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DEVELOPMENT MODELS

The study of economic development is one of the most exciting and challenging branches of the broader disciplines of economics and political economy. Although we can claim that Adam Smith was the first ‘development economist’, with his ‘Wealth of Nations’ published in 1776, the systematic study of the problems and process of economic development has emerged only over the past five decades. Contributions of various economists and their pioneering studies provided dramatic confirmation of the status of economic development as a separate field within the Economics discipline.

The scope of the Development economic is immense. It has given much importance to the efficient allocation of the existing scarce or idle productive resources and with their sustained growth over time. In addition to this, development economics also deals with economic, social, political, and institutional mechanisms, both public and private, necessary to bring about rapid and large scale improvements in levels of living for the masses of poverty-stricken, malnourished and illiterate peoples of less developed countries.

Thus development economics is concerned with the economic, cultural and political requirements for effecting rapid structural and institutional transformations of entire societies in a manner that will most efficiently bring the fruits of economic progress to the broadest segments of their populations. It is focusing on the mechanisms that keep families, regions, and entire nations in poverty traps, and on the most effective strategies for breaking out of these traps. As such, a larger government role and a good degree of coordinated economic decision making directed toward transforming the economy are usually viewed as essential components of development economics.

Because of the heterogeneity of the developing world and the complexity of the development process, development economics is eclectic, attempting to combine relevant concepts and theories from traditional economic analysis along with new models and broader multidisciplinary approaches derived from studying the historical and contemporary development experiences of various nations. Today development economics is a field on the crest of a breaking wave with new theories and new data.
continuously emerging. But the ultimate challenge remains the same: to help us better or improve the material lives of people.

Prior to 1970’s development was seen as an economic phenomenon in which, rapid gains in overall and per capita GNP growth would either trickle down to the masses in the form of jobs and other economic opportunities or create the necessary conditions for the wider distribution of the economic and social benefits of growth. During those periods, development was seen in terms of the planned alteration of the structure of production and employment so that agriculture’s share was on the decline and that of the manufacturing and service industries increases. All these indicators were supplemented by casual reference to non economic social indicators like gains in literacy, schooling, health conditions, and services and provision for housing. During 1970’s and 1980’s, economic development came to be redefined in terms of the reduction or elimination of poverty, inequality, and unemployment within the context of a growing economy. The World Bank during the 1980’s championed growth as the goal of development, joined the chorus of observers and policy makers by taking a broader perspective in its 1991 world development Report, by stating,

‘The challenge of development…… is to improve the quality of life. Especially in the world’s poor countries, a better quality of life generally calls for higher incomes—but it involves much more. It encompasses as ends in themselves better education, higher standards of health, and nutrition, less poverty, a cleaner environment, more equality of opportunity, greater individual freedom and a richer cultural life’.

Development is therefore conceived as a multidimensional process involving major changes in social structures, popular attitudes, and national institutions as well as the acceleration of economic growth, reduction of inequality, an environment for education, and the eradication of poverty. This view of development was identified by Amartya Sen, when he argued that the ‘capability to function’ is what really matters for status as poor or non poor person. According to Dr Amartya Sen, Development has to more concerned with enhancing the lives we lead and the freedom we enjoy.
2.1 Core Values of Development

Denis Goulet in his book ‘The Cruel Choice: A new Concept in the theory of development (New York: Atheneum, 1971) identifies three basic components or core values, which should serve as a conceptual basis and practical guideline for understanding the inner meaning of development. These core values – sustenance, self esteem and freedom - represent common goals sought by all individuals and societies.

**Sustenance** – All people have certain basic needs without which life would be impossible. Therefore basic function of all economic activity is to provide as many people as possible with the means of overcoming the helplessness and misery arising from a lack of food, shelter, health, and protection. Therefore raising per capita incomes, the elimination of absolute poverty, greater employment opportunity, and lessening income inequality therefore constitute the necessary condition for development.

