PROFIT-LED GROWTH IN A DEVELOPING ECONOMY:

A DEMAND-SIDE ANALYSIS

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MASTER OF PHILOSOPHY

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CERTIFICATE

This is to certify that dissertation entitled "**Profit-led Growth in A Developing Economy: A Demand-side Analysis**" submitted by me in partial fulfillment of the requirement of the degree of **Master of Philosophy** of Jawaharlal Nehru University is my original work and has not been previously submitted, in part or full, for award of any other degree of this University or any other University

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We recommend that this dissertation be placed before the examiners for evaluation.

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Chapter 1

Introduction

Over the past three-four decades, most of the developing countries in the world have given up the strategy of import-substituting industrialization. Instead they have embraced a more or less universal set of economic policies, mostly under the pressure of loan-conditional structural adjustment programmes imposed by the IMF and the World Bank, referred to by critics as the neo-liberal policy regime. Neo-liberal policies are economic policies aimed at liberating the economy from any kind of government intervention so that market forces can operate freely to achieve allocative efficiency and the economy is increasingly integrated with the world economy.[1]

Many economists argue that these policies have resulted in a worsening of income distribution, increase in poverty and decline in the purchasing power for the majority of the population in these developing economies as they entail cuts in goverment expenditure, tightening of monetary policy and labour market reforms.[2] Although we are in agreement with this argument, our

[1] Stiglitz (2008)

[2] For example Patnaik, U. (2003) and Bhaduri (2010)

concern in the present work is not to evaluate the performance of neo-liberal economic policies in developing countries. The question that we raise here is the following: How is it that some of these economies, which are witnessing a contraction in the real income of majority of the popuplation and which are failing to maintain current account surplus consistently, are growing at high rates instead of stagnating?[3]

Consider the Indian economy for instance. India started neo-liberal economic reforms in 1991 and is often applauded in various quarters for its gradual approach. It has registered for most of the last decade very high rates of growth of GDP and is considered one of the emerging economic powers in the world. Nonetheless in the post-reform period there has been an increase in inequality in the country. Sen and Himanshu (2004) show that economic inequality in all aspects have risen sharply during the 1990s. According to the UNDP Human Development Report (2010), the relative share of wages in income declined by upto five percentage points between 1990 and 2008.

There is a huge debate on the estimation of poverty for the post-reforms period in India. In fact even within the government there is no consensus about the poverty estimates. The Tendulkar Committee report of 2009, using Rs 446.68 for rural areas and Rs 578.80 for urban areas (per capita per month) as the poverty line, estimated that 41.8 per cent of the rural population and 25.7 per cent of the urban population were below the poverty line in 2004-05. On the other hand the National Commission for Eenterprises in the Unorganised Sector (NCEUS) in 2007 had estimated that average monthly

[3]Brazil, Egypt, India, Mexico and South Africa have experienced such a growth process between 1990 and 2010. Source: World Economic Outlook Database, April 2011, IMF

per capita expenditure of 77 per cent of the total population was below Rs 20 per day in 2004-05. Sen and Himanshu (2004) argue that poverty reduction in India recieved a setback in the first decade of post-reform period. Given the plethora of poverty estimates one can safely assume that atleast one-third to one-half of the Indian population lives under the conditions of utter impoverishment.

At the same time, despite the rapid growth in GDP and high levels of the investment-GDP ratio, there has not been much job creation in the organised sector of the country during the last decade. According to the Economic Survey of the Government of India (2010-11) the total employment in the organised sector has fluctuated between 264.43 lakhs to 279.6 lakhs in the period 2000-2008, indicating very sluggish employment growth in the organised sector.[4] Bhaduri (2008b) terms such a growth process accompanied by heightened misery for the poor and joblessness (due to increasing labour productivity) in the formal or the organised sectors of the economy as 'predatory growth'.

Throughout the post-reform period India has not been able to maintain a trade surplus.[5] Moreover after the enactment of the Fiscal Responsiblity and Budget Management (FRBM) Act in 2003, it has become a formal policy goal of the government to keep a check on government expenditure so as to keep the share of goverment deficit in the GDP below specified limits.[6]

[4] The highest figure (279.6 lakhs) is for the year 2000 and the lowest (264.43 lakhs) is for the year 2004.

[5] Government of India (2006 and 2011)

[6] With the enactment of this act the central government set a target of completely eliminating the revenue deficit by 2009 and of reducing the fiscal deficit as a percentage

Aggregate demand in the economy is the sum of total consumption, investment, government expenditure and the surplus of exports over imports, i.e., the trade surplus. Clearly the high growth rates of output that the Indian economy has registered for the most part of the last decade is neither due to increasing goverment expenditure nor due to increasing trade surplus.[7]

Patnaik (2007) succintly sums up Kalecki's argument as to why an economy, where both budget deficit and trade surplus are negligible, may be expected to stagnate if the profit share rises. Suppose for the moment, the poor are the wage earners and the rich are the profit or surplus earners. According to Kalecki, investment in any given period depends upon decisions taken earlier. If the poor do not save then in that period, investment generates savings out of profit equal to itself in the equilibrium. Assuming that the rich consume only a fixed proportion of the profit, the fixed level of investment then determines the level of profit. Now if the profit share is fixed by Kalecki's 'degree of monopoly' then the level of investment also determines the level of output. However if income distribution worsens and the profit share increases, due to a rise in the 'degree of monopoly' then in the equilibrium, the output level must be less than what it would be when there is no change in the income distribution. And if investment decisions depend on the level of demand, then this fall in output will bring a fall in investment in the next period.

Kalecki (1971), commenting on the debate between Tugan-Baranovsky and Rosa Luxemburg on the possiblity of expanded reproduction in a closed capitalist economy, observed that government's budget spending and technolog-

of the GDP to 3 percent by 2008. See Government of India (2005).

[7]Patnaik (2007)

ical innovation are two channels through which these economies could escape stagnation. Increase in government spending as long as it is more than the increase in taxes increases the level of demand in the economy by increasing the budget deficit. However we need not focus on the government spending part of Kalecki's argument because the policy regime in the economies that concern us, emphasizes on keeping a check on government spending.

According to Kalecki, technological innovation or progress not only leads to obsolesence of old machinery and plants leading to their replacement by new ones but also provides a strong stimulus for investment by opening up new investment opportunities. In fact he argued that the impact of a steady stream of innovations on investment is comparable with the impact of a steady increase in profit because both give rise to "certain additional investment decisions".[8] However he also emphasized that despite this demand-stimulating nature of technological innovation, there is no guarantee that the degree of utilization of resources stays at a constant level.

Pasinetti (1983) points out another aspect of technological innovation. If technological progress raises labour productivity then either wages or profit must increase. This increase in the income of either wage earners or profit earners or both, as the case may be, forces them to take decisions regarding how they are going to spend the increase in income. Specifically, with increasing income, demand for evey commodity does not increase proportionately. If demand for every commodity does not increase in a proportionate manner then the composition of both consumption demand and investment demand keeps changing as a result of technological change.

[8]Kalecki (1969), pp. 58

In developing countries like India technological change can happen simply through imitation of foreign production techniques. Increasing inequality can induce changes in the composition of demand and technological change in the economy instead of technological progress inducing changes in income distribution and composition of demand. According to Patnaik (2007), the richer section of the population in these countries aspire for a consumption standard that is comparable to the consumption standard in the advanced countries. As their income increases because of a worsening of the income distribution, they are more in a position to afford commodities available in the advanced countries. This increase in the demand for goods available in the adavanced world gives the domestic firms an incentive to invest in the production of these goods by imitating the production techonology.

Patnaik (2007) calls this simultaneous change in the composition of demand and investment along with change in technology (due to imitation) caused by a tilting of the income distribution in favour of the rich, 'structural-cum-technological' change in the economy. A rapid rate of 'structural-cum-technological' change allows economies like India to escape stagnation despite worsening of the income distribution, despite not much growth in government expenditure and negative trade surplus. At the same time, he argues that the production technology of the new goods, demanded by the rich as their income increases, are more labour saving. Therefore as more and more of such goods are introduced, the labour productivity of the economy increases. Thus the economy can experience increasing growth rate of output along with decreasing growth rate of employment. However his model predicts that this growth process is highly volatile and any sufficiently strong negative shock to investment which pushes the rate of growth of investment below its equilibrium rate of growth can lead the economy straight into stagnation.

Bhaduri (2008b) argues that 'predatory growth' is fuelled by the expanding market for goods and services demanded by the rich in the economy as inequality worsens. The rich demand a set of commodities which is beyond the reach of the rest of the population. Most of them are luxury goods in nature, with income elasticity greater than unity. As a result, due to growing inequality, when income of the rich increases the demand for the commodities consumed by the rich expands faster than the growth in their income. This causes a change in the the production structure of the economy as producers find it more profitable to invest in the production of goods consumed by the rich. Thus both in Bhaduri (2008b) and Patnaik (2007), the rapid growth in consumption by the rich, which accompanies increasing incomes resulting from a worsening of the income distribution, is the driving force which generates the process of 'predatory growth'.

The results of our analysis in this dissertation show that as long as the rich in the developing countries aspire to emulate the consumption standards of the advanced countries and this provides new investment opportunities to producers, the economy can experience, under certain conditions, steady and stable growth in profit, investment and output even without worsening of income distribution. On the other hand, if there is exogenous worsening of income distribution then the economy can experience a process of 'predatory growth' where profit and investment growth at constant equilibrium rates along with increasing rates of growth of output and labour productivity and declining growth rate of employment. Thus we present a model of profit-led growth in developing countries in which 'predatory growth' arises because of 'structural-cum-technological' change suggested by Patnaik (2007) and the exogenous worsening of the distribution of income induced by changes in the policies of the government.

We argue that the aspiration of the rich in developing countries to emulate the consumption standards of the advanced countries, increases their consumption when more of the goods already avialable in the advanced countries find their way into the market. In a two-class closed economy model where rich are profit earners and poor are wage earners, we assume that consumption out of aggregate profit increases not only when the level of aggregate profit goes up but also when the rate of introduction of new luxury goods in the economy is faster. The rich in the economy are assumed to consume only luxury goods which are basically goods developed and initially available only in the advanced countries and among the luxury goods they are assumed to consume more of new luxury goods than the old ones. Following Patnaik (2007) we assume that the production techniques of the more sophisticated newer luxury goods are more labour saving. Therefore as additional luxury goods are introduced at a faster rate, the labour productivity of the luxury goods sector also increases at a faster rate. In the model we use the rate of change in the labour productivity of the luxury goods sector to proxy the rate of introduction of new luxury goods in the economy.

The rate of introduction of new luxury goods in the economy (proxied by the rate of change in the labour productivity of the luxury goods sector) also serves as the link between investment and the changing composition of demand of of the richer section of the population in our model. If the rate of introduction of new luxury goods in the economy is more rapid, new opportunities for investment for domestic producers arise at a faster rate. Given the nature of consumption of the rich in the economy, all firms would like to invest more and more in the production of the new luxury goods and the lower the cost of imitating the foreign production techniques of these goods greater the positive effect on the level of investment in the economy.

A higher growth rate of aggregate profit has two implications in our model. One, the income of the rich increases at a faster rate because of which they can now afford to consume more sophisticated or relatively more high-end goods available in the advanced countries and second, domestic producers find it easier to meet the cost of imitating the foreign production techniques of the luxury goods. Technological change in the luxury goods sector is therefore endogenously induced by the growth of aggregate profit as high growth rates of aggregate profit make it more profitable to introduce more sophisticated luxury goods in the economy. Since production techniques of the new luxury goods are more labour saving, we capture the the process of technological change in the luxury goods sector using a 'technical progress function' which makes the growth rate of labour productivity in the luxury goods sector an increasing concave function of the growth rate of aggregate profit.

The 'technical progress function' for the luxury goods sector along with changes in the demand of the richer section of the population following from growing incomes can together result in a process of 'structural-cum-technological' change in the economy even without a change in the distribution of income in favour of the rich. This 'structural-cum-technological' change in the economy is capable of generating steady and stable (locally stable) growth in aggregate profit, investment and labour productivity in the luxury goods sector. In the absence of any change in the income distribution, output grows at a rate equal to the steady growth rate of aggregate profit.

If technological change is absent in the sector (or sectors) producing commodities consumed by the rest of the population then along the steady growth path of aggregate profit, the growth rate of labour productivity in the overall economy declines and approaches zero. This is because as labour productivity in the luxury goods sector increases at a constant rate while that in the rest of the economy remains constant, the employment share of the luxury goods sector continuously declines. This must be the case because as long as the income distribution in the economy remains constant, aggregate profit, the wage bill and aggregate output grow at the same rate. And therefore one can expect that the output share of luxury goods sector increases only when there is an increase in the income share of the richer section of the population.

A declining growth rate of labour productivity in the overall economy implies that the growth rate of employment increases along the steady growth path of aggregate profit. This gain in employment however, is entirely due to the absence of technological change in the sectors producing commodities for the poor. As the growth rate of labour productivity in the overall economy approaches zero, the growth rate of employment approaches the constant growth rate of aggregate profit along its steady growth path. Since the wage bill grows at a constant rate equal to the equilibrium growth rate of aggregate profit, the growth rate of real wages must decline when the growth rate of employment increases and approach zero as the latter approaches the equilibrium growth rate of aggregate profit.

As already mentioned, Bhaduri (2008b) coined the phrase 'predatory growth' to describe a process of economic growth where investment and output grow at high rates but at the same time there is worsening of income distribution and joblessness (particularly in the organised sector) in the economy. The neo-liberal policy regime include policy measures which increases the profit share in the economy. Therefore in developing countries which replaced the policy paradigm of import substituting industrialization with the neo-liberal policy regime, it is important to take into consideration the impact of policy induced changes in income distribution on the growth process. The introduction of neo-liberal policy regime in place of the policy paradigm of import substituting industrialization entails policy changes like relaxing regulations constraining private investment and mergers and acquisition, adoption of labour reforms, reduction in taxes on corporate profit, privatization of state run enterprises, etc. These policy changes can increase the share of profits because they tend to increase the 'degree of monopoly' in the economy.

In countries like India, where the neo-liberal policy regime was introduced in a gradual fashion, the implications of changes in income distribution caused by the change in the policy paradigm assume more significance than say in countries like those constituting the erstwhile Soviet Union, where the neo-liberal policy regime was introduced through what is known as 'shock therapy'. When a change in the policy paradigm occurs gradually like in India, one can think of periods of time when pro-reform policy changes are given a thrust (resulting into a worsening of income distribution over those periods) and other periods when these policy changes are held back (and therefore there are no policy induced changes in the distribution of income in those periods). There can also be periods when, because of popular pressures, the government is forced to introduce policy measures which induce improvement in the distribution of income. Some policy measures related to employment guarantee programmes or minimum wages, for example, can improve the distribution of income by decreasing the 'degree of monopoly' in the economy. The nature of the growth process in economies, where the policy paradigm is changed gradually, can be expected to different in different time periods depending upon the nature of government policy and its impact on the distribution of income.

In our model we assume that the distribution of income changes only as a result of government policy measures. We then study the impact of such exogenous changes in the distribution of income on the growth rates of output, labour productivity and employment along the equilibrium growth path of aggregate profit and investment generated by 'structural-cum-technological change in the economy. We can assume that the equilibrium growth path of aggregate profit and investment is independent of such changes in the distribution of income as long as the later do not have any independent direct impact on consumption of the rich and aggregate investment but influence these only indirectly through changes in the level of aggregate profit.

We show that output grows at an increasing rate along the equilibrium growth path of aggregate profit in periods in which there are policy induced changes in the distribution of income irrespective of whether such changes increase or decrease the profit share. This allows for the possibility of both *exhilarationist* and *stagnationist* growth in the economy. In periods along the equilibrium growth path of aggregate profit when a policy induced exogenous increase in the profit share results in an increasing growth rate of output, the growth process is *exhilarationist.* On the other hand in periods along the equilibrium growth path of aggregate profit when a policy induced exogenous decrease in the profit share results in an increasing growth rate of output, the growth process is *stagnationist. Exhilarationist* and *stagnationist* growth in our model depend on whether the government's policy measures result in the worsening or the improvement of the income distribution rather than the relative sensitivities of the investment and savings functions to the profit share as in the case of *exhilarationist* and *stagnationist* growth regimes in Bhaduri and Marglin (1990).

In both periods of *exhilarationist* and *stagnationist* growth the behaviour of growth rates of labour productivity and employment in the aggregate economy is ambiguous along the equilibrium growth path of aggregate profit. This is because, in contrast to the case when income distribution remains constant, policy induced exogenous changes in the distrbution of income change the share of luxury goods sector's output in the total output of the economy. Nonetheless we show that as long as the output share of luxury goods sector increases at constant or increasing rate as result of increase in the profit share, the growth rate of labour productivity for the overall economy increases, under certain condtions, along the equilibrium growth path of aggregate profit. This increase in the growth rate of labour productivity for the overall economy can cause a decline in the growth rate of employment along the equilibrium growth path of aggregate profit. Thus in periods of *exhilarationist* growth, the process of economic growth can be what Bhaduri (2008b) called 'predatory growth' where aggregate profit and investment grow at a high stable and steady rate along with high and increasing growth rate of output, worsening of income distribution, increasing growth rate of labour productivity and declining growth rate of employment.

Our model of profit-led growth, captures 'predatory growth' in a transitory phase of developing countries where a set of policies which critics have termed the neo-liberal policy regime result in a worsening of income distribution. This is because the process of 'structural-cum-technological' change, which is the driving force of growth in the model, applies only when there is considerable gap between the average consumption standard of richer section of the population in the developing countries and the average consumption standard in the advanced countries. As the incomes of the rich in developing countries grow and the gap between the their consumption standard and that in the advanced countries narrows down, the rate of introduction of new luxury goods in the domestic economy will ultimately get tethered to the rate at which innovation take place in the advanced countries. Thus the 'technical progress function' for the luxury goods sector in which the growth rate of labour productivity is simply a function of the growth rate of aggregate profit ceases to apply once this gap disappears. Then the growth rate of labour productivity in the luxury goods sector will depend on the growth of labour productivity in the advanced countries and/or on the growth of technological capabilities in the domestic economy apart from the growth in aggregate profit.

The next chapter of this dissertation contains a review of the literature which aims to discuss how the role of aggregate demand in the process of growth has been adressed in various theories of economic growth. The first half of the chapter is devoted to the issues raised in the Harrod model, the neo-classical response to Harrod and the post-Keynesian critique of the the neo-classical growth model. In the next half we discuss two major demand-side approaches to economic growth- Joan Robinson's model of growth and the Kalecki-Steindl model of growth. Then we move on to a discussion of the debate about the investment function, which has a central role in all demand-side growth theories, and the possiblities of *exhilarationist*, *stagnationist*, profit-led and wage-led growth regimes. We also discuss how issues of endogenous technological change and employment are addressed in demand-side growth theories. We end the chapter with an elaborate discussion of the formal model in Patnaik (2007) and examine the volatile nature of economic growth driven by a process 'structural-cum-technological' change in the economy. In chapter 3 we present our model in which a process of 'structural-cum-technological' change similar to Patnaik (2007) and exogenous worsening of distribution of income induced by government's policy measures can give rise to periods of 'predatory growth' in which steady and stable growth of aggregate profit and investment is accompanied by accelerating growth of output and decelerating grow of employment. Chapter 4 contains concluding remarks which summarise and discuss the results of the model contained in chapter 3.

Chapter 2

Demand-side Approaches to Economic Growth

The role of aggregate demand in explaining economic growth is a contentious issue in the growth theory literature. In the neo-classical and the new endogenous growth theories, aggregate demand has no role at all because either it is assumed that all savings are automatically converted into investments or that inadequacy of aggregate demand can be a problem in the short run which is somehow taken care while considering the long run problem of economic growth. Thus aggregate demand finds no mention in the list of ideas that form the basic ingredients of "modern theories of economic growth" by Barro and Sala-i-Martin.[1]

The demand-side approaches differ from the neo-classical growth model on two major counts. First, investment is treated independent of savings and second, the rejection of the aggregate production function (and therefore the marginal productivity theory of income distribution). In this chapter we

[1]Barro and Sala-i-Martin (2004), pp no. 16

discuss two demand-side growth models. One is Joan Robinsons' model of growth[2] and the other is the Kalecki-Steindl model of growth, due to independent contributions by A. K. Dutt and R. E. Rowthorn.[3] In both these models investment plays a crucial role in the process of economic growth whereas they differ on the account of factors determining investment. Then we briefly discuss the debate about investment function and possibility of different regimes of growth drawing mainly from Bhaduri and Marglin (1990). After that we discuss the 'technical progress function' and its implication of the possible existence of multiple long run equilibria with different unemployment rates, irrespective of whether the growth regime is profit-led or wage-led. Then we very briefly discuss two contributions (Bhaduri (2006) and Dutt (2006)) where endogenous technological change is explained as a result of supply side pressures like labour shortage, competition for market shares and bargaining between the capitalists and the workers.

Last but not the least we examine whether what Patnaik (2007) calls 'structural -cum-technological' change can be seen as an explanation for the recent growth experience of the Indian economy where high growth performance has been sustained for a considerable period of time despite massive levels of poverty, worsening of income distribution and a sluggish rate of job creation (in the organised sector). We argue that such a process of growth which Bhaduri (2008b) called 'predatory growth' can arise because of a rapid rate of 'structural-cum-technological' change. This is because 'structural-cum-technological' change basically involves change in the composition of demand of the rich with associated changes in the production and technological struc-

[2]Robinson (1960)

[3]Dutt (1984) and Rowthorn (1982)

ture of the economy. As the income of the rich in the economy increases at a rapid rate it becomes more profitable for firms to invest in the production of goods and services that cater to the demand of this particular section of the population. However the model of 'structural-cum-technological change' in Patnaik (2007) is more suitable as an explanation for the volatility of growth process rather than as an explanation for sustained high growth performance as in the case of Indian economy for the majority of first decade of this century.

We begin this chapter with a discussion of the canonical Harrod model of growth and what Sen calls "Harrod's questions".[4] Harrod pointed out two aspects of a closed economy in which capital-output ratio, savings propensity out of income and growth rates of population and labour productivity are constants. One, steady state growth path for this economy is unstable and two, it is almost impossible for such an economy to grow steadily along with full employment of labour. In the growth literature there have been three different responses to Harrod. First, the neo-classical growth theory assumed away Harrod's dilemma about stability of the steady growth path, by assuming aggregate demand has no role at all in explaining growth, and established the existence of steady state growth with full employment by assuming sufficient flexibility of capital-labour and capital-output ratios. A second approach assumed that there is full employment in the long run and that imbalances in effective demand lead to changes in the income distribution, which ensures that the rate of accumulation and output growth are equal to the rate guaranteed by full employment of labour. This is post-

[4]Sen (1970), pp no. 10

Keynesian model of growth put forward by Kaldor and Pasinetti.[5] Finally, demand-side approaches to growth allowed for the possibility of involuntary unemployment in the long run while the equilibrium rate accumulation and output growth were determined by the rate of expansion of demand. In the next three sections we will discuss the neo-classical growth model, the post-Keynesian critique of the aggregate production funtion and theories theories of Kaldor and Pasinetti. From section 2.5 onwards, we finally start our discussion of demand-side approaches to economic growth.

2.1 Harrod's Questions

Any discussion of the role of aggregate demand in growth theory has to start with "Harrod's questions". According to Sen, Harrod was primarily concerned with three issues.[6] First, can an economy (a closed economy with no government) with a positive constant capital-output ratio, v, and a positive constant savings-output ratio, s, grow at a steady rates? In such an economy one unit of capital always will produce $\frac{1}{v}$ output, out of which $\frac{s}{v}$ will be savings. If the entire savings is always invested then the rate of accumulation of capital is $\frac{s}{v}$. The growth rate of output is $\frac{s}{v}$ because capital-output ratio, v, is a constant. Thus it is possible for the economy to grow at a positive steady rate.

