9. LONG TERM GROWTH OF INDIAN ECONOMY

9.1 - INTRODUCTION

Most growth models that have recently appeared are based on assumptions which are more relevant to the developed economies. Two important aspects of these economies are:

1. Savings tend to approach a more or less stable rate; and

2. the productive structure tends to be settled on a more or less fixed technology.**

If there have been any movements in the saving rate and capital output ratios of the developed countries, they have been downward. Under these conditions it is not surprising to find that in most of the models, the rate of savings and the capital output ratios have been assumed to be constant. And these assumptions will not be unjustified in the context of developed economies with the characteristics mentioned above.

However, the above assumptions by their very nature,


will be unjustified in the context of developing economies. For two things are absolutely necessary for any economy to be labelled developing. Firstly, capital should accumulate at an increasing rate, which in turns mean saving rate should rise; secondly, there must be, as far as possible, an optimal utilization of resources, which, taken in conjunction with the first, means that the technique of production and hence the capital-output ratio can be constant only by accident, i.e., the techniques of production will keep changing. Due to these facts, the usual models of economic growth are not very useful for the developing economies.

In addition, the developing economies have certain characteristics which make the usual models based on the customary multiplier and accelerator principles even less satisfactory. This is largely due to the following reasons. Firstly, almost all developing economies are short in capital. The scarcity of capital is the biggest impediment in the way of speedy development of these countries and forms the main bottleneck. The role of the accelerator is thus very much weakened, if not eliminated. For, real investment cannot react to changes in national income in the same manner in a capital scarce economy as it can do in a developing economy. It cannot exceed the volume of (exante) savings given the international movement of capital due to the simple fact of non-availability of additional capital. Similarly it can hardly fall below the volume of savings in a developing
economy owing to the existence of demand for consumption goods which ensures a ready market for goods produced and supplied.

In a developing economy, the consumption behaviour of the households, particularly in the early stages of development, may be significantly different from the rest of expenditure units. As such an increase in the household output might not generate the same sequence of increased consumption and investment as it might do normally. This is due to the allegedly negative elasticity of work effort to output. The influence of these households, however, seems to be limited in the developing economies. For the overall effect in all the countries moving on the path of development has been a general rise in work effort and consumption at an increasing rate. Moreover, the self subsistent character of the households weakens as the economy grows, education expands and means of communication and transportation are developed. Nonetheless, it is obvious that existence of self subsistent households does modify the multiplier effect by dampening it.

It should be pointed out, however, that the role of the multiplier has not been very dynamic even in the growth models pertaining to developed countries, it is still less so in models pertaining to developing countries.
9.2 - Structure of Model

Let the initial amount of labour and capital is $L_0$ and $K_0$ respectively. We assume that the labour force increases exogeneously at a constant rate per year. The rate of capital formation depends upon the rate of savings. We assume the savings rate at increase at a rate of 's' per year from an initial rate '$s_0'$. The total output in the economy at the $t_{th}$ year will be:

$$P_t = F(L_t, K_t)$$

(1)

where $L_t$ is labour force in $t_{th}$ year and $K_t$ the amount of capital we have.

$$L_t = L_0 e^{\lambda t}$$

(2)

$$K_t = S_0 e^{st} P_t$$

(3)

We finally assume that the productive activity of the economy is adequately described by the Cobb-Douglas production function, so that

$$K_t = S_0 e^{st} L_t K_t$$

$$= S_0 L^\alpha e^{(s+a)t} K^\beta$$

(4)

The solution of equation (4) by integration of differential equation will be
\[ K_t = \frac{S_0 L_0^\alpha}{S + \alpha} \cdot e^{(s+\alpha)t} + c \frac{1}{1 - \lambda} \]  

where \( C \) is the integration constant which can be determined by initial conditions and is given in our case by:

\[ K_0 = \frac{S_0 L_0^\alpha(1-\lambda)}{S + \alpha} + c^{1-\lambda} \]

or

\[ c = K^{1-\lambda} - \frac{S_0 L_0^\alpha(1-\lambda)}{S + \alpha} \]

