

# Comparison of the most prominent economic growth theories



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The importance of economic growth has been a prominent and interesting topic for economists. Economic growth is a result of greater quantity and better quality of capital, human and natural resources and technological advance that promote productivity.

Eighteenth and nineteenth century classical economists such as Adam Smith (1776), David Ricardo (1817), and Thomas Malthus (1798), were among the first to theorize economic growth. In fact, it is mentioned that Adam Smith's book "The Wealth of Nations" in 1776 was the suitable starting point for economic growth. He emphasized on the crucial role of technological progress, institutional and social factors beside capital accumulation in the economic growth process of a country.

Malthus identified diminishing returns to agriculture as the most important constraint on growth. Continuing the work of Smith and Malthus, Ricardo followed Smith in assuming markets would take care of the balance between agriculture and industry, and followed Malthus in assuming diminishing returns in agriculture. From his analysis, Ricardo concluded that in order to maximize growth, there should be free trade, minimal taxation and increased incentive in agriculture and industrial innovations. The rate of growth according to Ricardo could be raised by reinvesting the surplus of agriculture and manufacturing and these surpluses in turn could be raised through free trade or raising the efficiency of workers. (Abuhasan 1996)

The classical theory of economic growth has become virtually obsolete as it has been found that growth does not depend on the surplus of the productive sector over the unproductive one. This is due to the fact that

there is higher growth in capital than in population and this made the reliance on profits of investable surplus less important. (Barro and Sala-i-Martin 2004)

The concepts, that classical economists used, are extremely appeared in modern theories of growth. These concepts contains the role of diminishing returns and its relation to the accumulation of physical and human capital, the interplay between per capita income and the growth rate of population, the effects of technological progress in the forms of increased specialization of labor and discoveries of new goods and methods of production and the role of monopoly power as an incentive for technological advance.(Barro and Sala-i-Martin 2004)

Frank Ramsey (1928), Allyn Young (1928), Frank Knight (1944) and Joseph Schumpeter (1934) extended the work of these classical economists . The starting point of modern growth theory was the article of Ramsey (1928). He used inter-temporal separable utility function in household optimization for modeling economic growth. Today this function is widely used as Cobb-Douglas production function.

Harrod (1939) and Domar (1946) tried to analyze economic growth based on Keynesian model. They argued that capitalist system is unstable. They stressed the importance of capital accumulation in  $g$  and that the primary source of stimulus is the government. They used production function by with little substitutability among the inputs to prove their claim. Although, this idea attracted many attention of economist at the time (during and after Great Depression), but this analyze plays little role in today.

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The subsequent neoclassical growth model was introduced by Solow (1956), Swan (1956) Cass (1965) and Koopmas (1965).

Solow (1956) and Swan (1956) proposed an exogenous growth theory in neoclassical framework, known as Solow-Swan model. They used production function by constant returns to scale with two factors of production labor and capital. The model characterized by constant returns to scale, diminishing returns to each inputs, positive elasticity of substitution between them and the assumption that market function well (Barro 1991).

Neoclassical growth theory, as developed by Solow (1956) and his followers, has dominated economists' thinking about long-term or "trend" movements in per capita income for more than three decades. Solow focused attention on the process of capital formation. Aggregate savings, he argued, finance additions to the national capital stock. An economy with an initially low capital-labor ratio will have a high marginal product of capital. Then, if a constant fraction of the income generated by a new piece of equipment is saved, the gross investment in new capital goods may exceed the amount needed to offset depreciation and to equip new members of the workforce. Over time, capital per worker will rise, which (with constant returns to scale and a fixed technology) will generate a decline in the marginal product of capital. But if the marginal product continues to fall, the savings generated by the income accruing to new capital also will fall, and will eventually be only just sufficient to replace worn-out machines and equip new workers. At this point the economy enters a stationary state with an unchanging standard of living.(Grossman and Helpman 1994)

The new-classical model is in agreement with Malthus and Ricardo in that per capita growth will eventually cease when there are no more improvements in technology due to diminishing returns of capital. It observed that positive rates of per capita growth can persist over a century or more and that these growth rates have no clear tendency to decline.