Harrod's second concern was with the stability of this steady growth path and herein lies the importance of aggregate demand. As mentioned above, the possibility of achieving steady state growth crucially depended on all the planned savings being automatically converted into investment. Harrod

[5]Kaldor (1956) and Pasinetti (1962)

[6]The subsequent discussion of the Harrod model closely follows Sen (1970).

introduced an independent investment function such that investment in any period t, I_t, is determined through an accelerator (which is v), by the excess of expected output, X_t^e, over the actual output in the previous period, X_{t-1}.

$$I_t = v(X_t^e - X_{t-1}) \tag{2.1}$$

On the other hand,the actual output in any period t, X_t, is determined by the investment in that period, I_t, through the Keynesian multiplier.

$$X_t = \frac{I_t}{s} \tag{2.2}$$

Substituting for I_t from equation (2.2) in equation (2.1), we get

$$sX_t = v(X_t^e - X_t)$$

Dividing the entire equation by X_t^e and rearranging the terms we get the following expression for the ratio of actual to expected output.

$$\frac{X_t}{X_t^e} = \frac{v}{s}\left(\frac{X_t^e - X_{t-1}}{X_t^e}\right)$$

Now, $\frac{X_t^e - X_{t-1}}{X_t^e}$ is the expected rate of growth in period t, g_t^e. So the above equation can be written as

$$\frac{X_t}{X_t^e} = g_t^e\left(\frac{v}{s}\right) \tag{2.3}$$

From equation (2.3), it is clear that in any period t the actual and the expected output are the same if and only if $g_t^e = \frac{s}{v}$. Harrod defined $\frac{s}{v}$ as the warranted rate of growth, which if expected then ouput expectations are realised. Actual growth rate in Harrod is $g_t = \frac{X_t - X_{t-1}}{X_t}$.[7] Now

$$g_t = 1 - \frac{X_{t-1}}{X_t} = 1 - \left(\frac{X_{t-1}}{X_t^e}\right)\left(\frac{X_t^e}{X_t}\right)$$

[7]Generally growth rates are defined as $g' = \frac{X_t - X_{t-1}}{X_{t-1}}$ but it can be checked that $g' = \frac{g}{1-g}$ and therefore $\frac{\partial g'}{\partial g} = \frac{1}{(1-g)^2} > 0$

From equation (2.3), we know that $\frac{X_t^e}{X_t} = \frac{s}{g_t^e v}$ and given the definition of expected rate of growth, we get a relation between the actual rate of growth, g_t, the expected rate of growth, g_t^e, and the warranted rate of growth $\frac{s}{v}$.

$$g_t = 1 - (\frac{1 - g_t^e}{g_t^e})\frac{s}{v}$$

Rearranging the terms,

$$\frac{(1 - g_t^e)}{(1 - g_t)} = g_t^e(\frac{v}{s}) \tag{2.4}$$

From equation (2.4), the following three conditions follow[8]:

$$g_t = g_t^e \longleftrightarrow g_t^e = \frac{s}{v} \tag{2.5}$$

$$g_t > g_t^e \longleftrightarrow g_t^e > \frac{s}{v} \tag{2.6}$$

$$g_t < g_t^e \longleftrightarrow g_t^e < \frac{s}{v} \tag{2.7}$$

The conditions (2.5)-(2.7) are crucial for arriving at Harrod's famous result, instability of the steady state growth path. For the simplicity of exposition we will assume that expectations of any variable in period t is the actual value of the variable in period $t - 1$. We have seen earlier that, in the absence of an independent investment function, the economy grows at a steady rate $\frac{s}{v}$. Suppose that the economy grows in any period t at the rate $\frac{s}{v}$, then $g_{t+1}^e = g_t = \frac{s}{v}$. Then from (2.5) it follows that $g_{t+1} = \frac{s}{v}$. Thus, the rate of growth $\frac{s}{v}$ is here also a steady state rate of growth for the economy. Now suppose for some reason the economy which was growing at the steady rate of $\frac{s}{v}$, in period t experiences a rate of growth $g_t > \frac{s}{v}$ rate of growth. Because of our assumption about expectations, in period $t + 1$, $g_{t+1}^e = g_t > \frac{s}{v}$. Then from (2.6) it follows that $g_{t+1} > g_{t+1}^e = g_t$. In period $t + 2$, $g_{t+2}^e = g_{t+1} > \frac{s}{v}$ which then, again from (2.6), imply $g_{t+2} > g_{t+2}^e = g_{t+1}$. Thus in every period the economy will experience successively higher rates of growth, i.e.,

[8]Following Sen we assume that $g_t^e \neq 1$ becuase $g_t^e = 1$ only in the extreme case where $X_{t-1} = 0$.

$g_t < g_{t+1} < g_{t+2} < \cdots$. In the opposite case when for some reason an economy growing at the steady state rate of growth experiences, in period t a rate of growth $g_t < \frac{s}{v}$, it will experience successively lower growth rates in every future period, i.e, $g_t > g_{t+1} > g_{t+2} > \cdots$.[9]

The third major issue in Harrod is whether it is possible for the economy to grow at a steady rate along with full employment of labour. Given an exogenous rate of growth of labour force n and an exogenous growth rate of labour productivity g_x, full employment of labour requires a rate of growth of output $g_n = n + g_x$. Harrod called g_n the natural rate of growth. Steady growth along with full employment, given the assumptions of Harrod, requires $g_n = n + g_x = \frac{s}{v}$. In other words the warranted growth rate must equal the natural growth rate. Since n, g_x, s and v are all parameters the economy has to be extremely fortunate to be on such a growth path. On top of it, given the instability of the steady state growth path, any small disturbance will dislodge the economy from the steady state growth path with full employment, if in the first place by some happy accident it finds itself on that growth path.

2.2 Solow, Swan and the Neo-Classical Response to Harrod

The neo-classical growth model propounded by Solow (1956) and Swan (1956) put forth a simple adjustment mechanism which ensures equality between Harrod's warranted and natural growth rate by doing away with the assump-

[9] In Harrod's model a steady state growth path with rate of growth 0 is stable. See Patnaik(1997), Kalecki(1962)

tion of constant capital-output ratio. Instead they introduced substitutability between labour and capital which made the capital-output ratio variable whenever there is a mismatch between the warranted and the natural rates of growth. If the warranted rate of growth is greater than the natural rate of growth then $\frac{s}{v} - g_x > n$, which means that the growth rate of demand for labour is greater than the growth rate of supply of labour. This makes labour more expensive relative to capital which raises the capital-output ratio and thereby decreases the warranted rate of growth $\frac{s}{v}$. The warranted growth rate keeps declining as long as it is greater than the natural rate of growth. The reverse happens if the warranted rate of growth falls short of the natural rate of growth. There is excess supply of labour which makes labour cheaper relative to capital. This decreases the capital-output ratio and increases the warranted rate of growth $\frac{s}{v}$. The warranted growth rate keeps increasing as long as it is less than the natural rate of growth.[10]

The smooth convergence of the warranted rate of growth to the natural rate of growth is ensured by the neo-classical assumption of an aggregate production function. The neo-classical model of growth is a one commodity model. This commodity is used both as a consumption good and means of production. There are two factors of production. One, homogeneous labour L and two, capital stock K build by the accumulation of that part of each period's output which is not consumed and is of the physical form of the commodity itself. The aggregate production function gives the various combinations of capital and labour required to produce any level of output. In the absence of technological change (i.e., $g_x = 0$) it takes the following form:

$$X = F(K, L) \tag{2.8}$$

[10] Sen (1970)

where F is a twice-differentiable function. The aggregate production function has the properties of positive marginal product of each factor, diminishing mariginal productivity and constant returns to scale.

The aggregate production function is combined with the assumption of perfect competition in both commodity and factor markets. Any mismatch of the natural rate of growth and the warranted rate of growth, in perfectly competitive factor markets, either increases or decreases the relative price of labour *vis-a-vis* capital and maintains full employment of both the factors. When $\frac{s}{v} > n$, the relative price of labour goes up as discussed earlier.[11] The rise in the relative price of labour induces substitution of capital for labour. Given diminishing returns to factors, the substitution of labour by capital induces an increase in the capital-output ratio in the economy. The continuous substitution of capital for labour allowed by the aggregate production function ensures that the warranted rate of growth not only declines whenever it is greater than the natural rate of growth but becomes equal to the latter. And in the opposite case of $\frac{s}{v} < n$, the same adjustment occurs in the reverse direction to ensure convergence of the warranted growth rate to the natural rate of growth.[12]

Although the substitutability between factors of production made possible by the aggregate production function does provide a very simple solution to Harrod's third question, the neo-classical model has no solution for Harrod's second question. Rather the question of balance between the actual

[11] In the absence of technological change the natural rate of growth is equal to n.

[12] The existence of steady state in the neo-classical growth model requires a set of assumptions on F called the Inada conditions. These are $\lim_{i \to 0} \frac{\partial F}{\partial i} = \infty$ and $\lim_{i \to \infty} \frac{\partial F}{\partial i} = 0$ where $i = K, L$.

and the warranted rate of growth is assumed away by not introducing an independent investment function which tantamounts to assuming all savings get automatically converted into investment.

2.3 Post-Keynesian Critique of the Aggregate Production Function

A major part of the post-Keynesian critique of the neo-classical growth model focussed on the aggregate production function and the marginal productivity theory of income distribution. This was articulated in what Harcourt (1969) called 'Cambridge controversies in capital theory' that raged for two decades from mid-1950s to mid-1970s.[13] In this section we will very briefly discuss the major objections against the aggregate production function. These objections do not question the logical validity of the one good Solow-Swan model of growth where capital is treated as jelly-like, homogeneous and malleable but the issue is whether this model can be an approximation of the reality characterised by heterogeneous capital goods.[14]

Joan Robinson started the debate by pointing out that once the assumption of jelly-like, homogeneous and malleable capital is given up and the reality of heterogeneous capital goods is acknowledged, it is impossible to measure capital in terms of physical units. The only way then to measure capital is in terms of value, however expressing capital in terms of value can-

[13]Cohen and Harcourt (2003). Harcourt called the debate as Cambridge controversies in capital theory because most of the participants in the debate were directly or indirectly associated with either Cambridge, UK or Cambridge, Massachusetts.

[14]Sen (1970)

not be done independent of the rates of interest (or the rate of return on capital services) and wage.[15] A set of capital goods can be valued at any point of time by considering either the present value of the cost of production incurred while producing these capital goods in the past or the present value of future stream of output to be produced with the aid of these capital goods. To arrive at either of these factor prices have to known before hand, i.e., the distribution of income has to be assumed.[16]

The purpose of the aggregate production function in the neo-classical model is to simultaneously analyse a production system in which various combinations of quantities of capital and labour can be used to produce any particular level of output and explain the distribution of income through the technological properties of the production system (i.e., returns to capital and labour are determined by their respective marginal products for a given stock of capital and flow of labour). Since, in a world with heterogeneous capital goods, capital cannot be expressed independent of the rates of profit (or interest) and wage, the aggregate production function and the marginal products of the factors cannot be used to determine the distribution of income.

Joan Robinson proposed to measure capital in terms of labour time. That is the values of capital goods whose production capacities per unit labour are known are measured in terms of labour time required to produce them compounded at past rates of interest. This implies that the same set of capital goods can take different values at different rates of interest while different sets of capital goods will take different values at the same interest rates.

[15]Robinson (1954). Also see Harcourt (1969).

[16]Robinson (1954), Harcourt (1969) and Cohen and Harcourt (2003)

She defined equilibrium as situations in which expectations about the rate of profit have fulfilled in the past and the past expectations about the future rate of profit are expected to be fulfilled in the future too, i.e., a given situation is an equilibrium situation if the rate of profit in that situation has ruled in the past and is also expected to rule in the future.[17] In such situations a given capital good has the same value whether it is measured as the present value of its expected future earnings calculated using the present ruling rate of profit or its cost of production brought forward by compounding at the ruling rate of profit.

In any given equilibrium and at a given wage rate, the set of capital goods actually chosen for production and its value in terms of labour time be found because the chosen set (sets) of capital goods is (are) associated with the highest rate of profit consistent with that wage rate.[18] She proposed a version of the production function by repeating the above process for all wage rates and assuming that as a result of competition capitalists/entrepreneurs will choose equipments associated with highest possible profit rate, given a wage rate, to plot a relationship between capital measured in terms of labour time and wage rate. Every point on this curve corresponds to a distinct equilibrium and thus this production function can be used to make comparisions between different equilibrium positions. However contrary to the neo-classical aggregate production function, movements along this curve cannot be concieved of as the result of actual process of accumulation and changes in factor prices through historical time starting from a given set of initial conditions.

[17] Robinson (1954), Harcourt (1969)

[18] Harcourt (1969)

Nonetheless if a technique of production (i.e., a particular quantity of capital in terms of labour time) that is chosen at a particular rate of profit is not chosen at any other rate of profit and if techniques associated with high value of capital in terms of labour time are chosen at low rates of profit and vice versa then the neo-classical growth model with the assumption of jelly-like, homogeneous and malleable capital can be a good proxy of the complex reality of heterogeneous capital goods (only that the aggregate production function then has to be interpreted as a relationship between values of capital and output in terms of labour time for a given set of production techniques).[19] The neo-classical aggregate production function has three forceful implications which Samuelson (1962) had termed as "parables": (a) the real return on capital is determined by the assumption of diminishing marginal productivities; (b) a greater quantity of capital is associated with a lower marginal product of additional capital and therefore to a lower real return on capital and vice versa and the relationship between capital-output ratio and the rate of profit is also inverse and monotonic; (c) the distribution of output under the assumption of perfect competition is determined by relative factor scarcity and the marginal products.[20] The possibility of reswitching of technique and capital reversal noticed by Joan Robinson (1954, 1956), Champernowne (1954) and Sraffa (1960) in general models with heterogeneous capital goods meant none of the neo-classical "parables" apply once the assumption of jelly-like, homogeneous and malleable capital is abandoned.[21]

Reswitching of techinque refers to the phenomena in which the same tech-

[19]ibid.

[20]Cohen and Harcourt (2003)

[21]Harcourt (1969)

nique of production is chosen at two different rates of profit (or interchangeably rates of interest) while different techniques are chosen at intermediate rates. On the other hand, capital reversal refers to the phenomena of value of capital increasing with increases in the rates of profit. Reswitching of technique and capital reversal take place in models of heterogeneous capital goods beacuse of Wicksell effects which arise due to dependence of the value of capital on its rate of return (rate of interest/rate of profit). Real Wicksell effects involve changes in the value of capital stock at different rates of profit due to changes in the physical stock of capital goods while price Wicksell effects involve changes in the value of the same physical stock of capital goods as a result of new capital goods prices.[22] Reswitching of technique implies violation of "parables" (a) and (b) while capital reversal implies violation of "parables" (b) and (c).[23]

Possibility of reswitching of techniques and capital reversal in a world characterised by heterogeneous capital goods implies that the simplicity achieved by the neo-classical growth model using the aggregate production function comes at a high cost.[24] This is because once the jelly-like, homogeneous and malleable capital assumption is given up, the technical properties of the aggregate production function no longer determine the distribution of income. Moreover as Joan Robinson argued outside the one commodity neo-classical world an aggregate production function can at best be used to compare the production system in different long run equilibrium positions rather than analyse changes through time.[25]

[22]Cohen and Harcourt (2003)
[23]ibid.
[24]Sen (1970)
[25]Robinson (1954)

The post-Keynesian growth models on the other hand try to explain income distribution independent of the technical properties of the production process by abandoning the aggregate production function and the marginal productivity theory of income distribution. While Kaldor and Pasinetti turned toward different savings propensities of workers and capitalists, Robinson turned to capitalists' desire to accumulate. In the next two sections we discuss the theories of Kaldor, Pasinetti and Robinson.

2.4 Kaldor, Pasinetti and Adjustments in the Savings Propensity

Kaldor (1956) argued that if full employment is assumed then the Keynesian multiplier works to bring a balance between the warranted rate of growth and the natural rate of growth through changes in income distribution. If full employment is assumed then starting from a commodity market equilibrium, any increase in investment results in an increase in the price level relative to the level of money wage rate which increases the profit share in the economy (instead of an increase in the output level) to generate the additional amount of savings required to restore equilibrium in the commodity market. To focus on the determination of income distribution Kaldor assumed full employment in the long run.

If income distribution is not constant then the average savings propensity out of total output becomes an endogenous variable. The average savings propensity in an economy with only two kinds of income- profits and wages-is a weighted average of savings propensities out of profits and wages, where the weights are given by the income distribution. Kaldor assumed constant savings propensities out of profit and wage income[26], s_p and s_w respectively. Therefore the savings-output ratio, s, is

$$s = \frac{S}{X} = \frac{s_w W + s_p \Pi}{X}$$

where W is the total wage bill and Π is the aggregate profit. We can rewrite the above expression for s as

$$s = s_w(1 - h) + s_p h \tag{2.9}$$

where h is the profit share. Thus the average savings propensity is a function of the profit share, h.

Steady state growth along with full employment implies that the warranted growth rate is equal to the natural growth rate, i.e., $\frac{s}{v} = g_n$. Equation (2.9) then implies

$$\frac{\{s_w(1-h) + s_p h\}}{v} = g_n \tag{2.10}$$

Solving equation (2.10) for h gives the equilibrium value of profit share required for steady growth along with full employment. The equilibrium value of profit share is

$$h^* = \frac{g_n v}{(s_p - s_w)} - \frac{s_w}{(s_p - s_w)} \tag{2.11}$$

Since profit share is positive and less than one it must be that $s_p > s_w$ and $s_w < g_n v < s_p$.

Kaldor argued that any deviation of the warranted growth rate from the natural growth rate would give rise to changes in the profit share in such a

[26]Kaldor emphasised that he considered profits and wages to be two income categories differentiated mainly by different savings propensities.

manner that the economy will come back to the steady state growth path with full employment. Suppose that warranted growth rate is greater than the natural growth rate, i.e., $\frac{s}{v} > g_n$. This implies

$$\frac{s}{v} = \frac{\{s_w(1-h) + s_p h\}}{v} > g_n$$

or,

$$h > \frac{g_n v}{(s_p - s_w)} - \frac{s_w}{(s_p - s_w)} = h^*$$

Thus the profit share in the economy is greater than what is required for steady growth with full employment. Kaldor argued that in such a situation the profit share will come down to h^*. This is because along a steady growth path with full employment the rate of accumulation is equal to the natural rate of growth. A constant capital-output ratio then implies that the investment-output ratio on such a growth path is equal to $g_n v$. At any point if $\frac{s}{v} > g_n$ then $s > g_n v$. This implies that *ex-ante* savings greater than *ex-ante* investment, i.e., a situation of excess supply in the economy. In Keynesian manner it can be argued that price would fall more than money wages, which are sticky, leading to an increase in wage share and a resulting fall in profit share. Alternatively in Kaleckian manner it can be argued that in a situation of excess supply, degree of collusion between existing firms will fall and thus the price markup would fall. Consequently the profit share would fall. This downward adjustment in prices would continue as long as $h > h^*$ and $\frac{s}{v} > g_n$. In the opposite case the reverse will happen. However this adjustment will be constrained by requirements of minimum wage share that the workers are ready to accept, minimum profit rate that the capitalists are ready to accept and minimum price markup that is consistent with the structure of the economy.

Pasinetti (1962) interpreted the savings propensities in Kaldor's model as attached to classes of income earners rather than categories of income and criticised the model for neglecting the fact that accumulated savings over time becomes capital owned by wage earners because of which a part of the total profits accrues to them. He extended Kaldor's model by explictly incorporating this aspect in model and showed that if rate of profit is same for both the capitalists and the workers then along the steady state growth path with full employment, rate of profit and profit share are determined by the natural rate of growth and savings propensity of the capitalists. The equilibrium in the case with workers saving is not different from the case in which workers do not save and do not earn any profit.

2.5 Joan Robinson and the Desired Rate of Accumulation

Joan Robinson's theory of growth is more about classifying different kinds of growth paths- steady, unsteady, with and without full employment- than constructing a predictive growth model. The central force according to her which drives accumulation and growth in a capitalist economy is capitalists' or firms' desire to accumulate. She argued that firms would like to accumulate more if they expect a higher rate of profit.[27] This can be formalised by postulating that the investment-capital raio is given by a desired rate of accumulation, g_K^d, such that

$$g_K^d = g(r^e) \tag{2.12}$$

[27] Robinson (1962)

where r^e is the expected rate of profit, $g(r_{min}) = 0$ where r_{min} is a positive constant less than one, $\frac{dg}{dr^e} > 0$ and $\frac{d^2g}{dr^{e2}} \leq 0$.[28]

On the other hand she argued the actual rate of profit ruling at a point of time is determined by the actual rate of accumulation at that point of time. Given a rate of accumulation g_K (i.e., the savings-capital ratio) at any point of time, the actual rate of profit, r, at that point of time is then determined by the following equation.

$$g_K = s_p r \tag{2.13}$$

where s_p is the savings propensity out of aggregate profit and $0 < s_p < 1$. Equation (2.13) assumes that savings behaviour in the economy is such that all wages are spent on consumption while the capitalists save a constant fraction s_p out of the aggregate profit. This relationship between the rate of accumulation and the rate of profit is known as the *Cambridge* equation.[29] Robinson argued that in equlibrium firms' expectations about the profit rate is realised and the desired rate of accumulation becomes equal to the actual rate of accumulation. That is,

$$r^e = r \qquad and \qquad g_K^d = g_K \tag{2.14}$$

Figure 2.1 shows two possible equilibria. On the horizontal axis we have the actual and desired rates of accumulation while on the vertical axis we have the rate of profit. The curve labelled g_K^d is the graph for the desired rate of accumulation given by equation (2.12) and the straight line labelled g_K is the graph for the actual rate of accumulation given by equation (2.13). The two intersection points of g_K^d and g_K (A and B) are the equilibria because at these

[28] Dutt (1990)

[29] Dutt (1990), Foley and Michl (1999)

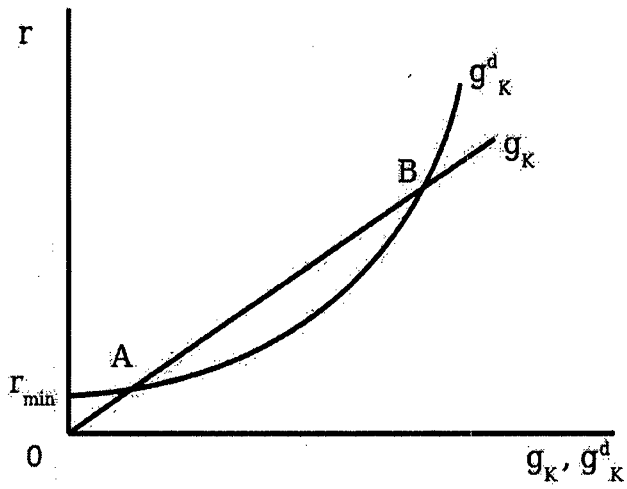


Figure 2.1

points the actual and the desired rates of accumulation are equal. Whenever the ruling rate of profit is such that the firms desire to accumulate at a rate less than the actual rate of accumulation, the actual rate of accumulation is greater than the desired rate of accumulation. Robinson argued that in such a situation firms' desire to accumulate will fall causing a decrease in the rate of profit. This is because such a situation implies excess of planned savings over investment which causes either excess capacity or a fall in the profit margin causing a decline in the rate of profit. And the opposite will happen whenever the actual rate of accumulation is less than the desired rate of accumulation. Thus A is an example of an unstable equilibrium while B is an example of a stable equilibrium.

Assuming a simple linear form for the desired rate of accumulation described in equation (2.12), we will first examine the conditions for existence and stability of equilibrium and then describe the properties of a stable equilibrium. Let us assume that g_K^d takes the following form:

$$g_K^d = \alpha + \beta r^e \tag{2.15}$$

where α and β are positive constants. The equilibrium condition (2.14) along with equation (2.13) and (2.15) imply,

$$\alpha + \beta r = s_p r$$

Solving the above equation we get the equilibrium rate of profit r^*,

$$r^* = \frac{\alpha}{(s_p - \beta)} \tag{2.16}$$

For the the equilibrium rate of profit to be positive it must be that $s_p > \beta$. The condition $s_p > \beta$ also ensures the stability of the equilibrium. Otherwise $s_p < \beta$ implies that at $r > r^*$, the actual rate of accumulation g_K is less than the desired rate of accumulation g_K^d. This as explained earlier increases the rate of profit taking it further away from r^*. Similarly at $r < r^*$, $s_p > \beta$ implies that the actual rate of accumulation g_K is greater than the desired rate of accumulation g_K^d. This reduces the the rate of profit r, again taking it further away from r^*.

The novelty of Joan Robinson's introduction of firm's desired rate of accumulation is that it ensures that two central results of Keynesian short run equilibrium get carried over to the long run equilibrium. First, $\frac{\partial g_K^*}{\partial s_p} = \frac{-\alpha\beta}{(s_p-\beta)^2} < 0$ where $g_K^* = \frac{s_p\alpha}{(s_p-\beta)}$ is the equilibrium rate of accumulation. This implies that any increase in capitalists savings propensity decreases the rate of accumulation. Thus the 'paradox of thrift' is a property of the long run equilibrium.