Substitution of equations (2) and (5) in (1) completes the model. We can compute the future growth of national product given values of \( S_0, L_0, \alpha, K, \) and \( s \). The model is illustrated with figures which are more or less relevant to Indian conditions. As one might be interested in percentage change rather than absolute value changes, let us assume \( L_0 = 1, = K_0, S_0 = 1, \alpha = .75, \beta = .25 \) and stipulate that \( S = .005 \) and \( \lambda = .02 \)

For these values model of equation (1) after substituting (2) and (5) in this equation will be:

\[ K_t = (3.75 e^{2t} - 2.75)^{3/4} \]  

From equations (2), (6) and (1), we compute the following table tracing the long term growth of developing economy.
TABLE 6. Long Term Growth of National Production

<table>
<thead>
<tr>
<th>t</th>
<th>L_t</th>
<th>K_t</th>
<th>P_t</th>
<th>P_t/K_t</th>
<th>P_t/L_t</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1.105</td>
<td>1.557</td>
<td>1.204</td>
<td>0.77</td>
<td>1.0896</td>
</tr>
<tr>
<td>10</td>
<td>1.221</td>
<td>2.238</td>
<td>1.421</td>
<td>0.63</td>
<td>1.1646</td>
</tr>
<tr>
<td>15</td>
<td>1.350</td>
<td>3.059</td>
<td>1.656</td>
<td>0.54</td>
<td>1.2266</td>
</tr>
<tr>
<td>20</td>
<td>1.492</td>
<td>4.032</td>
<td>1.913</td>
<td>0.47</td>
<td>1.2922</td>
</tr>
<tr>
<td>25</td>
<td>1.649</td>
<td>5.181</td>
<td>2.196</td>
<td>0.42</td>
<td>1.3317</td>
</tr>
</tbody>
</table>

The above table shows that for the values of the parameters, the value of national product is doubled in 20 to 25 years (Col.4). This conforms well with targets fixed in the successive Indian Plans.* The Indian planners have been generally thinking in terms of doubling the national product in 25 years. The output — capital ratio (Col. 5) — keeps falling at diminishing rate. This again is in keeping with underlying assumptions of Indian Plans.** The national product per worker shows a much lower rate of increase. It registers a rise of 33 percent only in 25 years. This is at variance with the assertion of the first two Five Year Plans that the level of national income in 1950-51 could be doubled by 1970-71 and that of per capita income by 1977-78.

* Third Five Year Plan, Government of India.

** Second Five Year Plan, p.21, p.11. Here the incremental capital output has been shown as increasing, i.e., the output capital ratio is falling. Figures in Table 1 are not real, because arbitrary units of measurement of initial values of labour and capital.
mistake was realized in Third Five Year Plan, though no systematic attempt has been made to estimate the rate of per capita growth of income.**

It is interesting to study the movement of the consumption level in the framework of theoretical model so constructed. The main concern of people at large in a developing economy is the rise of the per capita consumption level, even though the growth of national product is important. It is obvious that the aggregate consumption is equal to the total net product minus the net investment.

\[
C_t = P_t - K_t \tag{7}
\]

where \(C_t\) is aggregate consumption in period \(t\). As we have assumed that the initial rate of savings is \(.1\), and our unit of measurement of labour and capital is such that \(L_0 = 1 = K_0\) and hence \(P_0 = 1\), we must have \(C_0 = .9\) (For \(C_0 = P_0 - K_0 = 1 - .1 = .9\)).

As \(C_t = P_t (1 - S_0 e^{St})\), substituting \(\lambda = .02\) and \(s = .005\), we have the rate of growth per capital consumption

\[
W = \frac{\log P_t / C_0 (1 - S_0 e^{St})}{t} - \lambda
\]

\[
W = \log P_t / .9 (1 - .1 e^{.005 t}) - .02
\]

* If we assume a worker's family of five members, the per capita output will be one-fifth of the per worker output.

