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ENDOGENOUS GROWTH THEORY: SCOTT'S MODEL, 'NEW VIEW OF ECONOMIC GROWTH' AND POLICY IMPLICATIONS

Dr. Satyabrata Mishra
Associate Prof. and HOD P.G. Department of Environmental Economics, M.P.C. (A) College,Takhatpur, Baripada Mayurbhanj, Odisha.

Abstract
Standard of living of the people cannot be raised without economic growth. This is why the government of India has placed priorities to economic growth, its sustainability and investment. The experience of East Asian economy reveals that high growth can eliminate poverty and transform a developing economy in to a developed one. The new growth theory is different from the old growth theory and it emphasized the role of investment in physical capital in stimulating the growth of human capital.

I. Introduction

As mentioned by Paul Romer, "The phrase, 'endogenous growth' embraces a diverge body of theoretical and empirical work that emerged in the 1980s" (Romer, 1994, p. 3). A branch of growth theory that explains productivity growth through investment in human capital is known as Endogenous Growth Theory of the New Growth Theory. The New Growth Theory is different from old growth theory wherein the long-run (steady state) growth rate cannot be affected by changes in saving or investment without exogenous productivity growth. The modern approach to economic growth that does not take productivity growth as exogenously given, but instead, tries to account for it within the model is known as Endogenous Growth Theory. The New Growth Theory emphasizes the role of investment in physical capital in stimulating the growth of human capital.

The importance of growth theory in Macro-Economics is straightforward with the fact in view that the general standard of lining of the people of a country cannot be improved over time without growth. It is evident from the historical experience of most of the industrialized countries of the world. The theory of economic growth tries to highlight the factors that influence the long-run trend growth of an economy.

Realizing the importance of growth and investment, in the Economic Survey, 2006-07 these are placed among the issue and priorities of the Government.

"The economy appears to have decidedly 'taken off' and moved from a phase of moderate growth to an new phase of high growth. Achieving the necessary escape velocity to move from tepid growth into a sustained high growth trajectory requires careful consideration of *two issue and three priorities*. The two issue are: the sustainability of high growth with moderate inflation; and the inclusive nature of such high growth. The three priorities are: rising to the challenge of maintaining and managing high growth; bolstering the twin pillars of growth, namely fiscal prudence and high investment; and improving the effectiveness of Government intervention in capital areas such as education, health and support for the needy" (Economic Survey, GOI, 2006-07, p. 14).

Obviously, growth of economy, its sustainability and investment have been placed among issues and priorities by GOI. The nature of high growth in terms of inclusiveness implies, *inter alia*, putting more people in productive and sustainable jobs. The survey further states, "There cannot be inclusive growth without growth itself. The experience of East Asia how high growth can eliminate poverty and transform a developing country into a developed one" (Economic Survey, GoI, 2006-7, p. 15).

This paper is divided into five sections. First section is the introductory one. Second section comprises of review of literature. Third section consists of objectives of the study. Scott's model is discussed in detail in section four. The final section consists of conclusions and policy implications of the present paper.

II. Objectives of the Paper

The present paper is a modest attempt to present the gist of Scott's model of Endogenous Growth (1989, 1992), which he calls as 'New View of Economic Growth '. The main objectives of this study are:

- Review of existing literature on Endogenous Growth Theory
- To study Scott's Model in detail
- To bring forth conclusions and policy implications of the present paper

III. Review of Literature in Brief

Even though the main purpose of this paper is to discuss the endogenous growth model of Scott, it is desirable to go back a little to know a few growth models of old growth theory as well as other endogenous growth models in very brief. Growth Models are basically of two types. Firstly, neoclassical growth models that emanated mainly from the work of Solow (1956). Secondly, there are Endogenous Growth models that started off with the pioneering work of Romer (1986) and Lucas (1988), Even though Endogenous Growth theory is also recognized by the name 'The New Growth Theory', there is an evidence of initiation of this concept as back as in 1962 with the seminal paper of Arrow (1962) incorporating the concept of Learning By Doing that was generalized and extended by Levhari (1966) and Sheshinski (1967) without deviating from Arrow's general well known conclusion that socially too little is invested and produced. There has been immense work in the area of endogenous growth models especially since 1980s.

Growth theory cans be said to begin with the work of Harrod (1939) wherein he looked into the possibility of economic growth with full employment of resources, Prof. R.F. Harrod tried to show in his model as to how the steady or equilibrium growth may occur in the economy. His analysis was based on the Keynesian multiplier theory of aggregate demand.

Domar (1946) in his model took initiative to look into capacity improvement over time. Like Harr0d, Domar also visualized a path of output demand by appealing to Keynesian multiplier theory. He was mainly concerned to ensure if the path of demand would match the capacity at each instance. He concluded on a negative note that such a path was not plausible. He also concluded that capacity improve1nent brought about by investment is the result of technological development. This leads to rendering the existing technologies obsolete. Thereby the economic cost of the unutilized capacity might be aggravated further in the face of strong competition due to capital scrapping which may lead to inadequate returns to investment.