Second, there is now the possibility of the long run equilibrium with involuntary unemployment. Notice that α, β and s_p are all constants. If we assume that the rate of growth of labour supply is a constant n and that there is no technological progress then like in the Harrod model only by some very fortunate accident can the economy enjoy steady growth with full employment. In the case where $g_K^* < n$, the economy experiences an increasing rate of involuntary unemployment in the long run equilibrium. In the opposite case of $g_K^* > n$, the economy grows at a rate greater than full employment rate of growth. Given full employment has already reached, this scenario results into continuous increase in prices. Sooner or later a situation emerges where workers refuse any further worsening of real wages. This either forces the capitalists are forced to reduce prices and accept lower profit rate or leads to a situation of wage-price spiral.[30] Kalecki (1951) and Robinson (1962) argue that scarcity of labour may eventually increase the natural rate of growth by causing immigration and inducing labour saving innovations. However this model of growth and distribution does not have predictive power because existence and stability of equilibrium depend on the the specific functional form of the desired rate of accumulation.

2.6 The Kalecki-Steindl Model of Growth

The basic Kalecki-Steindl model of growth and distribution was independently developed by Dutt (1984) and Rowthorn (1982) drawing from the works of Kalecki (1971) and Steindl (1952). In our discussion of the model we will follow Dutt who developed this model in an attempt to explain in-

[30]Robinson (1962)

dustrial stagnation in India in the late sixties and the seventies.[31]

Dutt's model is of an oligopolistic industrial sector in which firms operate with excess capacity. Following Kalecki (1971) any mismatch of demand and supply in this sector gives rise to pure output adjustments whereas prices remain stable. Firms in this sector are not price takers. Kalecki argues that they set price after taking into consideration unit prime cost of production and prices of other firms producing similar products. Kalecki then arrives at an average price level in the economy which depends on the average unit prime cost and the average 'degree of monopoly' in the economy such that as long as the unit prime cost and the degree of monopoly remains stable, price level remains stable. Dutt's model uses a reformulation of Kalecki's price equation by Asimakopulos (1975) in which price, p, is set by applying a markup, τ, where $\tau > 0$ and is determined by the 'degree of monopoly' in the industrial sector, over the fixed unit prime cost, $\frac{w_m}{x}$, where w_m is the fixed money wage and x is the fixed labour productivity. Dutt assumes that there exists a large reservoir of labour either in the form of reserve army of labour or employed in the subsistence sector with no connection with the industrial sector. This reservoir of labour makes supply of labour to the industrial sector perfectly elastic at a level of money wage rate, say fixed by the government at a level which ensures minimum subsistence consumption for a fairly large range of price.[32] Thus the price level in the economy is given

[31]We follow Dutt's nomenclature in calling this model the Kalecki-Steindl model of growth. See Dutt(1990). In the literature this model is also known as the stagnationist model of growth or the *neo*-Kaleckian model of growth, for example see Taylor (1985) and Blecker (2005.)

[32]Dutt (1984)

by the following equation,

$$p = \frac{w_m}{x}(1+\tau) \tag{2.17}$$

The share of profit h is given by the following equation:

$$h = \frac{pX - w_m L}{pX} = 1 - \frac{w_m L}{pX} = \frac{\tau}{(1+\tau)} \tag{2.18}$$

Thus the 'degree of monopoly' determines the income distribution in this model. The rate of profit by definition is equal to,

$$r = \frac{\Pi}{K} = \frac{\Pi}{X}\frac{X}{X^*}\frac{X^*}{K}$$

where Π is aggregate profit, X is output, K is the capital stock and X^* is the full capacity output. Now $\frac{\Pi}{X}$ is the share of profit h, $\frac{X}{X^*}$ is the degree of capacity utilization and $\frac{K}{X^*}$ is the full capacity capital-output ratio which is assumed to be a constant by Dutt.[33] Let us denote the degree of capacity utilization by u and the full capacity capital-output ratio by v^*. Substituting them in the above expression, we get the following expression for the rate of profit.

$$r = \frac{hu}{v^*} \tag{2.19}$$

Substituting for h in equation (2.19) from equation (2.18) we get,

$$r = \frac{\tau u}{(1+\tau)v^*} \tag{2.20}$$

Since this model assumes existence of excess capacity as an inherent feature of the capitalist sector, investment depends not only on the expected rate of profit but also on the actual capacity utilization. Motivation for including the actual rate of capacity utilization as a separate argument in the investment function comes from both Kalecki and Steindl. Kalecki (1971)

[33]Dutt(1990)

thought firms' retained savings helped them to generate finance for new investment, thus have a positive impact on investment. In Kalecki's theory savings are determined by profits and profits are determined by capacity utilization, therefore capacity utilization has a positive impact on investment. Steindl on the other hand argues that since capital equipments are indivisibles, present value maximizing firms might find it profitable to build excess capacity ahead of demand because of uncertainy regarding expected growth in demand. Thus when utilization of capacity falls below the level of capacity utilization that firms have already planned then they would decrease rate at which they plan to accumulate. In the opposite case when capacity utilization goes above the planned level of capacity utilization, firms would like to invest more.[34]

Dutt assumes that the ratio of investment to capital stock is a linear function of both the rate of profit and degree of capacity utilization.

$$\frac{I}{K} = \alpha + \beta r + \gamma u \tag{2.21}$$

where β and γ are positive constants.[35]

If all wages spent on consumption and a constant fraction s_p of the aggregate profit is saved then the savings-capital ratio is,

$$\frac{S}{K} = s_p r \tag{2.22}$$

In equilibrium savings is equal to investment. This means

$$\frac{I}{K} = \frac{S}{K}$$

[34]Steindl (1952) as cited in Dutt(1984)

[35]Dutt (1984) assumes that the expected rate of profit is equal to the current rate of profit.

Therefore in equilibrium we have,

$$\alpha + \beta r + \gamma u = s_p r$$

Substituting the value of r from equation (2.20) in the above equation we get

$$\alpha + \frac{\beta \tau u}{(1+\tau)v^*} + \gamma u = \frac{s_p \tau u}{(1+\tau)v^*}$$

Solving the above equation for u we get the equilibrium level of capacity utilization,

$$u^* = \frac{\alpha(1+\tau)v^*}{(s_{p-\beta})\tau - \gamma(1+\tau)v^*} \tag{2.23}$$

For a meaningful equlibrium we require $u^* > 0$. This implies either $\alpha > 0$ and $(s_{p-\beta})\tau - \gamma(1+\tau)v^* > 0$ or $\alpha < 0$ and $(s_{p-\beta})\tau - \gamma(1+\tau)v^* < 0$. $(s_p - \beta) > 0$ ensures stability of the equilibrium degree of capacity utilization. Otherwise $(s_p - \beta) < 0$ implies if $u > u^*$ then $\frac{I}{K} > \frac{S}{K}$ which further increases the degree of capacity utilization and the reverse is true for the opposite case of happens in the opposite case of $u < u^*$. Thus the first set of conditions for a meaningful equilibrium (i.e., $\alpha > 0$ and $(s_{p-\beta})\tau - \gamma(1+\tau)v^* > 0$) ensures that the stability condition is also satisfied. Existence of excess capacity in the equilibrium implies $u^* < 1$. This condition also sets a lower bound on the mark up, $\tau > \frac{(\alpha+\gamma)v^*}{(s_p-\beta)-(\alpha+\gamma)v^*}$. Substituting u^* in equation (2.20), we get the equilibrium rate of profit

$$r^* = \frac{\alpha\tau}{(s_{p-\beta})\tau - \gamma(1+\tau)v^*} \tag{2.24}$$

Substituting r^* in equation (2.22) gives the equilibrium rate of accumulation,

$$g^* = \frac{s_p \alpha \tau}{(s_{p-\beta})\tau - \gamma(1+\tau)v^*} \tag{2.25}$$

Coming to comparative statics, we first note that the 'paradox of thrift' is again a property of the long run equilibrium.

$$\frac{\partial g^*}{\partial s_p} = -\frac{\{\alpha\beta\tau^2 + \alpha\gamma\tau(1+\tau)v^*\}}{\{(s_{p-\beta})\tau - \gamma(1+\tau)v^*\}^2} < 0$$

And second, any increase in the profit share decreases the equilibrium rate of accumulation. Notice that using the definition of r, the expression for g^* in equation (2.25) can be re-written as

$$g^* = \frac{s_p \alpha h}{(s_{p-\beta})h - \gamma v^*}$$

Thus,

$$\frac{\partial g^*}{\partial h} = -\frac{\gamma v^*}{\{(s_{p-\beta})h - \gamma v^*\}^2} < 0 \tag{2.26}$$

These results are not surprising because with an increase in the savings propensity of the capitalists or with an increase in the profit share (which is same as an increase in the mark up[36]), the level of demand falls and therefore the equilibrium level of capacity utilization falls as shown below.

$$\frac{\partial u^*}{s_p} = -\frac{\alpha(1+\tau)\tau v^*}{\{(s_{p-\beta})\tau - \gamma(1+\tau)v^*\}^2} < 0$$

and

$$\frac{\partial u^*}{\partial \tau} = -\frac{\alpha v^*(s_p - \beta)}{\{(s_{p-\beta})\tau - \gamma(1+\tau)v^*\}^2} < 0 \tag{2.27}$$

Proponents of this model argue that as capitalism develops, concentration in the industrial sector increases leading to an increase in the 'degree of monopoly'. This leads to increasing profit share and falling capacity utilization and rate of accumulation. So the economy eventually stagnates at low rate of growth and high profit share. This according to them explains the low levels of growth in advanced industrial countries. Thus the name stagnationist model of growth.

Lastly, in the absence of technological progress, capital-output ratio and labour productivity are constants. Then rates of growth of output and employment in the equilibrium are both equal to g^*. In this model the equilibrium growth rate of employment need not be equal to the rate of growth

[36]Because $\frac{dh}{d\tau} = \frac{1}{(1+\tau)^2} > 0$

of labour supply, n. Thus involuntary unemployment can exist and keep on increasing in the long run if $g^* < n$.

2.7 Issues with the Investment Function

It is evident that the main difference between the growth models discussed in the previous two section is the difference in the investment function. In the investment function introduced by Joan Robinson investment depends on the expected rate of profit whereas in the investment function used in the Kalecki-Steindl model, investment depends on the expected rate of profit as well as on the actual capacity utilization. Let us for the sake of simplicity in this section assume that expected and actual rates of profit are always equal. Bhaduri and Marglin (1990) criticise Joan Robinson's investment function for neglecting sensitiveness of investment to the constituents of the profit rate. From equation (2.19) we know that the rate of profit $r = \frac{hu}{v^*}$. Thus Joan Robinson's investment function implicitly assumes that a given rate of profit resulting either from a low share of profit and a high capacity utilization or from a high profit share but low capacity utilization will have the same impact on investment. Capitalists might not be willing to make new investment, despite high profit share, when there is excess capacity.

They also criticise the investment function used in the Kalecki-Steindl model of growth which tries to capture the impact of existing capacity on investment by introducing degree of capacity utilization along with the rate of profit as an independent variable in the argument of the investment function. Their arguement is that such an investment function imposes an unwarranted restriction on the relative responsiveness of investment to the constituents of the rate of profit- profit share and capacity utilization. Notice that the partial derivative of the investment function used in the Kalecki-Steindl model, $I(r,u)$, with respect to u gives the responsiveness of investment to capacity utilization. A condition like $\frac{\partial I}{\partial u} > 0$ implies with the rate of profit remaining constant, any increase in capacity utilization increases investment. However for the the rate of profit to remain constant an increase in capacity utilization has to be offset by an equivalent fall in the profit share.[37]

Bhaduri and Marglin instead suggest an investment function with the profit share and the level of capacity utilization as independent arguments. This avoids the problems with both Joan Robinson's investment function and the investment function used in the Kalecki-Steindl model mentioned above. Moreover this leads to an interesting result that there can be different regimes of demand determined growth depending on whether investment is more sensitive to changes in profit share than savings or not.[38] To see this let us assume that the investment capital ratio is a function of the profit share h and degree of capacity utilization u. Let

$$\frac{I}{K} = I(h,u) \tag{2.28}$$

such that $I_h > 0$ and $I_u > 0$, where I_h and I_u are partial derivatives of the function I with respect to h and u respectively. On the other hand let us assume that savings capital ratio is given by equation (2.22), i.e.,

$$\frac{S}{K} = s_p r$$

This along with equation (2.19) implies

$$\frac{S}{K} = \frac{s_p h u}{v^*} \tag{2.29}$$

[37]See also Blecker, 2005.

[38]Bhaduri and Marglin (1990) and Bhaduri (2008)

In equilibrium $\frac{I}{K} = \frac{S}{K}$. Therefore,

$$I(h, u) = \frac{s_p h u}{v^*} \tag{2.30}$$

Taking the total differential on both sides of (2.30) we get

$$I_h dh + I_u du = \frac{s_p u}{v^*} dh + \frac{s_p h}{v^*} du$$

Re-arranging the terms we get,

$$\frac{du}{dh} = \frac{(I_h - \frac{s_p u}{v^*})}{(\frac{s_p h}{v^*} - I_u)} \tag{2.31}$$

where $(\frac{s_p h}{v^*} - I_u) \neq 0$. Standard Keynesian stability condition for equilibrium requires $\frac{s_p h}{v^*} - I_u > 0$.[39] Thus $\frac{du}{dh}$ can be positive or negative depending on whether investment is more responsive to share of profit or savings. Bhaduri and Marglin call the case with $\frac{du}{dh} < 0$ as the *stagnationist* regime and the case with $\frac{du}{dh} > 0$ as the *exhilarationist* regime. The *stagnationist* regime is a case of wage-led growth because in this case a lower profit share increases the rate of capacity utilization and therefore rate of growth increases. In contrast the *exhilarationist* regime is a case of profit-led growth because in this case an increase in profit share instead of reducing the rate of capacity utilization, increases it and thus the rate of growth also increases.

They further classify the two regimes into either a cooperative regime or a conflictive regime. The *stagnationist* regime can be cooperative if the realised total profit varies inversely with the profit share, i.e, $\frac{\partial \Pi}{\partial h} = \frac{\partial (huX^*)}{\partial h} < 0$ or $-\frac{h}{u}\frac{du}{dh} > 1$. Otherwise the *stagnationist* regime is conflictive. The *exhilarationist* regime can be called cooperative if total wage bill of the workers

[39]Otherwise savings is less responsive to changes in output than investment. Any increase in output increases output further because the resulting increase in investment is more than that in savings.

increases when the profit share increases, i.e, $\frac{\partial\{(1-h)uX^*\}}{\partial h}$ or $\frac{h}{u}\frac{du}{dh} > \frac{h}{(1-h)}$. Otherwise the *exhilarationist* regime is a conflictive regime.

As discussed in the previous section the investment-capital ratio in the Kalecki-Steindl model is a function of the rate of profit and the degree of capacity utilization, like $\frac{I}{K} = F(r, u)$ where the parial derivatives of the function F with respect to r and u are positive, i.e., $F_r > 0$ and $F_u > 0$. Notice that that Bhaduri and Marglin's investment function, $I(h, u)$, is a reduced form of the function $F(r, u)$ because the rate of profit r depends on both the profit share and degree of capacity utiliztion. Substituting for h in the Bhaduri and Marglin investment function from equation (2.19) we obtain,

$$I = I(h, u) = I(\frac{rv^*}{u}, u)$$

Taking the total differentiation of I when r is constant we get

$$\frac{dI}{du} = -I_h\frac{rv^*}{u^2} + I_u$$

or,

$$\frac{dI}{du} = I_u - \frac{h}{u}I_h$$

The assumption of Kalecki-Steindl model that $F_u > 0$ then implies that $I_u - \frac{h}{u}I_h > 0$ or $uI_u > hI_h$. Multiplying $\frac{h}{u}$ on both sides of (2.31) we obtain the following expression.

$$\frac{h}{u}\frac{du}{dh} = \frac{(hI_h - \frac{s_p hu}{v^*})}{(\frac{s_p hu}{v^*} - uI_u)}$$

The conditon $uI_u > hI_h$ along with the standard Keynesian stability condition $\frac{s_p h}{v^*} - I_u > 0$ then implies that $\frac{s_p hu}{v^*} > uI_u > hI_h$. This implies, from the above equation, that $\frac{h}{u}\frac{du}{dh} < -1$, which is the condition for the *stagnationist* regime to be cooperative. Therefore Bhaduri and Marglin criticise Kalecki-Steindl model of growth for assuming away the *exhilarationist* regime and conflictive *stagnationist* regime.

However Lavoie (1995) has shown that including overhead labour in the Kalecki-Steindl growth model allows profit-led economic growth. Similarly Blecker (2005) has shown that profit-led growth regimes can exist even in the Kalecki-Steindl growth model, if it is extended to include positive savings out of wages, fiscal policy and international capital mobility. Blecker also points out that even with the Bhaduri and Marglin kind of investment function profit-led growth regime will not arise unless elasticity conditions are extreme. He shows that if the Bhaduri and Marglin investment function is of the linear form or of the Cobb-Douglas form then profit-led growth regimes cannot exist. Patnaik (2007) criticises Bhaduri and Marglins's rationale for including the profit share in the argument of investment function by pointing out that capitalists are more likely to be concerned about the profit level or the rate of profit that new investments are expected to yield and not with the profit share (or the profit margin) which is just an instrument for raising the level or the rate of profit.

2.8 Technical Progress Function, Regimes of Growth and Employment

Kaldor and Mirrlees (1962) were among the first to consider endogenous technical change in growth theory. In a vintage capital goods model, they argued that labour productivity growth in the economy is a result of introduction of new machines which is a function of gross investment. This relationship is captured by what they called the 'technical progress function':

$$g_x(t) = f(g_i(t)) \tag{2.32}$$

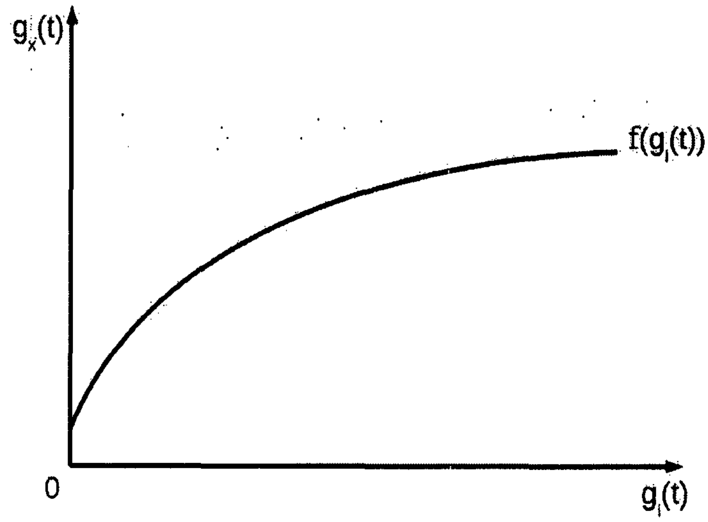


Figure 2.2

where $f(0) > 0$, $f' > 0$ and $f'' < 0$. $g_x(t)$ is the growth rate of labour productivity of workers working with newly installed machines in period t and $g_i(t)$ is the growth rate of gross investment per worker in period t.

Figure 2.2 illustrates the 'technical progress function'. They argue that constant investment in any period induces positive labour productivity growth but the latter increases with the growth rate of investment per worker though at a diminishing rate. According to Kaldor the concavity of the 'technical progress functon' is because at any point/period technical change represents the adoption of unexploited ideas and those ideas which are adopted first are the most profitable ones, i.e, those which raise output the most compared to the investment that they need.[40]

[40]Kaldor (1961)

Patnaik (2007) argues that in developing countries where most of the technical change takes place via imitation of techniques already in use techniques in the advanced world, the 'technical progress function' is more likely to be convex rather than concave. He argues that in developing countries technological capacity increases more with faster growth of investment which makes it easier to immitate more sophisticated techniques. We will elaborate more on the argument of Patnaik (2007) in the next chapter.

You (1994) proposed another version of the 'technical progress function' where the rate of capital deepening in the economy is an increasing convex function of the rate of accumulation of capital.[41] You argues that capitalists' decision in any given period about the choice of capital intensity or the capital-labour ratio depends on the expected real wage rate. The rate of capital deepening therefore depends on the expected rate of growth of real wages and the changes in the labour-saving bias of new technologies. Under the assumption of adaptive expectations, a higher growth rate of real wages implies a higher expected growth rate of real wages and induces a greater labour-saving bias in new technologies. You combines this with two more assumptions i.e., the relation between capital deepening and the growth rate of real wages is strictly convex and the growth rate of real wages depends on the rate of accumulation of capital, to postulate an increasing and convex relationship between the rate of capital deepening and the rate of accumulation of capital shown in figure 2.3 by the curve labelled T.

[41]Rate of capital deepening is the growth rate of capital-labour ratio, i.e., the capital intensity of the economy.

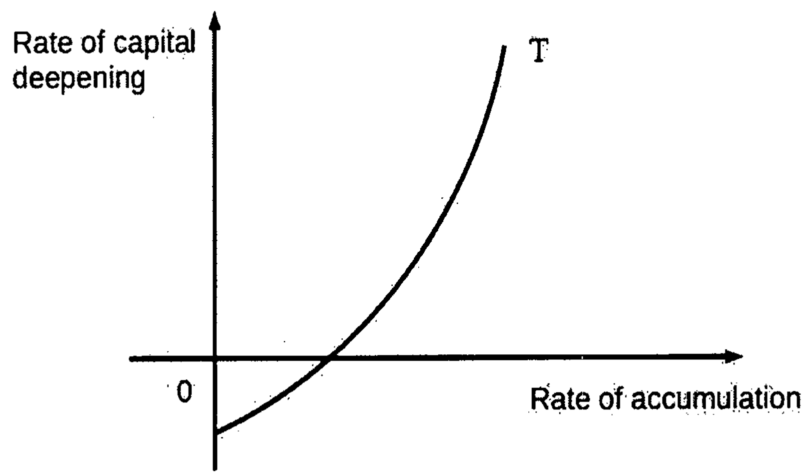


Figure 2.3

You combines his version of the 'technical progress function' with the results of Bhaduri and Marglin (1990) and the conflicting claims theory of income distribution by Rowthorn (1977) to study the stability of wage and profit-led growth regimes and employment capacity of the capital stock in the long run. The employment capacity of the capital stock (the 'accumulation ratio') is the ratio between total employment at full capacity utilization of the capital stock and total labour supply.

You defines the short run as one in which the 'accumulation ratio' is given by fixed coefficent technology. Demand dynamics is captured by the equilibrium condition in Bhaduri and Marglin (1990), i.e., equation (2.30), which along with bargaining over distribution of income between the capitalists and the workers (where the 'accumulation ratio' is an important factor determining workers' bargaining strength) simultaneously determine the degree of capacity utilization and the profit share in the short run. In the long run however, technology is not fixed and therefore the 'accumulation ratio' changes over time.

In long run equilibrium, the 'accumulation ratio' becomes a constant and the rate of accumulation, i.e, the growth rate of capital, is equal to the sum of the growth rate of labour supply and the rate of capital deepening. The non-linearity of the 'technical progress function' allows for the possibility of multiple long run equilibria with different 'accumulation ratios' and growth rates in both profit and wage-led growth regimes.[42] The main result of the paper is that a high growth equilibrium is stable only in the wage-led growth regime while a low growth equilibrium is stable only in the profit-led growth regime. And a corollary of this result is that a stable equilibrium is associated with a higher 'accumulation ratio' compared to an unstable equilibrium irrespective of the growth regime.

The intuition behind this result is simple. Whenever growth rate of employment is greater than the growth rate of labour supply, the 'accumulation ratio' increases. An increase in the 'accumulation ratio' increases the growth

[42] The definitions of profit and wage-led growth regimes in You (1994) are different from the definitions of *stagnationist* and *exhilarationist* regimes of Bhaduri and Marglin (1990). You defines a profit-led growth regime as one in which the growth rate of capital is negatively related to the 'accumulation ratio' while a wage-led growth regime is one in which the growth rate of capital is positively related to the 'accumulation ratio'. Then he shows that a wage-led growth regime is possible only if in the short run the absolute value of elasticity of degree of capacity utilization with respect to the profit share is greater than one. Notice that this is the condition required for cooperative *stagnationist* regime in Bhaduri and Marglin (1990).

rate of capital in the wage-led growth regime while decreases the latter in the profit-led growth regime. However the stability result is highly sensitive to the curvature of the 'technical progress function'. It can be easily shown that if You's assumption of strict convexity of the 'technical progress function' is replaced by Kaldor and Mirrlees' assumption of strict concavity then high growth equilibrium is stable only in the profit-led growth regime while low growth equilibrium is stable only in the wage-led growth regime.

