli for sustained growth. Innovations or external markets can provide such exogenous stimuli. In case of innovations, it was seen, that technological progress under capitalism was essentially labour saving in nature, which in the absence of high rate of growth of output can generate unemployment. At the same time, it was also shown that innovations cannot be considered an adequate external stimulus for explaining sustained growth under capitalism. Rather, the external market play a more important role in explaining the growth process under capitalism, an issue which will be taken up in the next chapter.