In overall, the standard neo classical growth model implies that in steady state equilibrium, the level of GDP per capita will be determined by the prevailing technology and exogenous rates of saving, population growth and technical progress. They conclude that different saving rates and population growth rates might affect different countries steady state level of per capita income.

One of the important concepts in the neoclassical g model that derives from the assumption of diminishing returns is the theory of convergence. The lower the starting level of per capita GDP, relative to the long run steady state position, the faster the growth rate. Economies that have less capital per worker tend to have higher rates of return and higher growth rates.

The convergence is conditional because the steady-state levels of capital and output per worker depend, in the Solow-Swan model, on the saving rate, the growth rate of population, and position of the production function characteristics and recently government policies and initial stocks of human capital that might vary across economy.

Strong evidence of convergence was found for the group of developed countries such as the OECD ((Dowrick and Nguyen 1989) ;(Gordon and Kevin 1989; Helliwell and Chung 1995). Cross country analysis of the con  
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hypothesis was also found among developing countries (Barro 1991; Mankiw, Romer et al. 1992).

Other study found strong divergence in income among countries where rich nations grew relatively richer ((Romer 1987; DeLong 1988). The rich countries tend to grow richer due to the increasing returns to scale in areas such as learning by doing and spillovers from the accumulation of knowledge. (Abuhasan 1996)

The obvious shortcoming of the neoclassical growth models is that it does not, in the end, shed light on economic growth. In the neoclassical model, an economy will always converge towards a steady state rate of growth, due to advances in technology, but technological progress is taken as exogenous. In other words, the long-run rate of growth is determined exogenously, that means it is determined outside of the model. (Mankiw, Phelps et al. 1995; Barro and Sala-i-Martin 2004)

Cass (1965) and Koopmans (1965) received the analysis of consumer optimization that was first used by Ramsey. The Cass- Koopmans version of neoclassical growth model was able to include the saving rate endogenously. The production function featured constant returns to scale and productive factor of labor and capital are paid their marginal product in a competitive framework.

Another shortcoming of the neoclassical growth models is that it was not able to satisfactorily to explain technological change due to its assumption of a competitive economy. (Barro and Sala-i-Martin 1995)

An important part of technological change is non-rival ideas, without which there would be no increasing return to scale. This finding is in conflict with the competitive assumption that prevents the possibility of research and development in generating non-rival idea. R&D activities can only be generated under an imperfectly competitive environment or by government subsidies.

Mankiw and et. al., 1995 mentioned that the neoclassical model is suitable when we want to explain why standards of living are higher today than a century ago. But, in his opinion, the goal is not to explain the existence of economic growth. A more challenging goal is to explain the variation in economic growth that we observe in different countries and in different times. For this purpose, the neoclassical model's assumption of constant, exogenous technological change does not preclude addressing many of the central issues of growth theory. (Mankiw, Phelps et al. 1995)

The concept learning by doing was introduced by Arrow (1962), who suggested that the level of knowledge is a productive factor by itself. Learning by doing will increase when the level of investment is increased. It is assumed that the productivity of a firm is an increasing function of aggregate output for the industry. The increase in capital stock of firm increase the level of knowledge to the entire economy through learning by doing and the economy as a whole would be operating on increasing returns to scale. Thus, externalities were possible under the assumption that knowledge is a public good. The Arrow-Levhari -Shesinki model assumed that technological progress was endogenous but steady state growth was still

determined by the labor force growth rate. In this model as Cass -Koopmans model, there is no government role in economic growth (Shaw 1992).

Probably because of its lack of empirical relevance, growth theory effectively died as an active research field by the early 1970s, on the eve of the rational-expectations revolution and oil shocks. For about 15 years, macroeconomic focused on short-term fluctuations. Academic interest in economic growth dwindled and major contributions gradually turned to the study business-cycle models, improved approaches to policy evolution, and the application of general-equilibrium methods to real business -cycle theory.