2.9 Endogenous Technological Progress

Apart from the 'technical progress function' approach, there have been recent attempts to incorporate supply-side inducements leading to technological progress within the framework of demand determined growth. In this section we will briefly mention two such attempts- Bhaduri (2006) and Dutt (2006). These attempts differ substantially from the new endogenous theories of growth in their explanation of technological progress. The new endogenous theories of growth capture technological progress in the process of economic growth either by postulating increasing returns to a broad class capital goods including human capital or by postulating R & D activities as incentive driven activities rewarded by *ex-post* monopoly power.[43]

Dutt (2006) postulates that the growth rate of labour productivity depends upon the difference between the growth rate of labour demand and growth rate of labour supply. In other words, labour shortages in the face of expanding demand in the commodity market forces firms to adopt production techniques which are labour saving. Thus this approach tries to incorporate

[43] Barro and Sala-i-Martin (2004)

both demand and supply side pressures while explaining the endogenous nature of technological progress. Dutt (2006) invokes support for this idea from Marx, who viewed labour-displacing machines as a weapon of class struggle in the hands of capitalists and Robinson (1962), who argued that the pace of diffusion of labour saving inventions in the face of labour shortages, rather than inventions themselves, is more important for explaining technological change in the process of economic growth.

Bhaduri (2006) views endogenous adoption and diffusion of new technologies from the supply side as a result of both intra-capitalists rivalry over market shares and inter-class struggle between the capitalists and the workers over income distribution. In a Schumpeterian manner firms with cutting-edge technology reap supernormal profits by charging lower than the average economy wide prices. Diffusion of new technology brings down the average price level in the economy which depending upon the dynamics of money wages tend to create an upward pressure on the real wage rate and the wage share. This, in a Marxian sense, creates pressures for adopting labour saving technology to keep the profit share from falling. Thus, in both Dutt (2006) and Bhaduri (2006), technological progress is viewed not merely as positive external effect of investment in various forms of capital or as result of incentives associated with innovation. Capitalists are forced to innovate in order to meet labour shortages in the face of an expanding market so that they can survive in the market and/or maintain their position vis-a-vis the workers in class struggle over income distribution.

2.10 Predatory Growth

Bhaduri (2008b) coined the phrase 'predatory growth' to describe the Indian growth experience in the first decade of the twenty-first century. As discussed in the previous chapter, the Indian economy has witnessed consistently high and at times accelerating GDP growth rates for the major part of the last decade. At the same time in the entire post-reforms period income inequality increased and the rate of reduction in poverty declined while employment (in the organised sector) has stagnated. Bhaduri argues that this growth process is sustained by an expanding market for goods and services that the richer section of the Indian population demands. Acute poverty and worsening of income distribution imply that the majority the of the population is completely excluded from the growth process. In a growth process accompanied with a minority of the population becoming super-rich relative to the rest of the population, the logic of the market dictates a change in the production structure in the economy such that the composition of output becomes biased in favour of this particular section's demand.

Patnaik (2007) argues that the high growth performance of the Indian economy despite a negative trade surplus for the entire last decade and insignificant government expenditure is a result of what he calls a rapid rate of 'structural-cum-technological change' in the domestic economy. He argues that in a developing country the richer section of the population aspires to match the living standard in the developed countries. As profit grows, the purchasing power of this section of the population increases enabling them to actually access goods consumed in the developed countries. The domestic firms therefore have an incentive for producing these goods. Technological change required for catering to the demand of this section of the population largely takes the form of imitation of technologies in use in developed countries. Thus as profit grows composition of output and technology change.

This 'structural-cum-technological' change can be an explanation of a 'predatory growth' process if the nature of technological change accompanying economic growth leads to rapid increases in the labour productivity of the economy. Patnaik argues that production techniques associated with the higher end of goods available in the developed countries are more labour saving, so once these techniques are introduced in the developing countries via imitation labour productivity starts rising rapidly. In the rest of this section we will discuss in details Patnaik's model of 'structural-cum-technological' change.

In the formal model of Patnaik (2007), one good is produced using different vintages of equipment and homogenous labour. These vintages of equipment produce the same amount of output of the good but the amount of labour required is less for newer vintages owing to rising labour productivity (due to technological change). It is assumed that in every period of time investment happens in a new vintage of eqiupment which adds to capacity only in the next period. Output in period t, $Y(t)$ is given by

$$Y(t) = b[I(t-1) + I(t-2) + ... + I(t-T)] \tag{2.33}$$

where b is the output-equipment ratio which is assumed to be same for all the vintages, $I(t)$ is the magnitude of investment in period t. The oldest vintage of equipment that is in use in period t is $I(t-T)$.

The consumption behaviour of surplus earners is captured by assuming that the consumption propensity out of aggregate profit is an increasing function of the aggregate profit.[44] The idea is that in developing countries any individual surplus earner can actually access goods consumed in the advanced world, say luxury goods, only if he/she can afford a minimum threshold level of expenditure. Prior to this threshold consumption propensity out of surplus is close to zero and beyond the threshold is close to one. For the surplus earners as a whole the consumption propensity is a weighted average of near zero values to near one values, where weights are given by the distribution of profit among the surplus earners. As aggregate profit increases more and more individual surplus earners cross the threshold expenditure required to access the luxury goods. This shifts the weights more in favour of the near one values and therefore the consumption propensity out of aggregate profit increases. Since consumption and savings propensity out of aggregate profit add upto one, savings propensity out of aggregate profit decreases as the consumption propensity increases due to increase in aggregate profit. Patnaik assumes that the savings propensity out of aggregate profit in any period to be a decreasing function of investment in that period.[45] Therefore, assuming wages are entirely consumed, investment savings equality implies that the

[44] It is assumed that the surplus of output over the real wage bill is entirely profit.

[45] The argument for this assumption is "...overall surplus is a sum of consumption out of surplus and investment, which is autonomous...". (Patnaik (2007), pp no. 2078) Thus it is implied that the autonomous investment determines the overall surplus and consumption out of it. However even if investment in a given period is assumed to be constant, it determines the level of overall surplus and the consumption out of surplus only in the short run equilibrium when savings become equal to investment. Thus making savings propensity out of surplus a decreasing function of the level of investment captures a relationship between savings and the total surplus which holds in equilibrium positions rather than in general.

level of aggregate profit in period t, $\Pi(t)$ is

$$\Pi(t) = \frac{I(t)}{s(I(t))} \tag{2.34}$$

where $s(I(t))$ is the savings propensity out of profit and $s'(I(t)) < 0$. To keep the model simple Patnaik uses a specific functional form for savings propensity:

$$s(I(t)) = \frac{A}{I(t)} \tag{2.35}$$

where A is a constant.[46] If the savings out the aggregate profit is given by $S(t) = \sqrt{A\Pi(t)}$ then equation (2.35) holds in the equilibrium when $I(t) = S(t)$. From equations (2.34) and (2.35), it follows that the growth rate of profit in period t is given by

$$g_\Pi(t) = \frac{\Pi(t)}{\Pi(t-1)} - 1 = (\frac{I(t)}{I(t-1)} - 1)(\frac{I(t)}{I(t-1)} + 1) \tag{2.36}$$

The investment function in Patnaik (2007) is such that the growth rate of investment in period $t+1$ is a linear function of the growth rate of aggregate profit in period t. That is,

$$g_I(t+1) = a g_\Pi(t) \tag{2.37}$$

where $g_I(t+1) = \frac{I(t+1)}{I(t)} - 1$ is the growth rate of investment in period (t+1) and $0 < a < 1$ is a constant.

Substituting for $g_\Pi(t)$ from equation (2.36) in (2.37), we obtain,

$$g_I(t+1) = a\{(\frac{I(t)}{I(t-1)} - 1)(\frac{I(t)}{I(t-1)} + 1)\}$$

[46]Patnaik assumes that $A \leq I(t)$ so that for all $t \geq 0$, $s(I(t)) \leq 1$. However in model in which $I(t)$ can take any value betweem zero and infinity, it cannot be always ensured that $I(t)$ is greater than or equal to A.

or,

$$g_I(t+1) = 2ag_I(t) + a(g_I(t))^2 \tag{2.38}$$

Equation (2.38) has two equilibria: Zero growth of investment and a positive equilibrium growth rate of investment $g_I^* = \frac{(1-2a)}{a}$ as long as $a < \frac{1}{2}$. When investment grows at g_I^* in every period then from equation (2.37), aggregate profit in the economy grows at a constant rate $\frac{g_I^*}{a}$ every period, which is greater than g_I^* because $a < 1$.

Patnaik argues that in a situation of constant growth of investment and constant real wage rate, if aggregate profit grows at a constant rate greater than the growth rate of investment then share of profit in output rises over time. Further since, the output growth rate is a weighted average of the growth rate of profit and the growth rate of the wage bill, where the respective weights are the profit share and the wage share, and the profit share rises every period, both the growth rates of output and wage bill are not constant but keep changing because the equipment-mix in the economy is not constant.[47]

The positive equilibrium g_I^* of the equation (2.38) is unstable while the zero growth equilibrium is stable. This is illustrated in figure 2.4 where the curve for $g_I(t+1)$ intersects the 45 degree-line from below. This means that whenever $g_I(t)$ lies on the right hand side of g_I^*, $g_I(t+1)$ is greater than $g_I(t)$ while whenever $g_I(t)$ lies on the left hand side of g_I^*, $g_I(t+1)$ is less than $g_I(t)$. Thus if in any period the economy experiences a growth rate of investement greater than g_I^* then there is an acceleration in investment growth in subsequent years while on the other hand if it experiences a growth rate of

[47]This is because T is an endogenous variable.

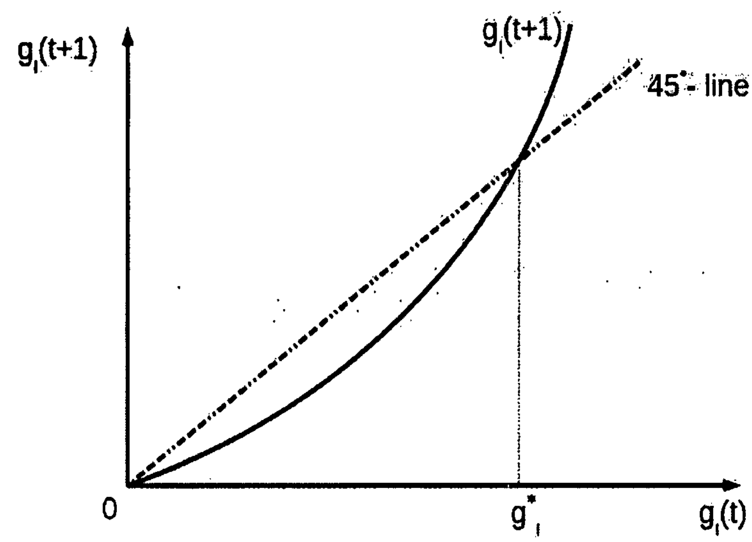


Figure 2.4

investement less than g_I^* then there is an deceleration in investment growth in subsequent years. The positive growth equilibrium in the 'structural-cum-technological' change model of Patnaik possesses a Harrod like *knife-edge* stability property. In contrast to g_I^*, the zero growth solution of equation (2.38) is locally stable. For all values of g_t between zero and g_I^*, the curve for $g_I(t+1)$ lies below the 45 degree-line. Thus whenever $g_I(t)$ is less than g_I^*, $g_I(t+1)$ is less than $g_I(t)$ implying a decline in the growth rate of investment period after period.

Patnaik combines a convex shaped 'technical progress function', mentioned earlier in section 2.8, with equation (2.38) to examine conditions under which the economy can experience accelerating growth of investment and decelerating growth of employment. *Knife-edge* stability property of the positive growth equilibrium makes this model more suitable to study volatility of the process of economic growth than explaining a sustained high growth experience for a considerable amount of time. This is because despite the fact the model does allow for accelerated growth in investment and possibly output (only if in some period economy experiences an investment growth rate greater than g_I^*), a sufficiently strong negative shock in any given period can push the economy into stagnation. Though Patnaik argues that 'structural-cum-technological' change provides for a case of *exhilaration* in developing economies, his formal model predicts that such *exhilaration* can only be a temporary phenomenon.

In the next chapter we present a model of profit-led growth in a developing economy where the driving force of economic growth is the same process of 'structural-cum-technological' change because of growing income of the rich. However there are three substantial differences with the model of Patnaik (2007). First, consumption of the rich in the economy not only depends on the surplus of output over wages but also on the rate at which new luxury goods are made available in the economy by the firms. Second, investment in the economy depends on both the level of profit and the rate at which new luxury goods are introduced. If new luxury goods are introduced at a faster rate then there is a faster rate of expansion in investment opportunities for the firms. If cost of imitation is low then a faster rate of introduction of new goods boosts the level of investment. In our model it is the rate of introduction of new luxury goods which serves as the link between changing composition of demand of the richer section of the population and investment rather than the level of profit.

And finally, we use a 'technical progress function' where rate of growth of labour productivity in the luxury goods sector (the sector catering to the demand of the richer section of the population) at a given point of time is an increasing concave function of the growth rate of profit. Like Patnaik, technological change in the luxury goods sector happens only through imitation. However at any given point of time we assume that technological possiblities of the economy to be given. This makes imitating highly sophisticated technology, as long as technological capabilities have not developed sufficiently, a costly affair. Therefore we assume the curvature of our 'technical progress function' to be concave rather than convex as in Patnaik's model.

We show that under certain conditions the economy experiences positive and stable (locally stable) steady growth rates of investment and profit. There is a steady growth of labour productivity in the luxury goods sector. Along this steady growth path of investment and profit, in periods when government policy measures increases the share of profit in output, the economy witnesses acceleration in the growth rate of output possibly with a deceleration in the growth rate of employment.

Chapter 3

Profit-led Growth in A Developing Economy

We will work with a closed economy model with no government budget. Since we are concerned with developing economies which have negative or negligble trade surpluses and in which the economic policy regime emphasizes on keeping a check on government expenditure, we want to focus on the processes of economic growth based on the private economy and the domestic market. This economy is neatly divided into two classes- capitalists and workers. The capitalists own all the means of production, i.e. capital. They carry out production by combining their capital with hired labour in order to earn profit. The workers on the other hand have only labour which they sell to the capitalists in return for wages.

The two kinds of income in this economy- profit and wages- are spent differently on different goods. The workers spend all their wages on the consumption of a subsistence good. The capitalists consume a part of their profit and save the rest. Capitalists consume only luxury goods. In the context of our model we define luxury goods to be goods which have been developed in the advanced countries and are initially available for consumption only in these economies. We assume that luxury goods are made available in this economy only through imitation of foreign production technologies. There are only two sectors in the economy- the luxury goods sector and the non-luxury goods sector. In the luxury goods sector, luxury goods and investment goods required to produce luxury goods are produced while in the non-luxury goods sector, the subsistence good and the investment goods required to produce the subsistence good are produced.[1]

We assume that the level of consumption out of profit increases not only when the level of profit increases but also, at the same level of profit, if more and more new luxury goods make their way into the market. In other words, we assume that consumption out of profit is directly related to both the level of profit and the rate at which new luxury goods are introduced in the market.

Following Patnaik (2007), we assume that the production technology associated with new luxury goods are more labour saving. over time goods with more sophisticated technologies and higher labour productivity are introduced in the advanced countries. So there is a hierarchy of goods in place in these countries. Whenever we refer to luxury goods as more sophisticated or high-end luxury goods we are referring to goods which are relatively higher up in the hierarchy..

To be able to compare the labour productivities associated with various luxury goods, we assume that labour productivity to be higher for new luxury

[1]Investment goods are intermediate goods.

goods not in a physical sense but in terms of value of output per unit labour.[2] Which means that we assume that there exists a ranking of the luxury goods that are introduced in the economy under consideration, such that the production techniques of newer luxury goods are associated with higher labour productivity[3].

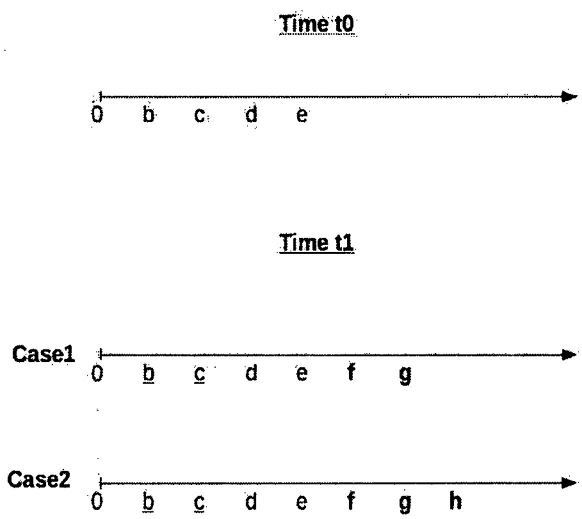
We also assume that the luxury goods are imperfect substitutes in the sense that as newer luxury goods are made available in the market the older luxury goods tend to disappear because their demand falls. Nevertheless, at any point of time there exists a vector of luxury goods ranked from the oldest to the newest or equivalently according to the non-decreasing order of labour productivity associated with their respective production techniques.[4]

We will assume that the faster is the rate at which new luxury goods are introduced in this economy, the higher is the rate of change in the labour productivity of the luxury goods sector, $\dot{a}$. This is because if at any point of time new luxury goods are introduced at a faster rate then at that point of time more of new luxury goods will be demanded than old luxury goods compared to a situation where there is a slower rate of introduction of luxury goods. Labour productivity of the luxury goods sector, a, will increase at a higher rate because one, a faster rate of introduction means that there are more goods with higher associated labour productivities. And two, since the

[2]The values of output of various goods are calculated in terms of the subsistence good, which we assume to be the nummeraire.

[3]Henceforth we use labour productivity to mean value of output per unit labour and output to mean output expressed in value terms.

[4]We assume that if more than one luxury goods are introduced at the same point of time then the labour productivity associated with the production techniques of all these goods is same.



Note- letters in bold are new luxury goods and
letters underlined are old goods which have gone out of the market.

Figure 3.1

luxury goods are substitutes in the sense described above, the market share of old luxury goods (i.e., the ratio of value of old luxury goods output to the value of total output of the luxury good sector) decreases more when new luxury goods are introduced at a faster rate.

Figure 3.1 shows an example to illustrate our assumption. Suppose at t0 point of time, there are four luxury goods in the market- b, c, d,and e- where b is the oldest and e is the newest luxury good. Assume that the labour productivities associated with b, c, d and e are 1, 2, 3, and 4 respectively. Since at any point of time more of new luxury goods are demanded and produced than old luxury goods, assume the market shares of b, c, d, and e are $\frac{1}{10}$, $\frac{1}{5}$, $\frac{3}{10}$ and $\frac{2}{5}$ respectively. Let the total output of luxury goods sector be Y_a. Then using the assumed labour productivties and market shares, we can calculate that $\frac{Y_a}{10}$, $\frac{Y_a}{10}$, $\frac{Y_a}{10}$ and $\frac{Y_a}{10}$ are respectively the employment in the production of b, c, d,and e at time t0. Therefore the total employment in the luxury goods sector at time t0 is $L_a = \frac{4}{10}Y_a$. The labour productivity of the luxury good sector at time t0 then is $a = \frac{Y_a}{L_a} = 2.5$.

At the instant of time t1, let us imagine two cases. In case 1, two new luxury goods are introduced- f and g- while in case 2, three new luxury goods are introduced- f, g and h. Labour productivities assosiated with these new luxury goods are greater than the labour productivity associated with e, the newest luxury good at the previous instance of time t0. We will assume that labour productivety associated with new luxury goods f, g and h to be 5. Since we assume that as new luxury goods are introduced old luxury goods tend to disappear from the market, we assume that in both the cases only b and c go out of the market.

Consider case 1 shown by the middle arrow in figure 3.1. At t1 point of time, four luxury goods exist- d, e, f and g. Given our assumptions, demand in market has shifted away from the old luxury goods to the new luxury goods. So we will assume that the combined market shares of d and e, has fallen from seventy percent to fifty percent. Specifically we will assume that the market shares of d, e, f and g are $\frac{1}{6}$, $\frac{1}{3}$, $\frac{1}{4}$ and $\frac{1}{4}$ respectively. Then using the assumed labour productivties and market shares, we can calculate that $\frac{Y_a}{18}$, $\frac{Y_a}{12}$, $\frac{Y_a}{20}$, and $\frac{Y_a}{20}$ are respectively the employment in the production of d, e, f and g. The total employment in the luxury goods sector then is $L_a = \frac{43}{180}Y_a = 4.186Y_a$. Labour productivity of luxury goods sector at t1 point of time, $a = \frac{Y_a}{L_a} = 4.186$ Thus the change in labour productivity is $4.186 - 2.5 = 1.686$.

Now consider case 2 shown by the bottom arrow in figure 3.1. In this case at t1 point of time, five luxury goods exist- *d, e, f, g* and *h*. Since in this case more new luxury goods exist at t1 point of time than in case 1, we will assume that demand in the market for the existing old luxury goods, *d* and *e*, is even less than in case 1. Let us assume that the combined market shares of *d* and *e* at t1 point of time in this case has fallen to forty percent from seventy percent at time t0. Specifically, let us assume that the market shares of *d, e, f, g* and *h* are $\frac{2}{15}$, $\frac{4}{15}$, $\frac{1}{5}$, $\frac{1}{5}$ and $\frac{1}{5}$ respectively. Again using the assumed labour productivties and market shares, we can calculate that $\frac{2Y_a}{45}$, $\frac{Y_a}{15}$, $\frac{Y_a}{25}$, $\frac{Y_a}{25}$ and $\frac{Y_a}{25}$ are respectively the employment in the production of *d, e, f, g* and h. The total employment in the luxury goods sector then is $L_a = \frac{52}{225}Y_a = 4.326Y_a$. Labour productivity of luxury goods sector at t1 point of time, $a = \frac{Y_a}{L_a} = 4.326$ Thus the change in labour productivity is $4.326 - 2.5 = 1.826$.

Thus in case 2 when more new luxury goods are introduced compared to case 1, the rate of change in the labour productivity of the luxury goods sector is also greater. Thus we will use the rate of change of labour productivity of the luxury goods sector, $\dot{a}$, to proxy the rate of introduction of new luxury goods in the economy.

We can therefore describe consumption out of profit, C, by the following function,

$$C = C(\Pi, \dot{a}) \tag{3.1}$$

with $0 < C_\Pi < 1$ and $C_{\dot{a}} > 0$, where Π is the aggregate net profit and C_Π and $C_{\dot{a}}$ are the partial derivatives of C with respect to Π and $\dot{a}$ respectively. Consumption out of profit, C, depends positively on the level of aggregate profit, Π, and the rate of change of labour productivity in the luxury goods sector, $\dot{a}$.

Since the workers do not save, savings for the economy is given by

$$S = \Pi - C(\Pi, \dot{a})$$

or,

$$S = S(\Pi, \dot{a}) \tag{3.2}$$

$0 < C_{\Pi} < 1$ and $C_{\dot{a}} > 0$ imply that $0 < S_{\Pi} < 1$ and $S_{\dot{a}} < 0$ where S_{Π} and $S_{\dot{a}}$ are the partial derivatives of S with respect to Π and $\dot{a}$ respectively. Savings in the economy, S, depends positively on the level of profit, Π, and negatively on the rate of change of labour productivity in the luxury goods sector, $\dot{a}$.

Net investment in this economy is assumed to depend on the current level of profit and the rate at which new luxury goods are introduced in the market. A high current level of aggregate profit is the predictor of a high future level of demand in the economy under the assumption of static expectations and also a high level of aggregate profit eases the financing constraints on the capitalists' decision to invest.[5] Therefore, we assume investment in the economy to positively depend on the current level of profit.

The relationship between the rate at which new luxury goods are introduced and investment is ambiguous and depends on the ease with which firms can imitate the production techniques of the new goods.[6] Given our assumptions about consumption demand out of profit, a higher rate of introduction new

[5]Kalecki, M. (1969)

[6]Henceforth by investment we mean net investment.

luxury goods into the market is associated with more opportunities to invest for the firms and all firms would like to invest at a higher rate in the production of new luxury goods.

On the other hand, if cost of imitation is very high, say due to strict enforcement of intellectual property rights, then at any point of time only a few firms will invest in the production of new luxury goods. Since we have assumed that as new luxury goods are introduced in the market older ones tend to disappear, firms producing old luxury goods, unable to get access to production techniques of the relatively new luxury goods, will hold back new investment on their existing plants and let their capital stock depreciate. Moreover if some of the old luxury goods are forced out of the market as new luxury goods are introduced, firms producing these goods will have to shut down in case they can not imitate production technology of new luxury goods.