**Self-Esteem** - All peoples and societies seek some basic form of self esteem, a sense of worth and self respect, identity, dignity, respect and recognition. Development is legitimized as a goal since; it is an important perhaps even an indispensable, way of gaining esteem.

**Freedom from servitude** – In this context development means the concept of human freedom. Freedom means, emancipation from alienating material conditions of life, and from social servitude to nature, ignorance, misery, institution and beliefs. Freedom also includes the expanding range of choices for society.

Thus development is both a physical reality and a state of mind in which society has, through some combination of social, economic and institutional processes, secured the means for obtaining a better life. Therefore the three objectives of development can be the following.

- To increase the availability and widen the distribution of basic life –sustaining goods such as food, shelter, health and protection
- To raise the levels of living, including higher incomes, provisions of more jobs, better education and greater attention to cultural and human values.
• To expand the range of economic and social choices available to individuals and nations by freeing them from servitude and dependence.

2.2. The Millennium Development Goals

In September 2000, the 189 member countries of the United Nations adopted eight Millennium Development Goals (MDGs), committing themselves to making substantial progress toward the eradication of poverty and achieving other human development goals by 2015. The MDGs are the strongest statement yet of the international commitment to ending global poverty. They acknowledge the multidimensional nature of development and poverty alleviation; an end to poverty requires more than just increasing incomes of the poor. The MDGs have provided a unified focus in the development community unlike anything that preceded them.

The eight goals are ambitious as to:

• to eradicate extreme poverty and hunger
• to achieve universal primary education
• to promote gender equality and empower women
• to reduce child mortality
• to improve maternal health
• to combat HIV/AIDS, malaria, and other diseases
• to ensure environmental sustainability, and-
• to develop a global partnership for development.

Thus in short, Development economics is a distinct yet very important extension of both traditional economics and political economy. While necessarily concerned with efficient resource allocation and the steady growth of aggregate output over time, development economics focuses on the economic, social, and institutional mechanisms needed to bring about rapid and large-scale improvements in standards of living for the masses of poor people in developing nations.

2.3 Classic Theories of Economic Development

The classic post–World War II literature on economic development has been dominated by four major and sometimes competing strands of thought: (1) the linear-stages-of-growth model, (2) theories and patterns of structural change, (3) the
international-dependence theories, and (4) the neoclassical, free-market counter-revolution.

2.3.1 Linear-Stages Theories

Theorists of the 1950s and 1960s viewed the process of development as a series of successive stages of economic growth through which all countries must pass. It was primarily an economic theory of development in which the right quantity and mixture of saving, investment, and foreign aid were all that was necessary to enable developing nations to proceed along an economic growth path that had historically been followed by the more developed countries. Development thus became synonymous with rapid, aggregate economic growth.

*Rostow’s Stages of Growth*

The most influential and outspoken advocate of the stages-of-growth model of development was the American economic historian Walt W. Rostow. According to Rostow, the transition from underdevelopment to development can be described in terms of a series of steps or stages through which all countries must proceed. One of the principal strategies of development necessary for any takeoff was the mobilization of domestic and foreign saving in order to generate sufficient investment to accelerate economic growth.

*The Harrod-Domar Growth Model*

The economic mechanism by which more investment leads to more growth can be described in terms of the Harrod-Domar growth model. It is based on a linear production function with output given by the capital stock $K$ times a constant, labeled $A$. In one form or another, it has been frequently applied in policy formulation in developing countries. Harrod-Domar growth model explains a functional economic relationship in which the growth rate of gross domestic product ($g$) depends directly on national net savings rate ($s$) and inversely on the national capital-output ratio ($c$).

2.3.2 Structural-Change Models

Structural-change theory focuses on the mechanism by which underdeveloped economies transform their domestic economic structures from a heavy emphasis on traditional subsistence agriculture to a more modern, more urbanized, and more industrially diverse manufacturing and service economy. It employs the tools of
neoclassical price and resource allocation theory and modern econometrics to describe how this transformation process takes place. Two well-known representative examples of the structural-change approach are the “two-sector surplus labor” theoretical model of W. Arthur Lewis and the “patterns of development” empirical analysis of Hollis B. Chenery and his co-authors.