After the mid 1980s, the research on economic growth has regained momentum by papers of Romer (1986) and Lucas (1988). The need of determinant for long run growth inside of model (the main weakness of the neo classical growth model) is a main motivation for restart study about economic growth. Both the papers by them used the work of Arrow (1962) as a starting point, by building and improving the economic growth models. (Romer 1986; Lucas Jr 1988)

Endogenous growth models developed within the framework of inter-temporal optimizing behavior of rational agents represent different intellectual influence. These endogenous growth models achieve positive and constant steady state growth rate both assuming non-decreasing returns to scale and by endogenizing technology improvements (Lucas Jr 1988; Becker, Murphy et al. 1990; Romer 1990; Barro 1991)



Technological spillover effects resulting from investment in research and development, human capital, or technological infrastructure ensure a self-feeding growth process in the economy.

Romer (1986, 1989) assumed that knowledge operates with increasing returns and thus, even in a competitive equilibrating, there is no limit to per capita income growth. He presents a model in which economic growth in the long run occurs not because of exogenous technological progress, but because the accumulation of capital generates externalities. Externalities of knowledge from investment in research of a particular firm will raise the production possibilities of other firms as a result of inadequate patent protection. Even though investment in research exhibits diminishing returns, the production of goods from increased knowledge demonstrates increasing returns. (Loayza and Soto 2002)

The studies that focused on the dynamic increasing returns to scale and growth include (Grossman and Helpman 1990) and (Krugman 1987). These studies suggest that large countries grow more quickly than smaller ones by exploiting their domestic markets to achieve economic of scale. With the assumption of increasing returns to scale, these models predict that higher investment rates will accelerate economic growth. Economic policies that affect the investment rate will thus have an impact on growth.

In addition to the assumption of endogenous technical change and role of R&D Lucas (1988) and Romer (1990) introduces a model in which human capital plays a fundamental role in perpetuating economic growth. Returns to investment in human capital do not diminish as the economy developed and

thus, human capital also exhibits increasing returns to scale. A country with higher stock of human capital also exhibits increasing returns to scale. Countries with higher stocks of human capital will have faster economic growth. In contrast to the previous model, the government has a crucial role in this model. Due to the fact that the producer of research are compensated sub optimally, government should subsidize the R&D sector (Grossman and Helpman 1990).

The appropriate R&D sector subsidy will be the most difficult decision faced by government. As second best solution, the government should subsidize human capital accumulation. The importance of the role of government was evident in the study by (King and Rebelo 1990). Their paper suggested that differences in public policy incentive can affect the acquisition of human and physical capital and hence steady state growth rate.

Further extensions to economic growth models included the imperfect competition framework. (Romer 1987; Grossman and Helpman 1990; Romer 1990) as pointed out earlier, investment in R&D activities can generate long run economic growth if there is some form of ex-post monopoly power.

Government policies are important in many areas such as taxation, providing infrastructure, securing property right, patent and regulation of trade and financial market. Besides generating their own research, developing country can benefit through learning by watching. (King and Rebelo 1990)

Through the diffusion of technology and demonstration effects, developing countries can imitate the innovation done by developed countries at substantially lower costs than performing their own research and

development. (Nelson and Phelps 1966) suggested that higher level of human capital would enable countries better to absorb new technology. However, even though higher levels of human capital have been found significantly to affects growth, the direction of causality between education and g is not obvious.

Another area of research is the analysis of the relationship between fertility and economic growth. Incorporating the analysis of fertility choice to the Lucas 1988 model, Becker Murphy tamura 1990 showed that per capita g and net fertility tend to move inversely. Fertility rate tend to fall with per capita income in middle to high income countries but for lower income countries fertility rate tend to rise with per capita income. (Abuhasan 1996)

Another class of models known as the AK type replace the assumption of diminishing marginal productivity of capital with the non-diminishing marginal productivity of the accumulable factor of production to achieve positive and suitable steady state growth rate in the economy (Jones and Joulfaian 1992)

The clearest distinction between the growth theory of the 1960s and that of the 1990s is that the recent research pays close attention to empirical implications and to the relation between theory and data. However, much of this applied perspective involved applications of empirical hypothesis from the older theory, notably the neoclassical growth model's prediction of conditional convergence. The cross-country regressions motivated by the neoclassical model surely became a fixture of research in the 1990s. An interesting research development in this area involves assessment of the

robustness of these kinds of estimates. Other empirical analyses apply more directly to the recent theories of endogenous growth, including the roles of increasing returns, R&D activity, human capital and the diffusion of technology.