Since we proxy the rate at which new luxury goods are introduced in the market by the rate of change of labour productivity of the luxury goods sector, $\dot{a}$, investment in the economy depends on $\dot{a}$. The impact of $\dot{a}$ on investment can be both positive or negative depending upon the ease with which firms can imitate the production techniques of new luxury goods and the impact of new luxury goods on the planned addition to the production capacity of firms producing old luxury goods.

Thus investment in the economy, I, is given by the following function,

$$I = I(\Pi, \dot{a}) \tag{3.3}$$

with $I_\Pi > 0$ where I_Π is the partial derivative of I with respect to Π, while there is no restriction on the sign of $I_{\dot{a}}$, the partial derivative of I with respect to $\dot{a}$.

Whenever investment in the economy is greater than savings, either price adjustment happens which raises the share of profit in output leaving aggregate output level constant or the level of aggregate output increases leaving share of profit in the aggregate output unchanged or both the adjustments happen simultaneously. In any case whenever investment is more than savings, the aggregate level of profit will rise. Similarly when investment is less than savings, the aggregate level of profit will fall and when investment is equal to savings, the aggregate level of profit will remain unchanged. This process of change in the aggregate level of profit due to mismatch between investment and savings is conveniently captured by the following equation.

$$(\dot{\ln \Pi}) = \alpha[\ln(\frac{I}{S})] = \alpha[\ln I - \ln S] \tag{3.4}$$

where α is a positive constant.

Differentiating equation (3.4) with respect to time we get,

$$\dot{g_{\Pi}} = \alpha[g_I - g_S] \tag{3.5}$$

where $\alpha > 0$ and $\dot{g_{\Pi}}$ is the rate of change in g_{Π} the growth rate of aggregate profit, g_I is the rate of growth of investment and g_S is the rate of growth of savings.[7]

[7]Bhaduri (2006) uses a general form function, instead of the natural logarithm function used in our model, to derive an expression for the rate of change in the growth rate of ouput, $\dot{g_Y}$, similar to equation (3.5), i.e., $\dot{g_Y} = \alpha[g_I - g_S]$ with $\alpha > 0$ by assuming that any mismatch between investment and savings gives rise only to output adjustments. However to get the expression $\dot{g_Y} = \alpha[g_I - g_S]$ from the general form function it is assumed that any deviation of investment, I, from an initial commodity market clearing equilibrium, $I = S$,

Differentiating equation (3.2) with respect to time we get,

$$\dot{S} = S_{\Pi}\dot{\Pi} + S_{\dot{a}}\frac{d\dot{a}}{dt}$$

where $0 < S_{\Pi} < 1$ and $S_{\dot{a}} < 0$. Using simple manipulations we can rewrite the above expression as

$$\frac{\dot{S}}{S} = (\frac{\Pi S_{\Pi}}{S})\frac{\dot{\Pi}}{\Pi} + (\frac{\dot{a}S_{\dot{a}}}{S})(\frac{1}{\dot{a}}\frac{d\dot{a}}{dt})$$

or,

$$g_S = \sigma_{S,\Pi}(g_{\Pi}) + \sigma_{S,\dot{a}}(\frac{1}{\dot{a}}\frac{d\dot{a}}{dt}) \qquad (3.6)$$

where $\sigma_{S,\Pi} > 0$ and $\sigma_{S,\dot{a}} < 0$ for $\dot{a} > 0$. $\sigma_{S,\Pi}$ and $\sigma_{S,\dot{a}}$ are elasticities of the savings function with respect to aggregate profit and the rate of change of labour productivity in the luxury goods sector (or the rate of introduction of new luxury goods). We assume them to be constant.

Similarly differentiating equation (3.3) with respect to time we get,

$$\dot{I} = I_{\Pi}\dot{\Pi} + I_{\dot{a}}\frac{d\dot{a}}{dt}$$

where $I_{\Pi} > 0$. Again, using simple manipulations we can rewrite the above expression as

$$\frac{\dot{I}}{I} = (\frac{\Pi I_{\Pi}}{I})\frac{\dot{\Pi}}{\Pi} + (\frac{\dot{a}I_{\dot{a}}}{I})(\frac{1}{\dot{a}}\frac{d\dot{a}}{dt})$$

or,

$$g_I = \sigma_{I,\Pi}(g_{\Pi}) + \sigma_{I,\dot{a}}(\frac{1}{\dot{a}}\frac{d\dot{a}}{dt}) \qquad (3.7)$$

stays aribitrarily close to the value of investment at the initial equilibrium. Moreover it is assumed that whenever $I = S$, output grows at some equilibrium rate, g_Y^*, in contrast to our contention that where $g_{\Pi} = 0$ whenever $I = S$. We simply argue that demand side adjustment in the economy, which is the focus of our model, stops whenever $I = S$.

where $\sigma_{I,\Pi} > 0$. $\sigma_{I,\Pi}$ and $\sigma_{I,\dot{a}}$ are elasticities of the investment function with respect to aggregate profit and the rate of change of labour productivity in the luxury goods sector. Like the elasticities of the savings function, we also assume that $\sigma_{I,\Pi}$ and $\sigma_{I,\dot{a}}$ are constants in our analysis.

Technological change in the luxury goods sector is endogenously driven by the growth of aggregate profit in the economy. Any increase in the growth rate of aggregate profit in the economy impacts both the demand and supply of luxury goods. On one hand, increase in the growth rate of aggregate profit increases the incomes of the profit earners at a faster rate. Thus their ability to consume to high-end of the goods available in the developed world increases at a faster rate.[8] On the other hand, the ability of the firms to meet the cost of imitation also increases at a faster rate as the growth rate of agregate profit increases. Therefore when the growth rate of aggregate profit increases it becomes profitable to introduce more of the high-end goods available in the developed world. The high-end goods in the developed world are associated with much higher labour productivities than the existing luxury goods in this economy. This combined with our assumption that the old luxury goods tend to disappear from the market with the introduction of the new luxury goods, implies that the labour productivity of the luxury goods sector tends to increase at higher rates.

Although at any point of time it becomes profitable to introduce more of the goods available in the developed world if aggregate profit grows at a higher rate, the current technological capablities of firms in the economy is commensurate with the technological requirements of the existing luxury

[8]Patnaik (2007)

goods being produced within the economy. It is reasonable to assume that as one moves up the hierarchy of goods being produced in the advanced countries, technological requirement of production become much more sophisticated compared to the current technological capabilities of firms in the economy. Thus as more and more new luxury goods are introduced in the economy at a point in time, the actual cost of imitation and introduction of additional new luxury goods increases. Therefore we assume that at any point of time, the rate of growth of labour productivity of the luxury goods sector in this economy increases with an increase in the growth rate of aggregate profit but at a decreasing rate. This relationship between the growth rate of labour productivity in the luxury goods sector, g_a and the growth rate of aggregate profit is given by the following equation.

$$g_a = \phi(g_\Pi) \tag{3.8}$$

with $\phi(0) = 0$ and for all $g_\Pi \in [0, \infty)$, $\phi'(g_\Pi) > 0$ and $\phi''(g_\Pi) < 0$. Figure 3.2 shows the graph of the function ϕ.

Patnaik (2007) assumes that the growth rate of labour productivity is an increasing convex function of the growth rate of investment, which in turn is an increasing function of the growth rate of aggregate profit. It is argued that the Kaldor-Mirrlees(1962) kind of technological progress function, is not applicable to in a developing economy where there is "immense possibility of imitating technology".[9] There is no given set of knowledge to be progressively used up but rather with increasing investment more investments in new projects, "where the minimum scale to employ new technology can be reached"[10], will be taken up. This we feel implicitly assumes that as the

[9]Patnaik (2007), pp no. 2079
[10]ibid., pp no.2079

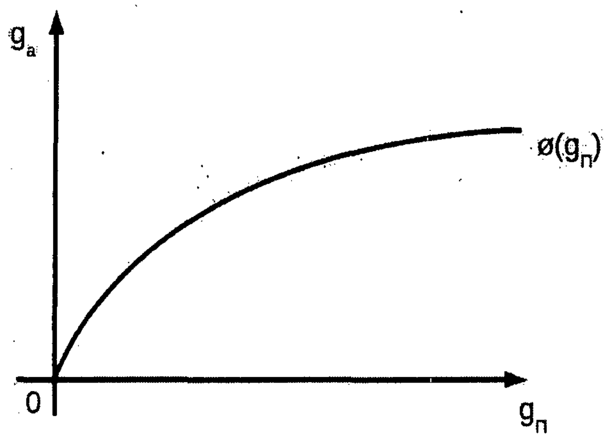


Figure 3.2

economy moves up the hierarchy of goods in the developed economies at any point of time, the cost of moving from one step to the next in the hierarchy goes down. Since we are discussing the rate of introduction of new luxury goods at a given point of time, where the technological capabilities in the economy are given, it is difficult to believe that at the margin the cost of introducing new luxury goods will go down. Therefore we think $\phi''(g_\Pi) < 0$ to be a more plausible assumption than $\phi''(g_\Pi) > 0$.

The growth rate of labour productivity in the luxury goods sector by defination is $g_a = \frac{\dot{a}}{a}$. This along with equation (3.8) implies that,

$$\dot{a} = a\phi(g_\Pi)$$

Taking natural logarithm of the above equation gives us,

$$\ln \dot{a} = \ln a + \ln \phi(g_\Pi)$$

Differentiating the above expression with respect to time we get,

$$\frac{1}{\dot{a}}\frac{d\dot{a}}{dt} = \frac{\dot{a}}{a} + \frac{\phi'(g_\Pi)}{\phi(g_\Pi)}\dot{g_\Pi}$$

or,

$$\frac{1}{\dot{a}}\frac{d\dot{a}}{dt} = \phi(g_\Pi) + \rho\frac{\dot{g_\Pi}}{g_\Pi} \tag{3.9}$$

where $\rho = \frac{g_\Pi}{\phi(g_\Pi)}\phi'(g_\Pi)$ is the elasticity of the growth rate of labour productivity in the luxury goods sector with respect to the growth rate of aggregate profit and $\rho > 0$ as $\phi' > 0$. We assume that ρ is a constant.

Substituting for $\frac{1}{\dot{a}}\frac{d\dot{a}}{dt}$ in equations (3.6) and (3.7) from equation (3.9) we get the rates of growth of savings and investment respectively,

$$g_S = \sigma_{S,\Pi}(g_\Pi) + \sigma_{S,\dot{a}}\{\phi(g_\Pi) + \rho\frac{\dot{g_\Pi}}{g_\Pi}\} \tag{3.10}$$

and

$$g_I = \sigma_{I,\Pi}(g_\Pi) + \sigma_{I,\dot{a}}\{\phi(g_\Pi) + \rho\frac{\dot{g_\Pi}}{g_\Pi}\} \tag{3.11}$$

Substituting for g_S and g_I from equations (3.10) and (3.11) respectively in equation (3.5), we get

$$\dot{g_\Pi} = \alpha[\sigma_{I,\Pi}(g_\Pi) + \sigma_{I,\dot{a}}\{\phi(g_\Pi) + \rho\frac{\dot{g_\Pi}}{g_\Pi}\} - \sigma_{S,\Pi}(g_\Pi) - \sigma_{S,\dot{a}}\{\phi(g_\Pi) + \rho\frac{\dot{g_\Pi}}{g_\Pi}\}]$$

Re-arranging the terms, we obtain

$$\dot{g_\Pi} = \frac{\alpha g_\Pi[(\sigma_{I,\Pi} - \sigma_{S,\Pi})g_\Pi + (\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\phi(g_\Pi)]}{[g_\Pi - \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho]} \tag{3.12}$$

where $\dot{g_\Pi}$ is not defined for $g_\Pi = \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho$. This implies that $\dot{g_\Pi}$ is not defined when $\phi(\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho) = \alpha(\sigma_{I,\Pi} - \sigma_{S,\Pi})(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho$.[11] We will

[11]By re-arranging equation (3.12) we get,

$$\dot{g_\Pi}[g_\Pi - \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho] = \alpha g_\Pi[(\sigma_{I,\Pi} - \sigma_{S,\Pi})g_\Pi + (\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\phi(g_\Pi)]$$

assume that $\phi(\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho) \neq \alpha(\sigma_{I,\Pi} - \sigma_{S,\Pi})(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho$.

Thus equation (3.12) expresses the rate of change of the growth rate of aggregate profit, $\dot{g_\Pi}$, as a function of the growth rate of aggregate profit, g_Π, in the economy. An equilibrium for equation (3.12), i.e., $\dot{g_\Pi} = 0$ implies either $g_\Pi = 0$ or $[(\sigma_{I,\Pi} - \sigma_{S,\Pi})g_\Pi + (\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\phi(g_\Pi)] = 0$.

3.1 Existence of A Positive Equilibrium Growth Rate of Aggregate Profit

From equation (3.12) it is obvious that a positive equilibrium growth rate of aggregate profit exists if and only if the equation

$$[(\sigma_{I,\Pi} - \sigma_{S,\Pi})g_\Pi + (\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\phi(g_\Pi)] = 0$$

has a positive solution. This implies that $\sigma_{I,\Pi} \neq \sigma_{S,\Pi}$ and $\sigma_{I,\dot{a}} \neq \sigma_{S,\dot{a}}$. Rearranging the above eqution gives us,

$$\phi(g_\Pi) = \frac{(\sigma_{S,\Pi} - \sigma_{I,\Pi})}{(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})} g_\Pi$$

or,

$$\phi(g_\Pi) = z g_\Pi$$

where $z = \frac{(\sigma_{S,\Pi} - \sigma_{I,\Pi})}{(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})}$, a constant. Define $\psi(g_\Pi) = \phi(g_\Pi) - z g_\Pi$. Thus equation (3.12) has a positive equilibrium growth rate of aggregate profit if and only if there exists a $g_\Pi > 0$ such that $\psi(g_\Pi) = 0$.

Substituting $\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho$ for g_Π in the above expression gives $\phi(\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho) = \alpha(\sigma_{I,\Pi} - \sigma_{S,\Pi})(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho$.

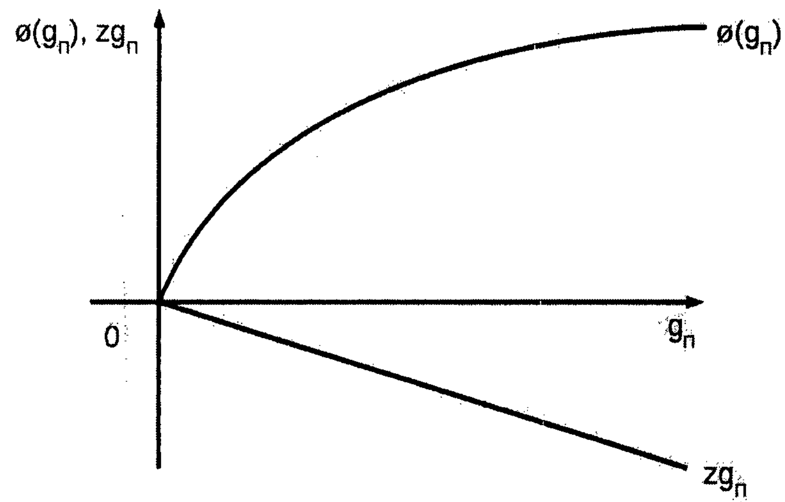


Figure 3.3

The necessary and sufficient conditions for the existence of a positive equilibrium growth rate of aggregate profit are discussed below.

Theorem 1 $[((\exists g_\Pi \in (0, \infty))(\psi(g_\Pi) = 0)) \longrightarrow (z > 0)]$

Proof. Suppose $[((\exists g_\Pi \in (0, \infty))(\psi(g_\Pi) = 0)) \wedge (z \leq 0)]$. Let $g^*_\Pi \in (0, \infty)$ be such that $\psi(g^*_\Pi) = 0$. Then, $(\psi(g^*_\Pi) = 0 \wedge z \leq 0)$ implies $\phi(g^*_\Pi) \leq 0$. Since $\phi(0) = 0$ and $\phi'(g_\Pi) > 0$ for all $g_\Pi \in [0, \infty)$, $\phi(g^*_\Pi) \leq 0$ implies that $g^*_\Pi \leq 0$. This contradicts our supposition that $g^*_\Pi \in (0, \infty)$. ■

Theorem 1 states that a necessary condition for the existence of a positive equilibrium growth rate of profit is $z > 0$. Figure 3.3 clearly shows that this result is trivial. If $z < 0$ then the only intersection between the straight line

zg_Π and the graph of the function $\phi(g_\Pi)$ is at g_Π equal to zero. The same is true in the case when $z = 0$. An implication of *Theorem 1* is that if there exists a positive equilibrium growth rate of profit then either $\sigma_{S,\Pi} > \sigma_{I,\Pi}$ and $\sigma_{I,\dot{a}} > \sigma_{S,\dot{a}}$ or $\sigma_{S,\Pi} < \sigma_{I,\Pi}$ and $\sigma_{I,\dot{a}} < \sigma_{S,\dot{a}}$. *Corollary 1.1* below states the above implication of *Theorem 1.*

Corollary 1.1 $[[(\sigma_{I,\dot{a}} \geq 0) \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)] \longrightarrow (\sigma_{S,\Pi} > \sigma_{I,\Pi})] \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| > |\sigma_{S,\dot{a}}|) \longrightarrow (\sigma_{S,\Pi} < \sigma_{I,\Pi})]]$

Proof. From (12), we know that $\sigma_{S,\dot{a}} < 0$. Therefore, $[(\sigma_{I,\dot{a}} \geq 0) \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)]]$ implies $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) > 0$. From *Theorem 1*, we know that $z \in (0, \infty)$. Thus $[(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) > 0 \wedge (z > 0)]$ implies $(\sigma_{S,\Pi} > \sigma_{I,\Pi})$. Similarly, $[(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| > |\sigma_{S,\dot{a}}|)]$ implies $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) < 0$. And $[(z > 0) \wedge (\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) < 0]$ implies $(\sigma_{S,\Pi} < \sigma_{I,\Pi})$. ■

The next theorem implies that a necessary condition for the existence of a positive equilibrium growth rate of aggregate profit is that the slope of the function ϕ at zero must be greater than z. Otherwise the graph of ϕ will lie below the straight line through the origin zg_Π for all $g_\Pi \in (0, \infty)$ because by assumption ϕ is a strictly concave function. Figure 3.4 shows this.

Theorem 2 $[[(z > 0) \wedge ((\exists g_\Pi \in (0, \infty))(\psi(g_\Pi) = 0))] \longrightarrow (\phi'(0) > z)]$

Proof. Suppose $[(z > 0) \wedge ((\exists g_\Pi \in (0, \infty))(\psi(g_\Pi) = 0))] \wedge (\phi'(0) \leq z)$. Since $(\phi''(g_\Pi) < 0)$, $(\phi'(0) \leq z)$ implies $((\forall g_\Pi \in (0, \infty))(\phi'(g_\Pi) < z))$. This implies $(\forall g_\Pi \in (0, \infty))(\psi'(g_\Pi) < 0))$. Since $\psi(0) = 0$, $((\forall g_\Pi \in (0, \infty))(\psi'(g_\Pi) < 0)$ implies $((\forall g_\Pi \in (0, \infty))(\psi(g_\Pi) < 0))$. This contradicts our supposition that

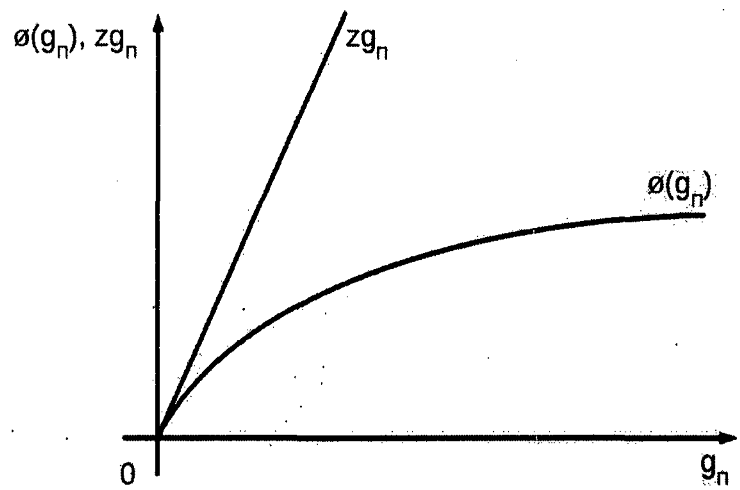


Figure 3.4

$((\exists g_\Pi \in (0,\infty))(\psi(g_\Pi) = 0))$. ■

Given $z > 0$ and $\phi'(0) > z$, *Lemma 3.1* below implies that if a positive equilibrium growth rate of aggregate profit exists then slope of the function ϕ at the equilibrium is less than z.

Lemma 3.1 $[[(z > 0) \wedge (\phi'(0) > z)] \longrightarrow [((\exists g_\Pi \in (0,\infty))(\psi(g_\Pi) = 0)) \longrightarrow (\psi'(g_\Pi) < 0)]]$.

Proof. Suppose $[[(z > 0) \wedge (\phi'(0) > z)] \wedge ((\exists g_\Pi \in (0,\infty))(\psi(g_\Pi) = 0))$. Let $g^*_\Pi \in (0,\infty)$ be such that $\psi(g^*_\Pi) = 0$. $\psi(0) = \psi(g^*_\Pi) = 0$. $\psi(g_\Pi)$ is a differentiable function in $(0, g^*_\Pi)$ and is continuous at 0 and g^*_Π. Therefore from *Rolle's Theorem*[12] it follows that $((\exists g_\Pi \in (0, g^*_\Pi))(\psi'(g_\Pi) = 0))$. Let $\hat{g_\Pi} \in (0, g^*_\Pi)$ be such that $\psi'(\hat{g_\Pi}) = 0$. Since $g^*_\Pi > \hat{g_\Pi}$ and $\psi''(g_\Pi) < 0$, it follows that $\psi'(g^*_\Pi) < 0$. ■

The next theorem states that given $z > 0$ and $\phi'(0) > z$, a necessary and sufficient condition for the existence of a positive equilibrium growth rate of aggregate profit is $\lim_{g_\Pi \to \infty} \phi'(g_\Pi) < z$. In other words, the slope of the function ϕ must be less than z for sufficiently large values of g_Π.

Theorem 3 $[[(z > 0) \wedge (\phi'(0) > z)] \longrightarrow [(\lim_{g_\Pi \to \infty} \phi'(g_\Pi) < z) \longleftrightarrow (\exists g_\Pi \in (0, \infty))(\psi(g_\Pi) = 0)]]$

Proof. Suppose $[(z > 0) \wedge (\phi'(0) > z)] \wedge (\lim_{g_\Pi \to \infty} \phi'(g_\Pi) < z)$. $\lim_{g_\Pi \to \infty} \phi'(g_\Pi) < z$ implies that for sufficiently large values of g_Π, $\psi'(g_\Pi) < 0$ because $\psi'(g_\Pi) = \phi'(g_\Pi) - z$. Let $\bar{g_\Pi} \in (0, \infty)$ such that $\psi'(\bar{g_\Pi}) < 0$. Since $\psi'(0) > 0$, $\psi'(\bar{g_\Pi}) < 0$ and $\psi'(g_\Pi)$ is a continuous function, it follows from the *Intermediate Value Theorem*[13] that there exists $g_\Pi \in [0, \bar{g_\Pi}]$ such that $(\psi'(g_\Pi) = 0)$. Let $\hat{g_\Pi} \in [0, \bar{g_\Pi}]$ such that $\psi'(\hat{g_\Pi}) = 0$. Since $\psi''(g_\Pi) = \phi''(g_\Pi) < 0$, $(\forall g_\Pi \in [0, \hat{g_\Pi}))(\psi'(g_\Pi) > 0)$. $\psi(0) = 0$ and $(\forall g_\Pi \in [0, \hat{g_\Pi}))(\psi'(g_\Pi) > 0)$ imply $(\forall g_\Pi \in (0, \hat{g_\Pi}])(\psi(g_\Pi) > 0)$. Also, $\psi''(g_\Pi) < 0$ and $\psi'(\hat{g_\Pi}) = 0$ imply that $(\forall g_\Pi \in (\hat{g_\Pi}, \infty))(\psi'(g_\Pi) < 0)$. Suppose $\lim_{g_\Pi \to \infty} \phi'(g_\Pi) = \lambda_1$ and $\lim_{g_\Pi \to \infty} \psi'(g_\Pi) = \lambda_2$. By assumption $\lambda_1 < z$. Therefore $\lim_{g_\Pi \to \infty} \psi'(g_\Pi) = \lambda_1 - z = \lambda_2 < 0$. Since $\psi''(g_\Pi) < 0$ it must be that for sufficiently large g_Π, $\psi'(g_\Pi) < -\epsilon$ where $\epsilon \in (0, |\lambda_2|)$. Let $\tilde{g_\Pi} \in (\hat{g_\Pi}, \infty)$ such that $((\forall g_\Pi \in [\tilde{g_\Pi}, \infty)(\psi'(g_\Pi) < -\epsilon))$. Since $[(\forall g_\Pi \in (0, \hat{g_\Pi}])(\psi(g_\Pi) > 0) \wedge ((\forall g_\Pi \in [\tilde{g_\Pi}, \infty)(\psi'(g_\Pi) < -\epsilon))]$ and

[12]See, for example Albrecht and Smith (2003), pp no. 106

[13]ibid., pp no. 95

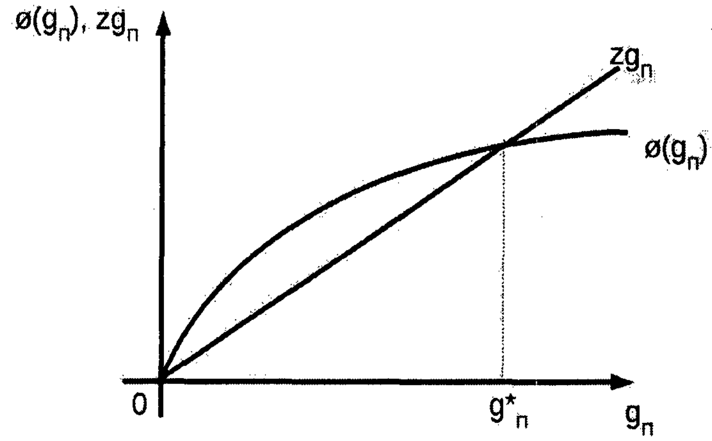


Figure 3.5

$\psi(g_\Pi)$ is a continuous function, it again follows from the *Intermediate Value Theorem* that there exists $g_\Pi \in (\hat{g_\Pi}, \tilde{g_\Pi})$ such that $\psi(g_\Pi) = 0$.