** Third Five Year Plan, Government of India, p.21.
Table 7 gives the values of \( w \) corresponding to 5, 10, 15, 20 and 25 years.

**TABLE 7. Movement of Per Capita Consumption Level for Assumed Values of Variables**

<table>
<thead>
<tr>
<th>( t )</th>
<th>Total Product</th>
<th>Total Consumption</th>
<th>Rate of growth of aggregate consumption per year over the last ( t ) years</th>
<th>Rate of growth per capita consumption per year over the last ( t ) years</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>9.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1.209</td>
<td>1.0805</td>
<td>0.0365</td>
<td>0.0145</td>
</tr>
<tr>
<td>10</td>
<td>1.421</td>
<td>1.2715</td>
<td>0.0346</td>
<td>0.0145</td>
</tr>
<tr>
<td>15</td>
<td>1.656</td>
<td>1.4775</td>
<td>0.0331</td>
<td>0.013</td>
</tr>
<tr>
<td>20</td>
<td>1.913</td>
<td>1.6922</td>
<td>0.0316</td>
<td>0.0118</td>
</tr>
<tr>
<td>25</td>
<td>2.196</td>
<td>1.9471</td>
<td>0.0309</td>
<td>0.0107</td>
</tr>
</tbody>
</table>

For the assumed initial values of the variables and assumed values of the parameters, Table 7, Col. 3, gives the magnitude of total consumption. The level of aggregate consumption in the 25th period is more than double of the level in initial period of the total product (Col. 2). The aggregate consumption per annum increases at a simple rate of roughly around 4%, but the compound rate reckoned from the initial rate decreases at a diminishing rate from 3.6% to 3.1% approximately. The overall rate of growth per capita consumption is 1.6% for the first five years, and 1.45% for
the first 10 years but it goes on decreasing at a diminishing rate.

Planners and policy makers are more concerned with the inverse of the problem stated above. In what has preceded, we assume a certain annual rate of increase in the rate of savings. But the important problem is that to ensure a certain given increase in the per capita consumption per annum. In this case, the rate of savings or investment in each year will be dependent upon magnitudes of output and consumption in each year. In fact, as argued earlier, the volume of investment in each year will be equal to the difference between the volume of output and consumption, i.e.,

\[ \ddot{K}_t = P_t - C_t \]  

(8)

We further envisage that per capita consumption is to be increased by \( \theta \) percent, so that

\[ \bar{C}_t = C_0 e^{\lambda + \theta} \]

where \( C_0 \) is initial level of consumption and \( \lambda \) is the rate of increase of population as usual. Therefore,

\[ \ddot{K}_t = L_t K_t - C_0 e^{(\lambda + \theta)t} \]  

(9)

Further, we have:

\[ K_t = K_{t-1} + \ddot{K}_{t-1} \]  

(10)

Equation (10) implies that savings of a period invested
in the succeeding period or else they are invested in the same period. It is obvious that if we know \( K_t \)'s for successive \( t \)'s, we can found out \( K_t \)'s for all \( t \)'s. \( K_t \)'s can be determined by solving equation (9). A general solution of equation (9), however, is not possible. Therefore, a method was adopted to find \( k_t \)'s for given initial values of \( L \) and \( K \) and assumed values of \( \lambda \) and \( \theta \) by interactive process. Table 8 gives the values of total output, consumption and investment for the first 10 years under the assumption that the per capita consumption increases at the rate of one percent per annum so that \( \theta = .01 \). Further as the initial saving is supposed to be .1 and \( C_0 = .9 \), the values of other variables and parameters remain the same as before.