Solow's model is popularly known as neoclassical growth model. Solow (1956) assumes diminishing returns to capital. As per the result of this model, without exogenous productivity growth, the long-run (steady state) growth rate cannot be affected by changes in saving or investment.

The early Harrod-Domar and Neoclassical models of growth had possessed in common the belief that technical progress was an exogenously determined, fortuitous and costless occurrence. In the neoclassical growth model, with exogenous population expansion and exogenous technical change there was virtually no role for government to play. On contrary, endogenous growth models allow technical progress to be an endogenously determined variable.

There are a number of endogenous growth models starting with the work of Arrow which dates back to 1962. Arrow (1962) can be regarded as the first one who succeeded in finding a link between productivity and growth. In his model of 'Learning by doing', he took a significant initiative towards offering a theory of productivity growth, thereby endogenizing the equilibrium rate of technical progress for the economy. He attributes productivity increases over time to learning, i.e., accumulation of experience with the labour force. He also explained the reasons underlying technological progress.

Thereafter, Romer (1986) came out with his pioneering work in growth theory. A new interest arose in the growth theory. It was through generalizing the scope of the Arrow paradigm. His further papers in 1989 and 1990 reveal his further thoughts in this area. Romer's findings can be summed up as-The equilibrium growth rate of an economy can be sustained by a combination of perfectly competitive and monopolistically competitive markets and the growth rate for the command economy is larger than that for a market economy. The essential feature of Romer's model is that knowledge displays increasing marginal productivity.

Findings of Lucas' (1988) model are - Saving has a role to play in the determination of equilibrium rate of growth. The growth rate of the system in the model of endogenous human capital formation along with accumulation of physical capital is determined endogenously by the parameters of the preference function and technology.

Summary of Rebelo's (1991) model as brought out by Dasgupta is – "Even in the presence of strong diminishing returns in parts of the economy, steady state capital accumulation is possible at an 'endogenously' chosen rate so long as there is a sub sector of the economy which produces capital goods by using capital goods alone and there are perfectly functioning asset markets. All other sectors into which coeds enter as inputs and where production is carried out under diminishing returns, adjust to this rate of growth a continuous fall in the relative price 0f capital goods" (Dasgupta, 2001 pp. 178-9).

Barro (1990), In this model, tried to capture the effect of introducing public services as an input into the growth process. The conclusion is that when government taxes private sector income and these proceeds are utilized for infrastructural support, then the growth rate of economy is a function of the tax rate.

The main conclusions of Aghion and Howitt's (1992) model are-The appearance of more productive resources in the presence of obsolescence has negative impact on the rate of private investment into research. But as the arrival of new inputs is uncertain, the growth rate of economy is a stochastic variable.

Scott's (1989) model is concerned with the productivity growth as an endogenous variable. Athukorala remarks in this regard - "The Scott model is rooted in the empirical observation that investment and technologic change are part and parcel of the same thing, and thus investment measured in 'gross term' (that is without netting for depreciation) captures both investment (Capital formation) and technological effort" (Athukorala et.al., 2002, p. 97). Scott considers there variables to determine the growth rate of output. These variables are – the rate of investment, the efficiency of investment and the growth of quality-adjusted labour force.

IV. SCOTT'S Model

Scott (1989) explained his model of economic growth through his '*new view of Economic Growth'*. Scott develops his growth model as a reaction to the empiric applicability of traditional neoclassical growth theory that is based on two assumptions. The two assumptions are like this. Firstly, output growth of technical change. This is known as growth accounting. The following production function is postulated regarding this view –

$$Y = A K^{a} L^{1-a}$$

Here, K and L are capital and labour inputs and A is the Hicks – neutral productivity term. Taking logs and then differentiating this production function following formula is obtained:

$$\frac{\underline{Y}}{Y} = \frac{\underline{K}}{K} + (1-\alpha)\frac{\underline{L}}{L} + \frac{\underline{A}}{A}$$

According to this equation, output growth is equal to the weighted average of capital growth, labour growth and the growth rate of A. Here$\underline{A}$ is the total factor productivity A growth and is taken to be the unexplained residual in the growth accounting episode.

The second assumption is regarding the diminishing returns to capital. As per the neoclassical growth theory the changes in the investment rate do not have any long term effect on the output growth.

Main prediction of neoclassical growth model is that investment rate does not determine long- run (or steady state) growth; it only impacts on growth during the transition from one steady state to another steady state. Main implication of this prediction is that policy can have impact only on the long run level of the income but not on the growth rate of income.

Scott starts with the criticism of these assumptions to construct his model. Regarding growth accounting, Scott is of view that growth comes about by firms changing the way they do things, and that invariably involves a cost. The cost involved in changing economic arrangement in terms of consumption foregone, is investment. The only way to bring about such change in economic arrangement is through technological change and like other involves a cost, i.e., investment. Hence technical change and investment are inseparable. He is of the View that measuring the change in capital stock as gross investment minus depreciation is unwarranted. He further says that if depreciation is mostly in obsolescence, it is not going to reduce output at all, but it merely causes transfer of income from the owners to the workers as a part of process of technical change.