Next suppose $[(z > 0) \wedge (\phi'(0) > z)] \wedge ((\exists g_\Pi \in (0,\infty))(\psi(g_\Pi) = 0))$. Let $g^*_\Pi \in (0,\infty)$ such that $\psi(g^*_\Pi) = 0$. From *Lemma 3.1* we know that $\psi'(g^*_\Pi) < 0$. Since $\psi''(g_\Pi) < 0$, $((\forall g_\Pi \in [g^*_\Pi, \infty))(\psi'(g_\Pi) < 0))$. This implies that $\lim_{g_\Pi \to \infty} \psi'(g_\Pi) < 0$. Thus it follows that $\lim_{g_\Pi \to \infty} \phi'(g_\Pi) < z$. ■

We will henceforth assume that the necessary and sufficient conditions for the existence of a positive equilibrium growth rate of aggregate profit are satisfied. This means that we will assume $z > 0$, $\phi'(0) > z$ and $\lim_{g_\Pi \to \infty} \phi'(g_\Pi) < z$. From *Theorems 1,2* and *3*, we know that there exists $g_\Pi \in (0,\infty)$ such that $\psi(g_\Pi) = 0$. Let $g^*_\Pi \in (0,\infty)$ be such that $\psi(g^*_\Pi) = 0$. Figure 3.5 shows equilibrium growth rate of aggregate profit, g^*_Π. Since slope of $\phi(g_\Pi)$ is greater than z at 0 and is less than z at infinity, the curve for $\phi(g_\Pi)$ must intersect the line through the origin with slope z at some positive value of g_Π, less than infinity, because $\phi(g_\Pi)$ is a continuous function. Moroever, since $\phi(g_\Pi)$ is a strictly concave function, its slope is less than z at the intersection point and the intersection point is unique as shown in figure 3.5. We provide the formal proof below.

Corollary 3.1 g^*_Π is the unique positive equilibrium growth rate of aggregate profit.

Proof. Let $\bar{g_\Pi} \in (0, \infty)$ be such that $[(\psi(\bar{g_\Pi}) = 0) \wedge (\bar{g_\Pi} \neq g^*_\Pi)]$. Suppose $\bar{g_\Pi} > g^*_\Pi$. From *Lemma 3.1*, we have $\psi'(g^*_\Pi) < 0$. And we know that $\psi''(g_\Pi) < 0$. Therefore $((\forall g_\Pi \in (g^*_\Pi, \infty))(\psi'(g_\Pi) < 0))$. Since $\psi(g^*_\Pi) = 0$, $((\forall g_\Pi \in (g^*_\Pi, \infty)(\psi'(g_\Pi) < 0))$ implies $((\forall g_\Pi \in (g^*_\Pi, \infty))(\psi(g_\Pi) < 0))$. This implies $\psi(\bar{g_\Pi}) < 0$ because $\bar{g_\Pi} > g^*_\Pi$, which results in a contradiction because by supposition $\psi(\bar{g_\Pi}) = 0$. Next suppose $\bar{g_\Pi} < g^*_\Pi$. From *Lemma 3.1*, we have $\psi'(\bar{g_\Pi}) < 0$. And we know that $\psi''(g_\Pi) < 0$. Therefore $((\forall g_\Pi \in (\bar{g_\Pi}, \infty)\}(\psi'(g_\Pi) < 0))$. Since $\psi(\bar{g_\Pi}) = 0$, $((\forall g_\Pi \in (\bar{g_\Pi}, \infty))(\psi'(g_\Pi) < 0))$ implies $((\forall g_\Pi \in (\bar{g_\Pi}, \infty))(\psi(g_\Pi) < 0))$. This implies $\psi(g^*_\Pi) < 0$ because $g^*_\Pi > \bar{g_\Pi}$, which leads to a contradiction because by supposition $\psi(g^*_\Pi) = 0$. ■

Given that aggregate profit grows at the positive equilibrium rate g^*_Π, investment and savings in the economy grow at constant positive rates $g^*_I = \sigma_{I,\Pi} g^*_\Pi + \sigma_{I,\dot{a}} \phi(g^*_\Pi)$ and $g^*_S = \sigma_{S,\Pi} g^*_\Pi + \sigma_{S,\dot{a}} \phi(g^*_\Pi)$. Thus the equilibrium growth rates of investment and savings depend, apart from the equilibrium growth rate of aggregate profit, on the responsiveness of investment and savings to aggregate profits and the rate of introduction of new luxury goods in the economy and on the form of the function ϕ. Moreover from the definition of g_{Π}^* we know that in equilibrium $g_I^* = g_S^*$.

3.2 Stability of Positive Equilibrium Growth Rate of Aggregate Profit

In this section we assume that a positive equilibrium growth rate of aggregate profit exists and discuss the necessary and sufficient condtions for local stability of the equilibrium. Let $g_{\Pi}^* \in (0, \infty)$ be the equilibrium growth rate of aggregate profit. Re-arranging equation (3.12) we obtain,

$$\dot{g_{\Pi}} = \frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})g_{\Pi}\psi(g_{\Pi})}{[g_{\Pi} - \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho]} \tag{3.13}$$

Differentiating (3.13) with respect to g_{Π}, we get

$$\frac{d\dot{g_{\Pi}}}{dg_{\Pi}} = \frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g_{\pi})}{[g_{\Pi} - \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho]} + \frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})g_{\Pi}\psi'(g_{\Pi})}{[g_{\Pi} - \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho]}$$

$$- \frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})g_{\Pi}\psi(g_{\Pi})}{[g_{\Pi} - \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho]^2}$$

Substituting g_{Π}^* for g_{Π} in the above expression we get,

$$\frac{d\dot{g_{\Pi}}(g_{\Pi}^*)}{dg_{\Pi}} = \frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})g_{\Pi}^*\psi'(g_{\Pi}^*)}{[g_{\Pi}^* - \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho]} \tag{3.14}$$

where $\frac{d\dot{g_{\Pi}}(g_{\Pi}^*)}{dg_{\Pi}}$ is $\frac{d\dot{g_{\Pi}}}{dg_{\Pi}}$ evaluated at $g_{\Pi} = g_{\Pi}^*$.[14] The positive equilibrium growth rate of aggregate profit, g_{Π}^* is locally stable if and only if $\frac{d\dot{g_{\Pi}}(g_{\Pi}^*)}{dg_{\Pi}} < 0$.

The necessary and sufficient conditions for local stability of g_{Π}^* are discussed below.

[14]Expression for $\frac{d\dot{g_{\Pi}}(g_{\Pi}^*)}{dg_{\Pi}}$ is simpler than the expression for $\frac{d\dot{g_{\Pi}}}{dg_{\Pi}}$ because $\psi(g_{\Pi}^*) = 0$.

Theorem 4 g_Π^* is locally stable if and only if $[[(\sigma_{I,\dot{a}} \geq 0) \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)]] \wedge (g_\Pi^* > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)]$

Proof. Suppose $[(\sigma_{I,\dot{a}} \geq 0) \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)]] \wedge (g_\Pi^* > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)$. Since from equation (3.6) we have $\sigma_{S,\dot{a}} < 0$, $[(\sigma_{I,\dot{a}} \geq 0) \vee (\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)]$ implies $\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}} > 0$. And from *Lemma 3.1* we have $\psi'(g_\Pi^*) < 0$. It follows from equation (3.14) that $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}} > 0) \wedge (\psi'(g_\Pi^*) < 0) \wedge (g_\Pi^* > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)$ implies $\frac{d\dot{g}_\Pi(g_\Pi^*)}{dg_\Pi} < 0$ because $\alpha > 0$, and $g_\Pi^* > 0$. Now suppose g_Π^* is locally stable. Which means $\frac{d\dot{g}_\Pi(g_\Pi^*)}{dg_\Pi} < 0$. From *Lemma 3.1* we have $\psi'(g_\Pi^*) < 0$. Also $\alpha > 0$, $\rho > 0$, and $g_\Pi^* > 0$. Therefore $\frac{d\dot{g}_\Pi(g_\Pi^*)}{dg_\Pi} < 0$ implies $[(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}} > 0) \wedge (g_\Pi^* > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)] \vee [(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}} < 0) \wedge (g_\Pi^* < \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)]$. However, $[(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}} < 0) \wedge (g_\Pi^* < \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)]$ implies $g_\Pi^* < 0$, which is a contradiction because by assumption, $g_\Pi^* > 0$. Thus $\frac{d\dot{g}_\Pi(g_\Pi^*)}{dg_\Pi} < 0$ implies $[(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}} > 0) \wedge (g_\Pi^* > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)]$. And $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}} > 0)$ implies $[(\sigma_{I,\dot{a}} \geq 0) \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)]]$ because $\sigma_{S,\dot{a}} < 0$. ■

Theorem 4 implies that the economy can experience a stable equilibrium growth rate of aggregate profit, investment and savings if and only if two conditions are satisfied. First, the equilibrium growth rate of aggregate profit is sufficiently large. And second, either investment responds non-negatively to changes in the rate of introduction of new luxury goods or even when it responds negatively, the responsiveness of savings is more than the responsiveness of investment. In what follows in the rest of this section, we explain the necessary and sufficient conditions for local stability of the positive equilibrium growth rate of aggregate profit.

The growth rate of aggregate profit changes in the economy due to the difference between the rate of growth of investment and rate of growth of savings. That is, from equation (3.5), g_Π increases when $g_I > g_S$ and decreases when $g_I < g_S$. From equations (3.8), (3.10) and (3.11), the growth rate of investment in the economy is $g_I = \sigma_{I,\Pi} g_\Pi + \sigma_{I,\dot{a}} g_a + \frac{\sigma_{I,\dot{a}}\rho}{g_\Pi}\dot{g_\Pi}$ and the growth rate of savings in the economy is $g_S = \sigma_{S,\Pi} g_\Pi + \sigma_{S,\dot{a}} g_a + \frac{\sigma_{S,\dot{a}}\rho}{g_\Pi}\dot{g_\Pi}$. Thus the rate of change in the growth rate of aggregate profit depends on the relative impacts of the growth rate of aggregate profit, the growth rate of labour productivity in the luxury goods sector and the rate of change in the growth rate of aggregate profit itself on the growth rates of investment and savings in the economy.

The growth rate of labour productivity in the luxury goods sector, from equation (3.8), depends on the growth rate of aggregate profit in the economy. Therefore the rate of change in the growth rate of aggregate profit depends on the relative impacts of the growth rate of aggregate profit on the growth rates of investment and savings (both directly and indirectly, through the growth rate of labour productivity in the luxury goods sector) and the rate of change in the growth rate of aggregate profit itself. The following equation, obtained after substituting the expressions for g_I and g_S in equation (3.5), makes this point clear.

$$\dot{g_\Pi} = \alpha[\sigma_{I,\Pi} g_\Pi + \sigma_{I,\dot{a}}\phi(g_\Pi) - \sigma_{S,\Pi} g_\Pi - \sigma_{S,\dot{a}}\phi(g_\Pi)] + \frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho}{g_\Pi}\dot{g_\Pi}$$

If we re-arrange the above equation, using the definition of $\psi(g_\Pi)$, we get,

$$\dot{g_\Pi} = \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g_\Pi) + \frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho}{g_\Pi}\dot{g_\Pi} \qquad (3.15)$$

The right hand side of equation (3.15) is the impact of excess of growth rate of investment over the growth rate of savings on the the rate of change in the growth rate of aggregate profit. In the remaining discussion on the local stability conditions, we will refer to the excess of growth rate of investment over the growth rate of savings as the growth rate of the I/S ratio. That is the growth rate of the I/S ratio is equal to $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g_\Pi) + \frac{(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi}\dot{g_\Pi}$. Notice the first term in this expression is zero when $g_\Pi = 0$, i.e., $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g_\Pi) = 0$ when $g_\Pi = 0$, while the second term is zero when $\dot{g_\Pi} = 0$, i.e., $\frac{(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi}\dot{g_\Pi} = 0$ when $\dot{g_\Pi} = 0$. Therefore we can think of $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g_\Pi)$ as the component of the growth rate of the I/S ratio explained by g_Π and $\frac{(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi}\dot{g_\Pi}$ as the component of the growth rate of the I/S ratio explained by $\dot{g_\Pi}$.

The partial derivative of the first term on the right hand side of the equation (3.15) with respect to g_Π, $\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi'(g_\Pi)$, then captures the impact of g_Π on $\dot{g_\Pi}$ through the component of the growth rate of the I/S ratio which is explained by g_Π. On the other hand, the partial derivative of the second term on the right hand side of equation (3.15) with respect to $\dot{g_\Pi}$, $\frac{\alpha(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi}$, captures the impact of $\dot{g_\Pi}$ on itself through the component of the the growth rate of the I/S ratio which is explained by $\dot{g_\Pi}$.

From equation (3.15), it is clear that the rate of change in the growth rate of aggregate profit ($\dot{g_\Pi}$) has the same sign as the component of the growth rate of the I/S ratio explained by the growth rate of aggregate profit, $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g_\Pi)$, if and only if the impact of $\dot{g_\Pi}$ on the component of the growth rate of the I/S ratio explained by $\dot{g_\Pi}$, $\frac{(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi}$, is less than $\frac{1}{\alpha}$, i.e., the impact of $\dot{g_\Pi}$ on itself through the component of the growth rate of I/S ratio explained by $\dot{g_\Pi}$, $\frac{\alpha(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi} < 1$. Otherwise when $\frac{\alpha(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi} > 1$, the change in the the growth rate of aggregate profit has a sign opposite to the sign of the component of the growth rate of the I/S ratio explained by the growth rate of aggregate profit, $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g_\Pi)$.[15]

Suppose $[(\sigma_{I,\dot{a}} \geq 0) \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)]] \wedge (g^*_\Pi > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)$. $(g^*_\Pi > \alpha(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho)$ implies that for values of g_Π in a sufficiently small neighbourhood of g^*_Π, $\frac{\alpha(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi} < 1$. Then from the above discussion we know that for g_Π sufficiently close to g^*_Π, the rate of change in the growth rate of aggregate profit ($\dot{g_\Pi}$) has the same sign as the component of the growth rate of I/S ratio explained by the growth rate of aggregate profit $((\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\psi(g_\Pi))$.

$[(\sigma_{I,\dot{a}} \geq 0) \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)]]$ implies $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) > 0$ because $\sigma_{S,\dot{a}} < 0$. The indirect impact of a positive growth rate of aggregate profit through the growth rate of labour productivity of the luxury goods sector is therefore either to increase the growth rate of investment and decrease the growth rate of savings (when accessing production techniques of new luxury goods is relatively easy) or to decrease the growth rate of investment less than the growth rate of savings (when accessing production techniques of new luxury goods is relatively difficult). In either case, the indirect impact of a positive growth rate of aggregate profit on its rate of change is always positive, i.e., $\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\phi(g_\Pi) > 0$. However, from *Corollary 1.1*, $[(\sigma_{I,\dot{a}} > 0) \vee [(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| < |\sigma_{S,\dot{a}}|)]]$ implies $(\sigma_{S,\Pi} - \sigma_{I,\Pi}) > 0$. This means that the direct impact of a positive growth rate of aggregate profit on both the growth rate of investment and growth rate of savings is positive

[15]We have ruled out the case $\frac{\alpha(\sigma_{I,\dot{a}}-\sigma_{S,\dot{a}})\rho}{g_\Pi} = 1$ by assuming above that $\phi(\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho) \neq \alpha(\sigma_{I,\Pi} - \sigma_{S,\Pi})(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho$.

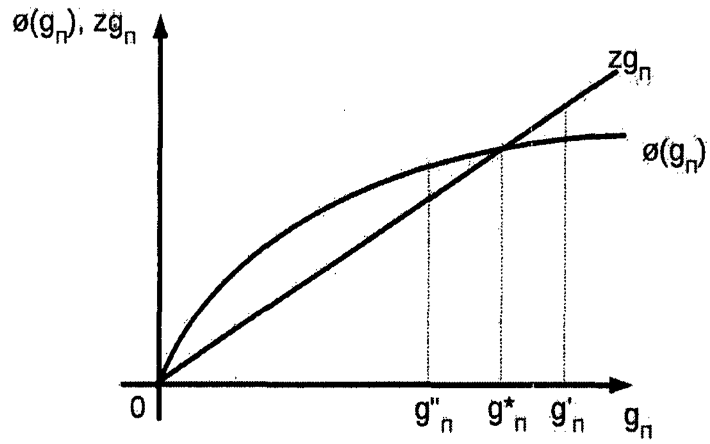


Figure 3.6

but the impact on the growth rate of savings is more than the growth rate of investment. So the direct impact of a positive growth rate of aggregate profit on its rate of change is negative, i.e., $(\sigma_{I,\Pi} - \sigma_{S,\Pi})\dot{g_\Pi} < 0$.

From the definition of g^*_Π, $\psi(g^*_\Pi) = 0$ and from *Lemma 3.1*, $\psi'(g^*_\Pi) < 0$. This means for g_Π close to g^*_Π, if $g_\Pi < g^*_\Pi$ then $\psi(g_\Pi) > 0$ and if $g_\Pi > g^*_\Pi$ then $\psi(g_\Pi) < 0$. Figure 3.6 shows two values of g_Π, g'_Π and g''_Π, close to g^*_Π. Since $g'_\Pi > g^*_\Pi$, $\psi(g'_\Pi) < 0$. This implies from the defination of $\psi(g_\Pi)$ that $\alpha(\sigma_{S,\Pi} - \sigma_{I,\Pi})g'_\Pi > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\phi(g'_\Pi)$. The direct negative impact of the growth rate of aggregate profit on the rate of change in the growth rate of aggregate profit dominates the indirect positive impact. Thus the component of the growth rate of I/S ratio explained by g_Π at g'_Π, $\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g'_\Pi) < 0$. Since the rate of change in g_Π has the same sign as the component of the growth rate of the I/S ration explained by g_Π. It follows that $\dot{g_\Pi} < 0$ at g'_Π. Therefore the growth rate of aggregate profit, g_Π, decreases at g'_Π and continues to decrease with g_Π asymptotically approaching g^*_Π, where the direct and the indirect impacts of g_Π on itself cancel out each other.

Similarly at g''_Π, since $\psi(g''_\Pi) > 0$ because $g''_\Pi < g^*_\Pi$, we have $\alpha(\sigma_{S,\Pi} - \sigma_{I,\Pi})g''_\Pi < \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\phi(g''_\Pi)$. In this case the indirect positive impact of the growth rate of aggregate profit on its rate of change dominates the direct negative impact,so that the growth rate of aggregate profit, g_Π, increases at g''_Π and continues to increase with g_Π asymptotically approaching g^*_Π. Thus g^*_Π is locally stable because the growth rate of aggregate profit in the economy from values close to g^*_Π tends to converge at g^*_Π. However this convergence crucially depends on g^*_Π being greater than $\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho$. Otherwise if $(g^*_\Pi < \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)$ then for g_Π close to g^*_Π, $\frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho}{g_\Pi} > 1$. Then from equation (3.15), g_Π increases at g'_Π and decreases at g''_Π implying that g^*_Π is an unstable equilibrium.

Next suppose $[(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| > |\sigma_{S,\dot{a}}|)]$. This implies $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) < 0$. Notice $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) < 0$ means that for all $g_\Pi > 0$, $\frac{\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho}{g_\Pi} < 1$. Thus from equation (3.15) we know that the rate of change in the growth rate of aggregate profit $(\dot{g_\Pi})$ has the same sign as the component of the growth rate of I/S ratio explained by g_Π, i.e., $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g_\Pi)$.

Since $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) < 0$, the indirect impact of the growth rate of aggregate profit through the growth rate of labour productivity of the luxury goods sector is to decrease the growth rate of investment more than the the growth rate of savings. Thus the indirect impact of the growth rate of aggregate profit on its rate of change is negative. However, from *Corollary 1.1*, $\{(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| > |\sigma_{S,\dot{a}}|)\}$ implies $(\sigma_{S,\Pi} - \sigma_{I,\Pi}) < 0$. This means that the direct impact of the growth rate of aggregate profit on the growth rate of investment is larger than on the growth rate of savings. Thus the direct impact of the growth rate of aggregate profit on its rate of change is positive.

Now let us see what happens at g'_Π and g''_Π, shown in figure 3, in this case when $[(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| > |\sigma_{S,\dot{a}}|)]$. At g'_Π we know that $\psi(g'_\Pi) < 0$. Using the definition of $\psi(g_\Pi)$, $\psi(g'_\Pi) < 0$ and $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) < 0$ imply $\alpha(\sigma_{S,\dot{a}} - \sigma_{I,\dot{a}})\phi(g'_\Pi) < \alpha(\sigma_{I,\Pi} - \sigma_{S,\Pi})g'_\Pi$. This means at g'_Π, the positive direct impact of the growth rate of aggregate profit on its rate of change dominates the indirect negative impact. That is the component of growth rate of I/S ratio explained by g_Π at g'_Π, $\alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\psi(g'_\Pi) > 0$. Since $\dot{g_\Pi}$ has the same sign as the component of the growth rate of I/S ratio explained by g_Π, it follows that $\dot{g_\Pi} > 0$ at g_Π. Similarly at g''_Π, since $\psi(g''_\Pi) > 0$, $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) < 0$ implies $\alpha(\sigma_{S,\dot{a}} - \sigma_{I,\dot{a}})\phi(g''_\Pi) > \alpha(\sigma_{I,\Pi} - \sigma_{S,\Pi})g''_\Pi$. This means at g''_Π, the indirect negative impact of the growth rate of aggregate profit on its rate of change dominates the direct positive impact because of which g_Π decreases. Therefore when $[(\sigma_{I,\dot{a}} < 0) \wedge (|\sigma_{I,\dot{a}}| > |\sigma_{S,\dot{a}}|)]$, at both g'_Π and g''_Π, g_Π moves away from g^*_Π. Hence, g^*_Π is an unstable equilibrium in this case.

3.3 Comparative Statics

In this section we will examine the effect of changes in the degree of responsiveness of the investment and savings to aggregate profit and the rate of introduction of new luxury goods on the equilibrium growth rate of aggregate profit. We will also analyse the effect on the equilibrium growth rate of aggregate profit of changes in the elasticity of the growth rate of labour productivity of the luxury goods sector with respect to the growth rate of aggregate profit. Suppose there exists a locally stable positive equilibrim growth rate of aggregate profit, g_{Π}^{*}, as shown in figure 3.5. Let us assume that initially aggregate profit in the economy is growing at the rate g_{Π}^{*}. This implies $z > 0$, $\phi'(0) > z$, $\lim_{g_{\Pi} \to \infty} \phi'(g_{\Pi}) < z$, $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) > 0$ and $(g_{\Pi}^{*} > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho)$.