The broad consensus highlighted in the literature is that a country's growth over a long period is basically determined by three factors, namely the effect utilization of the existing stock of resource, the accumulation of productive resources such as human capital, and technology progress.

It is worth emphasizing that the contribution of endogenous growth models to the literature on economic growth is very significant. Endogenous growth specifications allowed researchers to examine the effects of policy variables and human capital, and to articulate the hypothesis of conditional income convergence. This helped to resolve some puzzling results derived from traditional Solow growth models.

The paper by Xavier Sala-i-Martin in this volume is devoted to reviewing the main contributions of the new growth literature. Sala-i-Martin identifies three defining characteristics of this literature. They are, first, the empirical touch, that is, the close connection between the new theories and the empirical data and methods used to test them; second, the emphasis on endogenous technological progress, in particular on the type that generates increasing returns and is provided by the market through monopolistic competition; and third, the merging of different strands of economics, which is both a feature of the new growth literature and a consequence of it. One particular example is the fruitful interaction, induced by economic growth, between

macroeconomics-previously dominated by business cycle theories-and economic development-formerly centered on institutional analysis and economic planning. (Barro and Sala-i-Martin, 1995).

### Theoretical framework

In the late 1980s, Romer and Lucas extended the Solow's neo-classical growth theory by making the rate of technological change and/or population growth endogenous rather than exogenous and developed " endogenous growth theory" in which attempts to explain technological change, especially investment in research and development, but also institutional factors such as protection of property rights, regulation of international trade, and taxation, endogenously as the outcome of market activity in response to economic incentives. The main implication of recent growth theory is that policies which embrace openness, competition, change and innovation will promote growth. Conversely, policies which have the effect of restricting or slowing change by protecting or favoring particular industries or firms are likely over time to slow growth to the disadvantage of the community.

Considering the technological change is endogenous, they modify the general form of production function (output) as:

$$Y_t = F(K_t, N_t, A_t)$$

Where A is endogenous here, firm's output depends not only on its own level of K and N, but also on the economy wide level of A advances in the A are therefore assumed to increase the productivity of all firms. In endogenous growth model, the growth of technology is assumed to depend on the growth

of capital. New investment fosters inventions and improvements in the machines that comprise the stock of capital. It is assumed in the neoclassical model that the increase in  $K$  and  $N$  will cause output to rise proportionately. These increase in  $K$  and  $N$  will advance the economy wide  $A$  and increase in  $A$  will lead to an additional increase in output. Models with endogenous technological change therefore, exhibit increasing returns to scale, changes in the saving rate and therefore in the rate of capital formation can have permanent effects on the long run equilibrium growth rate of output. Therefore, with endogenous technological change and increasing returns to scale, policies that affect the saving rate and thus the rate of capital formation will affect the long run equilibrium growth rate of output. Many government policies have potential effects on these variables. (Froyen 1996)

Endogenous growth theory emphasizes the interaction between the products of ideas, investment in physical capital and investment in human capital (education, skills and technology) to explain why poor country cannot instantly boost their standard of living up to the level of rich countries, because, it takes many years to investment in physical and human capital for the ideas developed in the rich countries to benefit the poor countries. (Gordon 2000 p. 313)

In this theory technology, diffusion plays a central role in the process of economic development. In contrast to the traditional growth framework, where technological change was left as an unexplained residual, the recent growth literature has highlighted the dependence of growth rates on the state of domestic technology relative to that of the rest of the world. Thus, growth rates in developing countries are, in part, explained by a 'catch-up'