Regarding assumption of diminishing returns to capital Scott argues that actual evidence suggests opposite wherein return to capital increase as the stock of cumulative investment increases. He argues that better approach to growth empirics is to treat both, growth due to capital growth and technical progress as the result of investment. Scott defines investment as - "Investment in my view, should be defined as the cost (in terms of consumption foregone) of changing, hopefully of improving, economic arrangements" (Scott 1992 p. 625).

In Scott's view there are no diminishing returns to capital stock and since current investment changes economic arrangements, it creates new opportunities for investment. There are externalities attached with the investments. According to him, there are two externalities, namely the learning externality and the market externality. In case of former, there is the creation of opportunities of investment for the other firms when one firm invests at a faster rate. The latter externality is about possibility that in the environment of imperfect markets, if all firms are to expand their investment together, all these firms are likely to find their demand curves Shilling faster' to the right, and thereby all the firms in the economy would be benefited

from a coordinated investment increase. Implication of above views is that marginal return to new investment will not drop and rather may go up.

Scott argues that unlike in the conventional production function of neoclassical growth theory, process of economic growth is best depicted by a set of inexhaustible opportunities that are continually remade. He refers to the possibility that the average quality of investment may not stay constant. As a result of investment proceedings whereby country catches up with new opportunities, wage rates will bid up und ultimately the set of opportunities can become infinite. Also there are the possibilities that persistent increase in the rate of investment may lead to worsening of average quality resulting in shrinking of opportunities. Scott considers that based on empirical regularities, as a working hypothesis, an inexhaustible constant set of investment opportunities seems plausible. In Scott's words - "Investment opportunities emerge mainly from the existing situation. That is continually changing because of investment, and so new opportunities are continually emerging." (Scott, 1992, p. 625)

The simple linear equation of growth as put up by Scott is as follows-

$$g = \alpha Qs + \beta gL$$

Here,

g - growth rate of output;
Q - an index of the quality or efficiency of investment;
s - investment rate;
gL -growth rate of the quality adjusted labour force;
and a. and p are constants

On the contrary, in the neoclassical model of economic growth, the growth rate of output will be determined by the exogenous rate of growth of technical change and the growth of labour force. In the neoclassical model, growth is determined as-

$$g = a + \beta gL$$

The main difference between these two equations is the absence of the investment rate in the latter equation. In this model, Scott combines technological change and related policy factors in a directly testable form. In the model, economic growth is determined simply by three variables, the gross investment rate, the efficiency of investment and the growth rate of the quality adjusted labour force. Scott's growth theory, thus, allows the investment rate to impact on the long-term growth, like in the other endogenous growth theories but unlike the latter, qualities the relationship between investment and growth by taking into account the efficiency of investment. Moreover, it allows for policy to impact on the relationship between investment and growth by affecting the efficiency of investment.

One of the important advantages of the Scott model is that it allows the policy to influence the growth by impacting on both the volume and the quality 0 f investment. This advantage is missing in the mainstream endogenous growth theory. However, the phenomenon of investment rate to determine economic growth exists in the mainstream endogenous growth theory as well which was missing in the neoclassical growth theory.

Is the worth mentioning a few of Scott's conclusions for policy - "Investment is a much more important proximate cause of growth than conventional theory, backed up by many growth-accounting studies, would have us believe. Furthermore, raising investment ratio raises the rate of growth indefinitely and not by an amount which diminishes asymptotically to zero. Finally, there is a large externality of investment due mainly to the learning effect whereby investment by one firm creates and reveals investment opportunities for other firms. These conclusions from study which, if accepted, point to the need for policies to promote investment." (Scott, 1992, p. 629)

V. Conclusions and Policy Implications

So, endogenous growth theory emphasizes the role of investment in physical capital in stimulating the growth of human capital. With this increased human capital, the marginal product of physical capital improves. Growth of productivity IS not by chance or purely exogenous, it is brought about by greater investment in human capital and Research and Development (R & D) Scott's model seems more beneficial than the neoclassical growth model and other endogenous growth models. In that main advantage is in terms of endogenity of technical progress in contrast with that of neoclassical model. The mainstream endogenous growth theory unlike the neoclassical growth model allows the investment rate to determine economic growth.

Scott's model provides a clear theoretical case for using the gross investment rate, rather than the stock of capital as an appropriate measure of investment in explaining long-term growth. It also provides an explicit role for policy to influence, interactively with gross investment, the relationship between investment and growth. According to Scott, economic growth is

a function of three variables, namely, the gross investment rate, the efficiency of investment and the growth rate of the quality adjusted labour force. This model provides an analytical framework for empirically testing the causality running from the investment to growth. This is an important analytical framework from investment-growth nexus analyzing point of view.

Hence, investment is much more proximate cause of growth and raising investment rate is likely to raise the rate of growth indefinitely. Also Investment in one firm creates externalities for the entire economy. The existence of this externality suggests that a large subsidy to saving and investment should be made.

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