Let us first consider an increase in the degree of responsiveness of savings to the rate at which new goods are introduced in the economy on the equilibrium growth rate. Since in our model, we proxy the rate at which new goods are introduced by the rate of change in the labour productivity of the luxury goods sector this means an increase in the absolute value of the elasticity of savings with respect to $\dot{a}$, $|\sigma_{S,\dot{a}}|$. Since $\sigma_{S,\dot{a}} < 0$, any increase in $|\sigma_{S,\dot{a}}|$ implies $\frac{(\sigma_{S,\Pi} - \sigma_{I,\Pi})}{(\sigma_{I,\dot{a}} + |\sigma_{S,\dot{a}}|)}$ decreases.

Figure 3.7 shows the new equilibrium growth rate of aggregate profit in the economy due to an exogenous increase in the responsiveness of savings to the rate at which new luxury goods are introduced. At the initial equilibrium growth rate of aggregate profits, g_{Π}^{*}, suppose $\frac{(\sigma_{S,\Pi} - \sigma_{I,\Pi})}{(\sigma_{I,\dot{a}} + |\sigma_{S,\dot{a}}|)} = z$. An exogenous increase in $|\sigma_{S,\dot{a}}|$ causes a decrease in $\frac{(\sigma_{S,\Pi} - \sigma_{I,\Pi})}{(\sigma_{I,\dot{a}} + |\sigma_{S,\dot{a}}|)}$. In the new situation let $\frac{(\sigma_{S,\Pi} - \sigma_{I,\Pi})}{(\sigma_{I,\dot{a}} + |\sigma_{S,\dot{a}}|)} = z_1$ which is less than z. Provided $\lim_{g_{\Pi} \to \infty} \phi'(g_{\Pi}) < z_1$, the new equilibrium growth rate of aggregate profits, g_{Π}^{o}, is given by the intersection of the dashed line with slope z_1 and the curve $\phi(g_{\Pi})$ lies to the right of the initial equilibium growth rate of aggregate profit g_{Π}^{*}. Thus a higher degree of responsiveness savings to the rate at which new luxury goods are introduced *ceteris paribus* implies a higher equilibrium growth rate of aggregate profit.

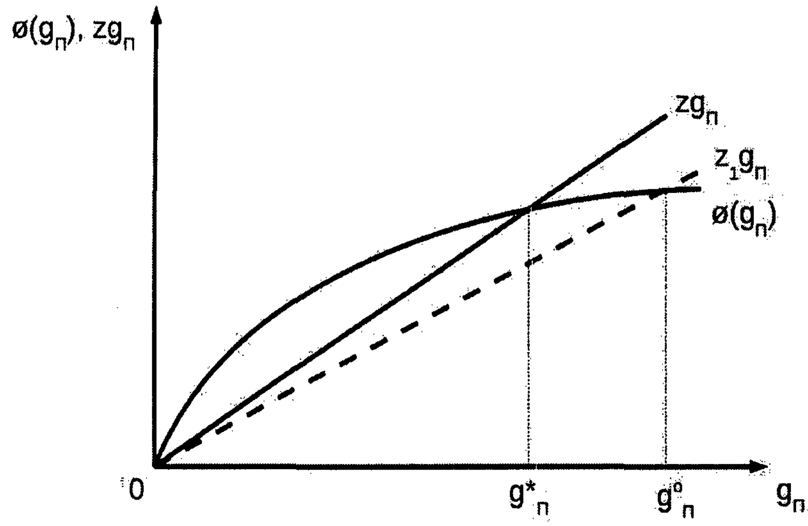


Figure 3.7

Any exogenous increase in the degree of responsiveness of savings to the rate at which new luxury goods are introducted *ceteris paribus* implies that at the previous equilibrium growth rate of aggregate profit, growth rate of investment now becomes greater than the growth rate of savings. Thus from equation (3.5) we know that the growth rate of aggregate profits will increase. Similarly any exogenous increase in the responsiveness of the investment function to both aggregate profit and the rate of introduction of new luxury goods result into higher levels of the equilibrium growth rate of aggregate profit by lowering $\frac{(\sigma_{S,\Pi}-\sigma_{I,\Pi})}{(\sigma_{I,\dot{a}}+|\sigma_{S,\dot{a}}|)}$. An exogenous increase in $\sigma_{I,\Pi}$ or $\sigma_{I,\dot{a}}$ *ceteris paribus*, makes the growth rate of investment greater than the growth rate of savings at g^*_Π thus increases the the growth rate of aggregate profits.

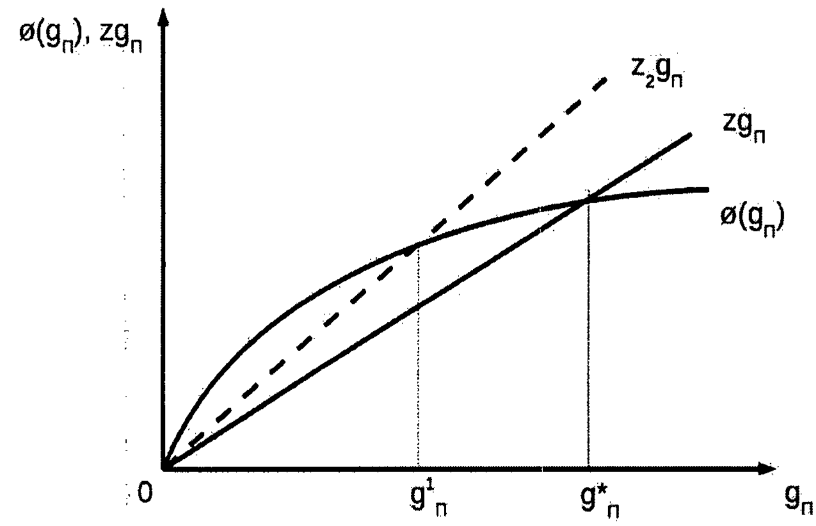


Figure 3.8

Let us next consider exogenous changes in the degree of responsiveness of savings to aggregate profits, $\sigma_{S,\Pi}$. Any exogenous increase in $\sigma_{S,\Pi}$ increases $\frac{(\sigma_{S,\Pi}-\sigma_{I,\Pi})}{(\sigma_{I,\dot{a}}+|\sigma_{S,\dot{a}}|)}$. Figure 3.8 shows the impact of such a change on the equilibrium growth rate of aggregate profit. As before let g_{Π}^{*} be the initial equilibrium growth rate of aggregate profit given by the intersection of the bold line with slope z and the curve $\phi(g_{\Pi})$. We know that any exogenous increase in $\sigma_{S,\Pi}$ increases $\frac{(\sigma_{S,\Pi}-\sigma_{I,\Pi})}{(\sigma_{I,\dot{a}}+|\sigma_{S,\dot{a}}|)}$. Let in the new situation $\frac{(\sigma_{S,\Pi}-\sigma_{I,\Pi})}{(\sigma_{I,\dot{a}}+|\sigma_{S,\dot{a}}|)}$ be z_2 which is greater than z. Assuming $\phi'(0) > z_2$, the new equilibrium growth rate of aggregate profit, g_{Π}^{1}, given by the intersection of the dashed line from the origin with slope z_2 and the curve $\phi(g_{\Pi})$ in figure 3.8. Clearly g_{Π}^{1} lies to the left of g_{Π}^{*}. Thus any exogenous increase in the degree of responsiveness of the savings to aggregate profit *ceteris paribus*, decreases the equilibrium growth rate of aggregate profit because at the initial equilibrium g_{Π}^{*} growth rate of investment becomes less than the growth rate of savings. This is the property of 'paradox of thrift' associated with all demand-led growth models which follows from Keynes' result that any *ex-ante* increase in savings reduces aggregate demand in the economy.

Finally let us consider exogenous changes in the elasticity of the the growth rate of labour productivity of the luxury goods sector with respect to the growth rate of aggregate profit, i.e., the elasticity of the function $\phi(g_\Pi)$, ρ. Notice that constant elasticity of the function $\phi(g_\Pi)$, given that $\phi(0) = 0$, $\phi'(g_\Pi) > 0$ and $\phi''(g_\Pi) < 0$, implies the following form for the function $\phi(g_\Pi)$.

$$\phi(g_\Pi) = A(g_\Pi)^\rho$$

where A is a positive constant and $0 < \rho < 1$. Thus any exogenous increase in ρ implies an increase in the growth rate of labour productivity of the luxury goods sector associated with any positive growth rate of aggregate profit, i.e., increase in $\phi(g_\Pi)$ for all positive values of g_Π.

Figure 3.9 shows the change in the equilibrium growth rate of profit due to an exogenous increase in ρ. Let the initial equilibrium growth rate of aggregate profit be g_Π^*, given by the intersection of the bold curve for $\phi(g_\Pi)$ and the bold line from the origin with slope z. As discussed any exogenous increase in ρ implies increase in the growth rate of labour productivity of the luxury goods sector for all positive values of g_Π. Thus the curve for $\phi(g_\Pi)$ pivots upwards from the origin. This is shown in figure 3.9 by the dashed curve labeled ϕ_1. Assuming that $\lim_{g_\Pi \to \infty} \phi_1'(g_\Pi) < z$, the intersection of the dashed curve labeled ϕ_1 and the bold line from the origin with slope z, gives the new positive equilibrium growth rate of aggregate profit, g_Π^2, which lies to the right of g_Π^*.

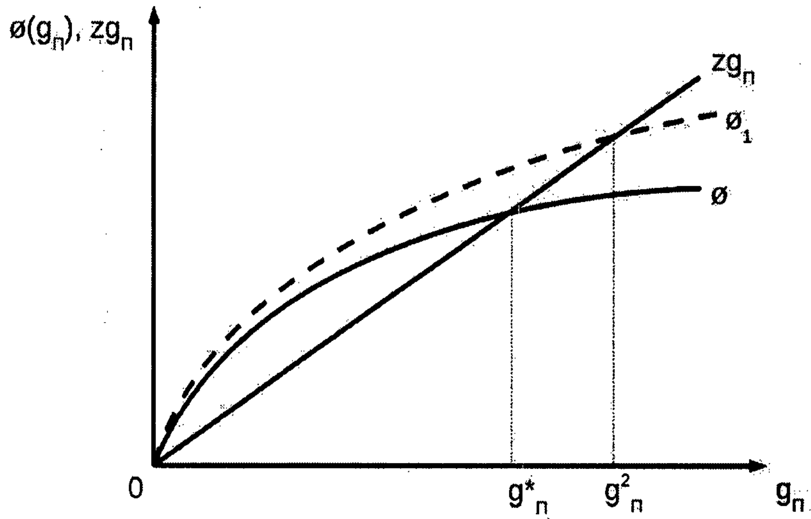


Figure 3.9

An exogenous increase in ρ increases $\phi(g_\Pi)$ at all positive values of g_Π. Since the rate of change in the labour productivity of the luxury goods sector $\dot{a} = a\phi(g_\Pi)$, an increase in ρ means faster rate of introduction of new luxury goods in the economy. Therefore at the initial equilibrium g^*_Π, consumption out of profits increases leading to a fall in the savings while investment can both fall or rise (depending upon the relative ease of access to production technologies of these luxury goods). However from *Theorem 4* we know that $(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}}) > 0$. This means that even if investment demand falls due to faster rate of introduction of new luxury goods, increase in consumption out of profits more than compensates it. This makes the growth rate of investment greater than that of savings at g^*_Π. Therefore an increase in the elasticity of the growth rate of labour productivity in the luxury goods sector with respect to the growth rate of aggregate profit *ceteris paribus* increases the equilibrium growth rate of aggregate profit in the economy.

We can summarise the results of this section in the form of the following two propositions. Let us assume that for all permissible values of z and permissible forms of the function ϕ, positive locally stable equilibrium growth rates of aggregate profit exist.

Proposition 1 Let $g_\Pi^1 \in (0,\infty)$ and $g_\Pi^2 \in (0,\infty)$ be such that $\psi(g_\Pi^1; z_1) = 0$ and $\psi(g_\Pi^2; z_2) = 0$ where z_1 and z_2 are two positive constants.[16] Then $z_1 > z_2$ implies $g_\Pi^1 < g_\Pi^2$.

Proof. Suppose $z_1 > z_2$. We know that $\psi(g_\Pi^1; z_1) = \phi(g_\Pi^1) - z_1 g_\Pi^1 = 0$. Thus $\psi(g_\Pi^1; z_2) = \phi(g_\Pi^1) - z_2 g_\Pi^1 > 0$. From *Lemma 3.1* we have $\frac{\partial\psi(g_\Pi^2;z_2)}{\partial g_\Pi} < 0$. Also $\frac{\partial^2\psi(g_\Pi;z_2)}{\partial g_\Pi^2} = \phi''(g_\Pi) < 0$. Therefore, for all $g_\Pi \in (g_\Pi^2, \infty)$, $\frac{\partial\psi(g_\Pi;z_2)}{\partial g_\Pi} < 0$. This along with $\psi(g_\Pi^2; z_2) = 0$ imply for all $g_\Pi \in (g_\Pi^2, \infty)$, $\psi(g_\Pi; z_2) < 0$. Therefore $\psi(g_\Pi^1; z_2) > 0$ implies $g_\Pi^1 < g_\Pi^2$. ■

Proposition 2 Let for all $g_\Pi \in (0,\infty)$, $\phi_1(g_\Pi) > \phi_2(g_\Pi)$. Let $g_\Pi^1 \in (0,\infty)$ and $g_\Pi^2 \in (0,\infty)$ be such that $\psi(g_\Pi^1; \phi_1) = 0$ and $\psi(g_\Pi^2; \phi_2) = 0$.[17] Then $g_\Pi^1 > g_\Pi^2$.

Proof. $\psi(g_\Pi^2; \phi_2) = \phi_2(g_\Pi^2) - z g_\Pi^2 = 0$. Since $\phi_1(g_\Pi^2) > \phi_2(g_\Pi^2)$, $\psi(g_\Pi^2; \phi_1) > 0$. From *Lemma 3.1* we have $\frac{\partial\psi(g_\Pi^1;\phi_1)}{\partial g_\Pi} < 0$. Also $\frac{\partial^2\psi(g_\Pi;\phi_1)}{\partial g_\Pi^2} = \phi''(g_\Pi) < 0$. This implies for all $g_\Pi \in (g_\Pi^1, \infty)$, $\frac{\partial\psi(g_\Pi;\phi_1)}{\partial g_\Pi} < 0$. This and $\psi(g_\Pi^1; \phi_1) = 0$ imply for

[16] We define $\psi(g_\Pi; z_1) = \phi(g_\Pi) - z_1 g_\Pi$ and $\psi(g_\Pi; z_2) = \phi(g_\Pi) - z_2 g_\Pi$.

[17] We define $\psi(g_\Pi; \phi_1) = \phi_1(g_\Pi) - z g_\Pi$ and $\psi(g_\Pi; \phi_2) = \phi_2(g_\Pi) - z g_\Pi$.

all $g_\Pi \in (g_\Pi^1, \infty)$, $\psi(g_\Pi; \phi_1) < 0$. Therefore $\psi(g_\Pi^2; \phi_1) > 0$ implies $g_\Pi^2 < g_\Pi^1$. ∎

3.4 Changes in Income Distribution and Output Growth

In this and the next section we will consider exogenous changes in the income distribution along the equilibrium growth path of aggregate profit and examine the effect on output and employment growth in the economy. The exogenous changes in the income distribution that we are considering here are government policy induced changes. Since we are looking into the growth process in economies which have given up import substituting industrialization and embraced neo-liberal economic reforms, policy induced changes in income distribution become important. Policy changes in tune with these reforms like relaxation of regulations constraining private investment, mergers and acquisition, labour reforms, privatization of state run enterprises, reduction of corporate income tax, etc., tend to increase the 'degree of monopoly' in the economy. On the other hand policies related to employment guarantee and minimum wages introduced by governments under popular pressures tend to reduce the 'degree of monopoly'. We assume that such policy changes do not have any independent effect on investment and savings in the economy but influence investment and savings only through changes in the level of aggregate profit.

The fact that under certain conditions in our model a positive and stable equilibrium growth rate of aggregate profit exists implies not only that there exists an equilibrium growth path in the economy such that at every instance of time investment in this economy is greater than savings but also the ratio

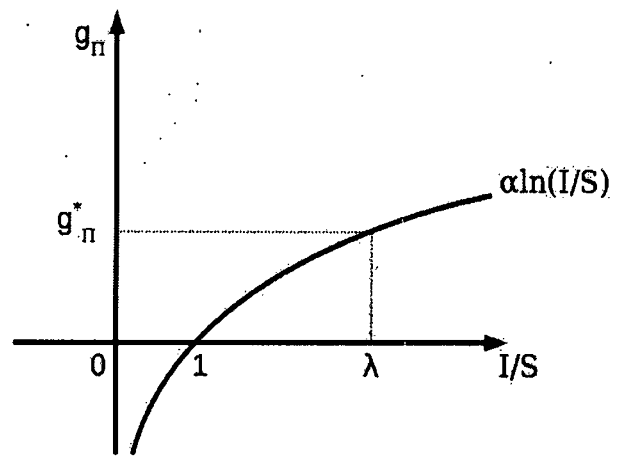


Figure 3.10

between investment and savings remains same at every instance of time. This observation is obvious from equation (3.4) which captures the change in the aggregate level of profit due to any mismatch in the level of investment and savings in the economy. Notice that we can re-write equation (3.4) as

$$g_{\Pi} = \alpha[\ln(\frac{I}{S})] \tag{3.16}$$

Let g_{Π}^{*} be the positive equilibrium growth rate of aggregate profit in the economy and let us also assume that g_{Π}^{*} is locally stable. Substituting g_{Π}^{*} in equation (3.16) and then re-arranging it, we get the following.

$$\frac{g_{\Pi}^{*}}{\alpha} = \ln(\frac{I}{S}) \tag{3.17}$$

Since $\frac{g_{\Pi}^{*}}{\alpha}$ is a positive constant, $\frac{I}{S}$ must be a constant greater than one. Figure 3.10 illustrates this point. It shows that when aggregate profit in the economy grow at the equilibrium rate g^*_Π, investment-savings ratio in the economy is a constant given by λ such that $\lambda > 1$.

Investment-savings ratio being a constant greater than one means that the short-run macroeconomic equilibrium characterised by the equality investment and savings in the *ex-ante* sense is never realized on the equilibrium growth path of aggregate profit in the economy. This is because profit growth in our model is fueled by the excess of investment over savings in the *ex-ante* sense.[18]

Any excess of investment over savings increases aggregate profit in the economy. We assume that this adjustment in the level of aggregate profit is achieved through an increase in output in the absense of any policy induced increase in the profit share. In periods along the equilibrium growth path of aggregate profits in which there is policy induced worsening of the income distribution[19], we assume that a part of the increase in profit required due to exess of investment over savings is automatically achieved by the exogenous rise in the profit share while the rest is achieved through endogenous output increase. In other words we assume that the multiplier mechanism works only to increase the output level in the face of any excess of investment over savings and does not increase the profit share.

By defination $\Pi = Yh$, where Y is the total output of the economy and h is share of profit in output, i.e., $\frac{\Pi}{Y}$. Therefore the growth rate of aggregate

[18]In the *ex-post* sense, savings is always equal to investment.

[19]By worsening of income distribution we mean increase in the share of profit in output and therefore by improvement in income distribution we will mean decrease in the profit share.

profit is $g_\Pi = g_Y + \frac{\dot{h}}{h}$, where g_Y is the growth rate of output and $\frac{\dot{h}}{h}$ is the growth rate of profit share. When aggregate profit in the economy grows at the constant equilibrium rate then the growth rate of output net of growth in profit share must be equal to the the equilibrium growth rate of aggregate profit. Which means,

$$g_\Pi^* = g_Y + \frac{\dot{h}}{h} \tag{3.18}$$

where g_Π^* is the positive equilibrium growth rate of aggregate profit. We will assume that the change in profit share, $\dot{h}$, is an exogenously given policy determined parameter. Thus output grows at a rate equal to the equilibrium growth rate of aggregate profit when income distribution does not change, that is $\dot{h} = 0$. When profit share increases, that is $\dot{h} > 0$, then $g_Y < g_\Pi^*$ whereas when profit share decreases, that is $\dot{h} < 0$, $g_Y > g_\Pi^*$.

From equation (3.18), rate of growth of output, $g_Y = g_\Pi^* - \frac{\dot{h}}{h}$. Suppose $\dot{h} > 0$, then profit share, h, increases over time. This implies $\frac{\dot{h}}{h}$ decreases as $\dot{h}$ is fixed. Thus it follows that g_Y increases as $\dot{h} > 0$. Next suppose $\dot{h} < 0$, then the profit share, h, decreases over time. This implies $|\frac{\dot{h}}{h}|$ increases as $\dot{h}$ is fixed. Since $\dot{h} < 0$, it follows that g_Y increases. Thus given our assumption on the multiplier mechanism, in periods along the equilibrium growth path of aggregate profit when there are no policy induced changes in income distribution the growth rate of output is constant and in periods when there are policy induced changes in income distribution the growth rate of output is increasing.

The fact that output growth accelerates whenever government policy changes the income distribution in the economy means that along the equilibrium growth path of aggregate profit there can be some periods in which the process of economic growth is *exhilarationist* while in other periods it is *stagnationist.* However whether growth is *exhilarationist* or *stagnationist* depends on factors different than *exhilarationist* and *stagnationist* growth regimes in Bhaduri and Marglin (1990). In Bhaduri and Marglin (1990) whether the growth regime is *exhilarationist* or *stagnationist* depends on the relative sensitivities of the investment and savings functions to the profit share while here whether the growth process is *exhilarationist* or *stagnationist* depends on the effects of the government's economic policies on the distribution of income.

If in any period along the equilibrium growth path of aggregate profit, government policy changes induce a worsening of income distribution (i.e., $\dot{h} > 0$) then the acceleration in the output growth can be termed *exhilarationist* growth. We will call periods along the equilibrium growth path of aggregate profit in which the growth process is *exhilarationist* as *exhilarationist* periods. Alternatively, if in any period along the equilibrium growth path of aggregate profit, government policy changes induce an improvement in income distribution (i.e., $\dot{h} < 0$) then the acceleration in the output growth can be termed *stagnationist* growth. And similarly, we will call periods along the equilibrium growth path of aggregate profit when the growth process is *stagnationist* as *stagnationist* periods.

3.5 Growth of Labour Productivity and Employment

Labour productivity of the entire economy is the weighted average of labour productivities in the luxury goods sector and the non-luxury goods sector with the weights being their respective employment shares. Thus the labour productivity of the entire economy, x is given by the following equation.

$$x = al_a + bl_b \tag{3.19}$$

In the above equation a and b denote the labour productivities of the luxury goods sector and the non-luxury goods sector or the rest of the economy respectively. We assume that labour productivity in the luxury goods sector is always greater than labour productivity in the non-luxury goods sector, i.e., $a > b$ always. l_a and l_b denote employment shares of the two sectors respectively, i.e., if L_a, L_b and L denote employment in the luxury goods sector, non-luxury goods sector and the entire economy respectively then $l_a = \frac{L_a}{L}$ and $l_b = \frac{L_b}{L}$ with $l_a + l_b = 1$.

Since we are concerned with tracing out the effects on output and employment growth of technological change in the luxury goods sector induced by growing profits, let us assume for simplicity that there is no technological change in the non-luxury goods sector.[20] This means that the labour productivity of the non-luxury goods sector , b, is a constant. By substituting $(1 - l_a)$ for l_b in equation (25) and then differentiating it with respect to time we obtain,

$$\dot{x} = \dot{a}l_a + \dot{l_a}(a - b)$$

where $\dot{x}$, $\dot{a}$ and $\dot{l_a}$ are the rates of change of x, a and l_a with respect to time respectively. Using simple manipulations we can re-write the above equation as

$$\frac{\dot{x}}{x} = \frac{\dot{a}}{a}\frac{al_a}{x} + \frac{\dot{l_a}}{l_a}\frac{l_a}{x}(a - b)$$

[20]We examine the implication of relaxing this assumption in the next chapter.

or,

$$g_x = \frac{l_a}{x}\{ag_a + (a-b)g_{l_a}\} \tag{3.20}$$

where g_x, g_a and g_{l_a} are respectively the growth rates of labour productivity for the entire economy, the luxury goods sector and the employment share of the luxury goods sector.

The level of aggregate profit in the economy determines the demand for luxury goods. We would expect that the share of the luxury goods output in total output to increase as the share of profit in output increases. Therefore we assume that the share of the luxury goods output in total output to be an increasing function of the profit share as described below.

$$\frac{Y_a}{Y} = f(h) \tag{3.21}$$

where $0 \leq f(h) \leq 1$ and $f'(h) > 0$. Y_a in the above equation denotes the output of the luxury goods sector.