**TABLE 8. Growth of National Production Under the Assumption of Annual Increase of One percent in Per Capita Consumption**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Capital Stock</th>
<th>Total Output</th>
<th>Total Investment</th>
<th>Total Consumption</th>
<th>Capital Output Ratio</th>
<th>Rate of Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>.1</td>
<td>.9</td>
<td>1</td>
<td>.1</td>
</tr>
<tr>
<td>1</td>
<td>1.1</td>
<td>1.04</td>
<td>.113</td>
<td>.927</td>
<td>1.057</td>
<td>.107</td>
</tr>
<tr>
<td>2</td>
<td>1.213</td>
<td>1.081</td>
<td>.125</td>
<td>.956</td>
<td>1.122</td>
<td>.116</td>
</tr>
<tr>
<td>3</td>
<td>1.338</td>
<td>1.125</td>
<td>.140</td>
<td>.985</td>
<td>1.189</td>
<td>.125</td>
</tr>
<tr>
<td>4</td>
<td>1.478</td>
<td>1.171</td>
<td>.154</td>
<td>1.017</td>
<td>1.262</td>
<td>.132</td>
</tr>
<tr>
<td>5</td>
<td>1.632</td>
<td>1.218</td>
<td>.172</td>
<td>1.046</td>
<td>1.339</td>
<td>.141</td>
</tr>
<tr>
<td>6</td>
<td>1.804</td>
<td>1.268</td>
<td>.191</td>
<td>1.077</td>
<td>1.422</td>
<td>.151</td>
</tr>
<tr>
<td>7</td>
<td>1.995</td>
<td>1.323</td>
<td>.212</td>
<td>1.111</td>
<td>1.508</td>
<td>.160</td>
</tr>
<tr>
<td>8</td>
<td>2.207</td>
<td>1.374</td>
<td>.230</td>
<td>1.144</td>
<td>1.606</td>
<td>.167</td>
</tr>
<tr>
<td>9</td>
<td>2.437</td>
<td>1.430</td>
<td>.251</td>
<td>1.179</td>
<td>1.704</td>
<td>.176</td>
</tr>
<tr>
<td>10</td>
<td>2.688</td>
<td>1.488</td>
<td>.273</td>
<td>1.215</td>
<td>1.808</td>
<td>.184</td>
</tr>
</tbody>
</table>
Comparing Tables 7 and 8, total consumption in latter is lower than that in the former for the first 10 periods. It shows that mere half a per cent annual increase in the rate of savings from an initial rate of 10 percent is compatible with a more than 1 per cent annual increase in the rate of per capita consumption per annum. As Col. 5 of Table 7 shows, this incremental rate is more than percent for all the years, though it is gradually diminishing. The latter, in turn, implies an obvious fact that a constant annual increase in the rate of savings under the type of models brings about diminishing rate of annual increase in the per capital consumption.*

9.3 - Conclusions

The simple model outlined above possesses the general defect of growth models that have been developed. These models take saving rate, technology and preference, as given and then set-up to work out a growth process mostly on the basis of accumulation of capital. The present model too assumes the rate of saving as given, but increasing at a constant rate. The model has not gone behind savings rate

* After a few periods, rate of growth per capita consumption in Table 2 will become less than 1 per cent. As the rate of savings in Table 3 increases at a faster rate than in Tables 1 and 2, both the total output and consumption will be higher under the assumptions of Table 3 after the critical period and thereafter keep increasing at a faster rate than that will be possible under assumption of the first two tables.
to study the forces that are at work in bringing savings rate
to the levels assumed. The increases in saving rate may be
either induced by deliberate monetary fiscal policies or they
may be brought about quite endogenously due to increases in
per capital income as the development process starts. In any
complete model these forces will have to be thoroughly ana-
lyzed and integrated. The use of a production function, how-
ever, is an improvement over that of capital output ratio,
in which it allows for substitution of factors, choice or
use of alternative technology commensurate with variations
in the availability of resources. In the developing countries,
these two aspects are crucially important, hence the need for
introducing a production function in growth model. Tables 6,
7 and 8 are the standard norms calculated at the standard
normal variables. Any strategy formulated at par or up will
certainly result in growth and prosperous economy.