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process in the level of technology. In a typical model of technology diffusion, the rate of economic growth of a backward country depends on the extent of adoption and implementation of new technologies that are already in use in leading countries. (Borensztein, De Gregorio et al. 1998)

Technology diffusion can take place through a variety of channels that involve the transmission of ideas and new technologies. Imports of high-technology products, adoption of foreign technology and acquisition of human capital through various means are certainly important conduits for the international diffusion of technology.(Grossman and Helpman 1990; Borensztein, De Gregorio et al. 1998)

According to endogenous growth theory, globalization also plays important roles in diffusion of technology. Here, the role of globalization in economic growth can be investigated through two important implications of globalization. using the neoclassical growth model often suggest that the gains from integration are small. If these estimates were calculated in the context of an endogenous growth model, integration might be found to be much more important.(Rivera-Batiz and Romer 1991)

Trade globalization plays important role in this theory, since each country can concentrate on developing the ideas to produce a few new goods and then trade them with other countries. When the concept of idea is applied broadly, it helps explain not only the introduction of new goods but also the development of better production techniques and higher quality in order goods. Most of these ideas would not work without associated investment in physical and human capital.

In these models, openness to trade provides access to imported inputs, which embody new technology; increases the effective size of the market facing producers, which raises the returns to innovation; and affects a country's specialization in research-intensive production.(Harrison 1996)

Theoretically, it has long been argued in the literature that trade affects long-term growth through multiple channels. International trade would allow countries to higher specialization in areas where they possess comparative advantage, expand potential markets and allow firms to take advantage of economies of scale, enable the diffusion of technological innovation and frontier managerial practices through stronger interactions with foreign firms and markets (Grossman and Helpman 1992) , and reduce incentives for firms to conduct unproductive rent-seeking activities through higher market competition.(Loayza and Soto 2002; Calderón and Poggio 2010)

Rivera-Batiz and Romer (1989) and Grossman and Helpman (1989) have recently constructed rigorous models in which technology is produced in profit maximizing firms. They show that openness to international markets can increase the growth rate of technology by increasing the size of the market available to technology producers and allowing those countries with a comparative advantage in technology production to specialize in this key industry. Romer (1986, 1990) also notes that international trade may improve domestic productivity and economic growth by increasing communication with and therefore " knowledge spillovers" from trading partners(Levine and Renelt 1991)



The endogenous growth model also emphasize on the importance of financial openness as implication of globalization. Investment of foreign companies in poor countries can bring with them required equipments and educated engineers and managers (Gordon 2000 p. 306).

Financial globalization has direct and indirect effects on economic growth. It can supplement domestic saving[1], increase levels of physical capital per worker, and help the recipient country raise its rate of economic growth and improve living standards. These potential benefits can be particularly large for some types of capital inflows, most notably foreign direct investment (FDI). (Agenor 2001)

It also enhances economic growth through three indirect channels. FDI may facilitate the transfer or diffusion of managerial and technological know-how—particularly in the form of new varieties of capital inputs—and improve the skills composition of the labor force as a result of “learning by doing” effects, investment in formal education, and on-the-job training (Grossman and Helpman 1991; Borensztein, De Gregorio et al. 1998)

In addition, financial openness induces competition in the product and factor markets that cause reduction in profits of local firms, spillover effects through linkages to supplier industries may reduce input costs, raise profits, and stimulate domestic investment (Agenor 2001).

Another channel through which international financial integration may affect positively the rate of economic growth is through its effect on total factor productivity.

In fact, the liberalization of international portfolio capital flows may lead to higher rates of economic growth because it may tend to accelerate the development of domestic equity markets and that, in turn, may lead to increased factor productivity. (Levine 2001)

Globalization through trade and financial, is one of the important policies that can affect on the saving and capital formation with endogenous technological change and hence affect on the equilibrium growth rate of output by stimulating net exports and foreign investment. Under endogenous growth model, globalization affects human capital accumulation and technological progress.

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