Since $l_a = \frac{L_a}{L}$ and $\frac{Y_a}{Y} = f(h)$, we can re-write l_a as,

$$l_a = \frac{L_a}{L} = \frac{Y_a}{a}\frac{x}{Y}$$

or,

$$l_a = \frac{f(h)x}{a} \tag{3.22}$$

Taking natural logarithms on both sides of the above equation we obtain,

$$\ln l_a = \ln f(h) + \ln x - \ln a$$

Differentiating both sides of the above equation with respect to time we obtain,

$$g_{l_a} = \frac{f'(h)}{f(h)}\dot{h} + g_x - g_a \tag{3.23}$$

Substituting for l_a and g_{l_a} respectively from equations (3.22) and (3.23) in equation (3.20), we get

$$g_x = \frac{f(h)}{a}[ag_a + (a-b)\{\frac{f'(h)}{f(h)}\dot{h} + g_x - g_a\}]$$

By re-arranging the terms we obtain the folowing expression for the growth rate of labour productivity of the entire economy.

$$g_x = \frac{bf(h)g_a + (a-b)f'(h)\dot{h}}{\{1-f(h)\}a + f(h)b} \tag{3.24}$$

When aggregate profit in the economy grows at the positive equilibrium growth rate, g^*_Π, then from equation (3.8) we know that the growth rate of labour productivity in the luxury goods sector, $g_a = \phi(g^*_\Pi)$. Therefore when aggregate profit in the economy grows at the positive equilibrium rate then the growth rate of labour productivity for the economy is,

$$g_x = \frac{bf(h)\phi(g^*_\Pi) + (a-b)f'(h)\dot{h}}{\{1-f(h)\}a + f(h)b} \tag{3.25}$$

Thus, the growth rate of labour productivity in the economy along the equilibrium growth path of aggregate profit depends on the constant growth rate of labour productivity in the luxury goods sector, $\phi(g^*_\Pi)$; labour productivities of the two sectors, a and b; the share of luxury goods sector's output in the total output, $f(h)$; and the exogenously given rate of change in the profit share, $\dot{h}$. Since the labour productivity of the luxury goods sector grows at a constant rate and the profit share is not constant as long as the exogenously given rate of change in profit share is not equal to zero, the growth rate of labour productivity in the economy is not constant along the equilibrium growth path of aggregate profit.

To start with let us suppose $\dot{h} = 0$, i.e, income distribution in the economy is exogenously fixed. Then from equation (3.25), the growth rate of labour productivity for the entire economy is given by the following expression.

$$g_x = \frac{bf(h)\phi(g_\Pi^*)}{\{1-f(h)\}a + f(h)b} \qquad (3.26)$$

Since a grows at a constant rate, $\phi(g_\Pi^*)$, the denominator of the expression in the right hand side of equation (3.26) keeps increasing and ultimately approaches infinity as a approaches infinity. Thus in any period along the equilibrium growth path of aggregate profit when $\dot{h} = 0$, i.e., there is no policy induced worsening of income distribution, the growth rate of labour productivity for the economy continuously declines.

This is obvious because when $\dot{h}$ is zero then $f(h)$ is a constant and from equation (3.26) we have $g_x < \phi(g_\Pi^*) = g_a$.[21] Equation (3.22) then implies that the share of employment in the luxury goods sector, l_a, declines as a increases. Since luxury goods sector's output share in the total output remains constant and the labour productivity of this sector grows at a constant rate(whereas that of the non-luxury goods sector remains constant), its employment share decreases while that of the non-luxury goods sector increases. Therefore the growth rate of labour productivity for the economy must decline because there is no increase in the labour productivity of the non-luxury goods sector. Ultimately, as a becomes very large and approaches infinity, l_a and l_b respectively tend to zero and one and g_x tends to zero.

When the income distribution in the economy is constant then the growth rate of output, $g_Y = g_\Pi^*$. The growth rate of employment in the economy is the given by $g_L = g_\Pi^* - g_x$. Since g_x is positive therefore $g_L < g_\Pi^*$. However since g_x continuously decreases and approaches zero as a continuously

[21]Because $0 < \frac{bf(h)}{(1-f(h))a+f(h)b} < 1$

increases and approaches infinity, the growth rate of employment in the economy must continuously increase and approach g_{Π}^{*}. This increase in the growth rate of employment in the economy is entirely due to the gain in employment share of the non-luxury goods sector. This is because in this sector labour productivity is constant whereas in the luxury goods sector it is continuously rising and the output shares of the two sectors remain fixed in the absence of any change in income distribution. Since the income distribution is fixed, the growth rate of real wages must decline and approach zero as the growth rate of employment increases to approach g_{Π}^{*}.[22]

However in periods along the equilibrium growth path of aggregate profit when there is policy induced changes in the income distribution then the growth rate of labour productivity for the economy need not always decline but can also increase. If $\dot{h} \neq 0$ then the expression for the growth rate of the economy's labour productivity is no longer given by the equation (3.26) but by the equation (3.25).

$$g_x = \frac{bf(h)\phi(g_{\Pi}^{*}) + (a-b)f'(h)\dot{h}}{\{1 - f(h)\}a + f(h)b}$$

Let us first consider the case of an *exhilarationist* period. In an *exhilarationist* period there is exogenous worsening of income distribution along the equilibrium growth path of aggregate profit, i.e., $\dot{h} > 0$, because of policy changes of kinds mentioned in the previous section. As discussed above g_x cannot be expected to remain constant because now not only a does grow at a constant rate $\phi(g_{\Pi}^{*})$ but h also increases at the exogenously given rate, $\dot{h} > 0$. Since $\dot{h} > 0$ and $f'(h) > 0$, $\frac{Y_a}{Y} = f(h)$ is not a constant but increases with time. Neither the numerator nor the denominator of the expression for g_x in

[22]The growth rate of real wages in the economy is discussed in a greater detail in the next chapter.

equation (3.25) are now constants. Therefore as opposed to the case when $\dot{h} = 0$ in this case we can not say anything conclusive about the behaviour of g_x from equation (3.25). In periods along the equilibrium growth path of aggregate profit when $\dot{h} > 0$ we do not know whether x grows at a rate less than the rate of growth of a as opposed to periods when $\dot{h} = 0$. Therefore just from equation (3.22) we can no longer say that the employment share of the luxury goods sector decreases over time. However we can examine the behaviour of g_x over time more clearly considering the total differential of g_x when both a and h increase. The total differential of g_x is

$$dg_x = \frac{\partial g_x}{\partial a}da + \frac{\partial g_x}{\partial h}dh \tag{3.27}$$

where dg_x, da and dh are the changes in g_x, a and h respectively with $da > 0$ and $dh > 0$; and $\frac{\partial g_x}{\partial a}$ and $\frac{\partial g_x}{\partial h}$ are the respective partial derivatives of g_x with respect to a and h.

From equation (3.25) the partial derivative of g_x with respect to a is,

$$\frac{\partial g_x}{\partial a} = \frac{f'(h)\dot{h}}{[\{1-f(h)\}a + f(h)b]} - \frac{(1-f(h))\{bf(h)\phi(g_\Pi^*) + (a-b)f'(h)\dot{h}\}}{[\{1-f(h)\}a + f(h)b]^2}$$

and the partial derivative of g_x with respect to h is,

$$\frac{\partial g_x}{\partial h} = \frac{\{bf'(h)\phi(g_\Pi^*) + (a-b)f''(h)\dot{h}\}}{[\{1-f(h)\}a + f(h)b]} + \frac{(a-b)f'(h)\{bf(h)\phi(g_\Pi^*) + (a-b)f'(h)\dot{h}\}}{[\{1-f(h)\}a + f(h)b]^2}$$

Substituting for $\frac{\partial g_x}{\partial a}$ and $\frac{\partial g_x}{\partial h}$ in equation (3.27) and then re-arranging the terms we get,

$$dg_x = \frac{f'(h)\dot{h}da}{[\{1-f(h)\}a + f(h)b]} + \frac{[bf'(h)\phi(g_\Pi^*) + (a-b)f''(h)\dot{h}]dh}{[\{1-f(h)\}a + f(h)b]} + \frac{[(a-b)f'(h)dh - \{1-f(h)\}da][bf(h)\phi(g_\Pi^*) + (a-b)f'(h)\dot{h}]}{[\{1-f(h)\}a + f(h)b]^2} \tag{3.28}$$

Since $\phi(g_\Pi^*)$, $\dot{h}$, a, and b are all positive with $a > b$ and $0 < f(h) < 1$, it follows from equation (3.28) that if $f''(h) \geq 0$ and $[(a-b)f'(h)dh - \{1-f(h)\}da] \geq$

0 then dg_x is positive. Otherwise dg_x can be negative. Re-arranging the inequality $[(a-b)f'(h)dh - \{1-f(h)\}da] \geq 0$ we get

$$adh[(1-\frac{b}{a})f'(h) - \frac{\{1-f(h)\}}{a}\frac{da}{dh}] \geq 0$$

Since $adh > 0$ the above inequality implies,

$$[(1-\frac{b}{a})f'(h) - \frac{\{1-f(h)\}}{a}\frac{da}{dh}] \geq 0$$

Notice $\frac{da}{dt} = \dot{a} = a\phi(g^*_\Pi)$ and $\frac{dh}{dt} = \dot{h}$. Thus substituting for da and dh in the above inequality and then re-arranging it we get

$$\frac{(a-b)f'(h)}{a\{1-f(h)\}} \geq \frac{\phi(g^*_\Pi)}{\dot{h}}$$

or,

$$(a-b)f'(h)\dot{h} \geq a\{1-f(h)\}\phi(g^*_\Pi) \tag{3.29}$$

If we assume that the share of luxury goods output increases at a constant or an increasing rate as the profit share increases, i.e., $f''(h) \geq 0$, then in *exhilarationist* periods the growth rate of labour productivity increases as long as the inequality (3.29) is satisfied. However since both sides of the inequality (3.29) increases over time we cannot say anything conclusively.

When $f''(h) \geq 0$ and the inequality (3.29) is satisfied then as the wage share in the economy worsens, the increase in the output share of the luxury goods sector prevents its employment share from declining despite the continuous increase in the labour productivity. And since the employment share of the luxury goods sector does not decrease, it follows from equation (3.20) that the constant growth of labour productivity of the luxury goods sector increases the labour productivity of the entire economy.

Again from the previous section we have the growth rate of output in the economy, $g_Y = g^*_\Pi - \frac{\dot{h}}{h}$. Therefore the growth rate of employment in the economy is $g_L = g_Y - g_x = g^*_\Pi - \frac{\dot{h}}{h} - g_x$. Substituting for g_x from equation (3.25) we obtain the following expression for the growth rate of employment in the economy.

$$g_L = g^*_\Pi - \frac{\dot{h}}{h} - \frac{bf(h)\phi(g^*_\Pi) + (a-b)f'(h)\dot{h}}{\{1-f(h)\}a + f(h)b} \tag{3.30}$$

Since both $\dot{h}$ and g_x are positive. From equation (3.30) it follows that that the growth rate of employment in the economy is less than the equilibrium growth rate of aggregate profit. What is interesting is that in periods along the equilibrium growth path of aggregate profit when there is policy induced worsening of income distribution, the growth rate of output is not constant but increases over time as discussed in the previous section. However if $f''(h) \geq 0$ and the inequality (3.29) is satisfied then as the labour productivity of the luxury goods sector and the profit share increases, the growth rate of labour productivity of the economy tends to increase. Therefore the employment growth rate can decline if the increase in g_x over time is more than the fall in $\frac{\dot{h}}{h}$.

Similarly in *stagnationist* periods where there is exogenous improvement in the distribution of income, i.e., $\dot{h} < 0$, (as a result of policy changes which decrease the 'degree of monopoly' in the economy like employment guarantee programmes and minimum wage policies) the behaviour of the growth rate of labour productivity for the economy over time is ambiguous. Like the case of $\dot{h} > 0$, in periods along the equilibrium growth path of aggregate profit when $\dot{h} < 0$ neither the numerator nor the denominator of the expression for g_x in equation (3.25) are constants. Even if we assume that $f''(h) \geq 0$ we cannot say anything about the sign of dg_x from equation (3.28) because now

$da > 0$ and $dh < 0$.

To sum up, output grows at a steady rate if income distribution remains fixed along the positive equilibrium growth path of aggregate profit. Growth rate of labour productivity for the entire economy steadily declines and approaches zero despite a steady growth of labour productivity in the luxury goods sector. The growth rate of employment increases and steadily approaches the constant growth rate of aggregate profit. On the other hand in *exhilarationist* and *stagnationist* periods, output growth rate accelerates along the positive equlibrium growth path of aggregate profit. In both these periods the behaviour of growth rates of labour productivity and employment in the economy is ambiguous.

Chapter 4

Conclusion

Critics of neo-liberal economic reforms have pointed out that these reforms instead of achieving allocative efficiency have resulted in a worsening of income distribution, an increase in poverty and reduced purchasing power for the majority of the population. The purpose of this exercise is to show that if investment in the economy is responsive enough to the changes in the composition of demand of the minority of the population which benefits from these policy reforms then there can be sustained growth in profit, investment and output in a model of a closed economy with no government spending.

We set our argument in developing countries like India. India for the majority of the last decade has witnessed very high growth of GDP and investment despite a worsening of income distribution, reduced purchasing power for the majority of the population and huge poverty throughout post-reforms period. This high growth in the Indian economy is associated with a sluggish employment growth in the organised sector indicating a rapid growth of the labour productivity in the organised sector. Bhaduri (2008b) has characterised this growth process in post-reform India as 'predatory growth'. This high growth experience has occured during a period in which the Indian economy has not been able to maintain trade surplus and with the enactment of the FRBM Act the emphasis in fiscal policy has been on keeping a check on the size of the budget deficit. Therefore neither trade surplus nor government expenditure is the source of 'predatory growth' in India. It is the growing income of the section of population which has benefited from these reforms that provides the expanding market required for rapid growth.

Following Patnaik (2007) we contend that the rich (who are profit earners) in such developing countries aspire to adopt the living standard of the advanced countries in a situation where production techniques of the more sophisticated consumption goods available in the developed countries are more labour saving. We assume that the demand of the rich increases when new luxury goods (i.e., the goods that are already available in the developed countries) are introduced at a faster rate. This opens up new opportunities for investment to the capitalists and if imitating foreign production technologies is not costly then this boosts investment in the economy. These assumptions are captured in our model by assuming that both consumtion out of aggregate profit and net investment are functions of aggregate profit and the rate of introduction of new luxury goods, which is represented in our model by the rate of change in the labour productivity of the luxury goods sector.

Technological change in the sector producing luxury goods is endogenously driven by the growth of aggregate profit in the economy. When aggregate profit grows at a fast rate, the rich in the economy are in a better position to afford the luxury goods hitherto only available in the advanced countries and at the same time it becomes easier for the firms to meet the cost of imitation. This makes the labour productivity in the luxury goods sector grow at rapid rates because it becomes profitable for the firms to introduce more sophisticated luxury goods in the economy. However at any given point of time the technological capablities of the economy are fixed while production of additional luxury goods are more likely to require increasing technological sophistication. Therefore the actual cost of imitating production techniques of additional luxury goods is likely to go up, given the fixed technological cabalities of the economy, as the rate of introduction of luxury goods increases. This nature of technological change in the luxury goods sector is captured by a 'technical progress function', given by the equation (3.8), which makes the growth rate of labour productivity in the luxury goods sector an increasing concave function of the growth rate of aggregate profit. The consumption function for profit earners (equation (3.1)), the investment function (equation (3.3)) and the 'technical progress function' for the luxury goods sector (equation (3.8)) together capture in our model what Patnaik (2007) calls the process of 'structural-cum-technological' change in the economy.

We show in the previous chapter that in a closed economy with no government budget, 'structural-cum-technological' change allows the possibility of positive steady growth rates of aggregate profit and investment as long as $z > 0$, $\phi'(0) > z$ and $\lim_{g_\Pi \to \infty} \phi'(g_\Pi) < z$. g_Π is the growth rate of aggregate profit, $\phi(g_\Pi)$ is the growth rate of labour productivity in the luxury goods sector and z is constant whose value depends upon the constant elasticities of investment and savings functions with respect to aggregate profit and the rate of change of labour productivity in the luxury goods sector. The first condition is a trivial necessary condition for the existence of a positve equilibrium growth rate of aggregate profit, whereas the other two conditions put some restrictions on the growth rates of investment and savings in the economy. $\phi'(0) > z$ requires that a small increase in the growth rate of aggregate profit increases the growth rate of investment more than the growth rate of savings at sufficiently small growth rates of aggregate profit. Similarly $\lim_{g_\Pi \to \infty} \phi'(g_\Pi) < z$ requires that a small increase in the growth rate of aggregate profit increases the growth rate of savings more than the growth rate of investment at sufficiently large growth rates of aggregate profit. The positive equilibrium growth rate of aggregate profit is locally stable as long as the positive equlibrium growth rate is sufficiently high (i.e., $g_\Pi^* > \alpha(\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}})\rho$) and the cost of imitating foreign production techniques is not so high that with the introduction of new luxury goods, the growth rate of investment not only falls but falls more than the growth rate of savings (i.e., $\sigma_{I,\dot{a}} - \sigma_{S,\dot{a}} > 0$).

Growth in our model is entirely due demand-side adjustments in the economy. Aggregate profit grows only if *ex-ante* investment is greater than *ex-ante* savings. We have assumed that this adjustment in the aggregate profit is done through endogenous output expansion via the multiplier mechanism and exogenous changes in the income distribution as a result of economic policy changes by the government. An obvious limitation of the model is result of this asumption that it does not accomodate endogenous changes in the distribution of income. However it allows us to study the impact of government policy measures that directly affect the income distribution on output and employment growth along the equilibrium growth path of aggregate profit.

If there are no exogenous policy induced changes in the distribution of income along the equilibrium growth path of aggregate profit then the output growth rate is same as the positive constant growth rate of aggregate profit. In the absence of technological change in the non-luxury sector, the growth rate of labour productivity in the economy declines because labour productivity in the luxury goods sector grows at a constant rate $\phi(g_{\Pi}^{*})$ along the equilibruim growth path of aggregate profit. As the labour productivity in the luxury goods sector approaches infinity, the growth rate of labour productivity in the economy approaches zero. Employment growth in the economy along the equilibrium growth path therefore increases over time to approach the constant growth rate of aggregate profit. The model allows for involuntary unemployment because the growth rate of employment may be less than the growth rate of labour supply.

On the other hand, if in some periods along the equilibrium growth path of aggregate profit there are exogenous changes in the income distribution as a result of government policy then output growth is not constant but increases irrespective of whether income distribution improves or worsens. This allows for the possibility of both *exhilarationist* and *stagnationist* growth along the equilibrium growth path of aggregate profit. In our model *exhilarationist* growth is the increase in the growth rate of output along the equilibrium growth path of aggregate profit as a result of rise in the profit share caused by policies of the government which increase the 'degree of monopoly' in the economy. And *stagnationist* growth is the increase in the growth rate of output along the equilibrium growth path of aggregate profit as a result of fall in the profit share caused by policies of the government which decrease the 'degree of monopoly' in the economy. Conditions underlying *exhilarationist* and *stagnationist* growth differ from those resulting in *exhilarationist* and *stagnationist* regimes of growth in Bhaduri and Marglin (1990) because they do not depend on the relative sensitivities of the investment and savings functions to the profit share but on the impact of government policy on income distribution.

In periods of *exhilarationist* and *stagnationist* growth, the behaviour of growth rates of labour productivity in the economy and employment is ambiguous contrary to the case when income distribution remains constant along the equilibrium growth path of aggregate profit. However if the share of luxury good output in total output increases at a constant or an increasing rate with increase in the profit share and the inequality (3.29) is satisfied then in periods of *exhilarationist* growth the growth rate of labour productivity increases. This increasing growth rate in labour productivity in the economy can result into declining growth of employment in *exhilarationist* periods. Thus 'predatory growth' can arise in *exhilarationist* periods.

Real wage growth along equilibrium growth path of aggregate profit depends upon the growth rate of labour productivity and changes in the distribution of income. Total income in the economy, Y, is distributed into aggregate profit, Π , and the wage bill, say W. The wage bill $W = wL$, where w is the real wage rate in terms of the subsistence good. Therefore we have,

$$Y = \Pi + wL$$

Dividing both sides of the above equation by Y and then re-arranging the terms we get,

$$w = x(1 - h)$$

Using logarithmic differentiation on both sides of the above equation we obtain the following expression for the growth rate of real wages,

$$g_w = g_x - \frac{\dot{h}}{1-h} \tag{4.1}$$

where g_w is the growth rate of real wages. In periods along the equilibrium growth path of aggregate profit when income distribution is constant (i.e., $\dot{h} = 0$), the growth rate of wages is equal to the growth rate of labour productivity in the economy and declines as the latter declines. In *stagnationist* periods (when $\dot{h} < 0$) the growth rate of wages is greater than the growth rate of labour productivity in the economy. On the other hand in *exhilarationist* periods (when $\dot{h} > 0$) the growth rate of wages is less than the growth rate of labour productivity in the economy. The growth rate of wages can decline in *exhilarationist* periods even when the growth rate of labour productivity in the economy is rising, if $\dot{h}$ is very large or the initial h is close to one (i.e., there is a large redistribution of income in favour of profits or there is redistribution of income in favour of profits when the profit share is already quite large). Thus, *exhilarationist* periods allow for extreme cases of 'predatory growth' in which aggregate profit and investment grow at stable, steady rates alongside a worsening income distribution leading to rising growth rates of output and labour productivity combined with declining growth rates of employment and wages.

The conclusions regarding the growth rate of labour productivity in the economy along the equilibrium growth path of aggregate profit are based on the assumption that there is no technological change in the non-luxury goods sector. Instead, suppose that labour productivity in the non-luxury goods sector grows at an exogenous positive rate, say $\bar{g}_b$.[1] Then the growth rate of labour productivity in the economy (g_x) instead of approaching zero along the equilibrium growth path of aggregate profit approaches $\bar{g}_b$, as a approaches infinity. In the same manner in which equation (3.25) was derived, the growth rate of labour productivity in the economy along the equilibrium growth path of aggregate profit is now given by the following equation.

$$g_x = \frac{bf(h)\phi(g_\Pi^*) + a\{1 - f(h)\}\bar{g}_b + (a - b)f'(h)\dot{h}}{\{1 - f(h)\}a + f(h)b} \tag{4.2}$$

When $\dot{h} = 0$ we can re-arrange equation (4.2) as

$$g_x = \frac{\phi(g_\Pi^*)}{[\{\frac{1-f(h)}{f(h)}\}\frac{a}{b} + 1]} + \frac{\bar{g}_b}{[1 + \{\frac{f(h)}{1-f(h)}\}\frac{b}{a}]}$$

Assuming that the growth rate of labour productivity in the luxury goods sector is higher than in the non-luxury goods sector (i.e., $\phi(g_\Pi^*) > \bar{g}_b$) as a approaches infinity growing at a constant rate $\phi(g_\Pi^*)$, the denominator of the first term on the right hand side of the above expression approches infinity while the denominator of the second term on the right hand side of the same expression approaches one. Thus as a approaches infinity g_x approaches $\bar{g}_b$. However in *exhilarationist* and *stagnationist* periods, the behaviour of the growth rate of labour productivity along the equilibrium growth path of aggregate profit is still ambiguous.

However such a growth process which is a result of the process of 'structural-cum-technological' change described by equations (3.1), (3.3) and (3.8) can not go on forever. As income of the rich in the economy steadily increases along the equilibrium growth path of aggregate profit and the gap between

[1]The assumption that labour productivity in the luxury goods sector is always greater than in the non-luxury goods sector implies that $\bar{g}_b$ cannot be greater than g_a.

their living standards and the average living standard in the developed countries sufficiently narrows, the rate of introduction of new luxury goods in such developing countries will ultimately get tethered to that in the advanced countries. This implies that after some point of time the 'technical progress function' given by equation (3.8) will cease to completely capture the nature of technological change in the luxury goods sector. In this sense our model captures only a transitory phase in which the gap between average living standard in the advanced world and the living standard of the rich in the economy we are concerned with is significant. Another limitation of the model is due to the assumption of a closed economy. This assumption has ruled out the possibility of foreign direct investment in the luxury goods sector. A major emphasis of the neo-liberal agenda is to remove regulations concerning foreign direct investment. If imitation is easy then our model will not be affected but on the contrary if intellectual property rights are enforced strictly then the growing income of the rich will attract foreign direct investment in the luxury goods sector. To include the impact of foreign direct investment we will have to extend the model to an open economy model.

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