The Lewis Theory of Development

One of the best-known early theoretical models of development that focused on the structural transformation of a primarily subsistence economy was that formulated by Nobel laureate W. Arthur Lewis in the mid-1950s and later modified, formalized, and extended by John Fei and Gustav Ranis. The Lewis two-sector model became the general theory of the development process in surplus-labor developing nations during most of the 1960s and early 1970s.

Model of structural change - Hollis B. Chenery

The best-known model of structural change is the one based largely on the empirical work of Harvard economist Hollis B. Chenery and his colleagues, who examined patterns of development for numerous developing countries during the postwar period. Their empirical studies, both cross-sectional (among countries at a given point in time) and time-series (over long periods of time), of countries at different levels of per capita income identified several characteristic features of the development process. These included the shift from agricultural to industrial production, the steady accumulation of physical and human capital, the change in consumer demands from emphasis on food and basic necessities to desires for diverse manufactured goods and services, the growth of cities and urban industries as people migrate from farms and small towns, and the decline in family size and overall population growth as children lose their economic value and parents substitute what is traditionally labeled child quality (education) for quantity, with population growth first increasing and then decreasing in the process of development. Proponents of this school often call for development specialists to “let the facts speak for themselves” rather than get bogged down in halo of theories.
2.3.3 The International-Dependence Revolution

During the 1970s, international-dependence models gained increasing support, especially among developing-country intellectuals, as a result of growing disenchantment with both the stages and structural-change models. While this theory to a large degree went out of favor during the 1980s and 1990s, versions of it have enjoyed resurgence in the twenty-first century as some of its views have been adopted, albeit in modified form, by theorists and leaders of the anti-globalization movement. Essentially, international-dependence models view developing countries as beset by institutional, political, and economic rigidities, both domestic and international, and caught up in a dependence and dominance relationship with rich countries. Within this general approach are three major streams of thought: the neocolonial dependence model, the false-paradigm model, and the dualistic-development thesis.

Neocolonial Dependence Model

The first major stream, which we call the neocolonial dependence model, is an indirect outgrowth of Marxist thinking. It attributes the existence and continuance of under-development primarily to the historical evolution of a highly unequal international capitalist system of rich country–poor country relationships. Whether because rich nations are intentionally exploitative or unintentionally neglectful, the coexistence of rich and poor nations in an international system dominated by such unequal power relationships between the centre (the developed countries) and the periphery (the developing countries) renders attempts by poor nations to be self-reliant and independent difficult and sometimes even impossible. Certain groups in the developing countries (including landlords, entrepreneurs, military rulers, merchants, salaried public officials, and trade union leaders) who enjoy high incomes, social status, and political power constitute a small elite ruling class whose principal interest, knowingly or not, is in the perpetuation of the international capitalist system of inequality and conformity in which they are rewarded. Directly and indirectly, they serve (are dominated by) and are rewarded by (are dependent on) international special interest power groups, including multinational corporations, national bilateral aid agencies, and multilateral assistance organizations like the World Bank or the International Monetary Fund (IMF), which are tied by allegiance or funding to the
wealthy capitalist countries. The elites’ activities and viewpoints often serve to inhibit any genuine reform efforts that might benefit the wider population and in some cases actually lead to even lower levels of living and to the perpetuation of underdevelopment. Underdevelopment is thus seen as an externally induced phenomenon, in contrast to the linear stages and structural-change. Revolutionary struggles or at least major restructuring of the world capitalist system is therefore required to free dependent developing nations from the direct and indirect economic control of their developed-world and domestic oppressors.

*The False-Paradigm Model*

False-paradigm model attributes underdevelopment to faulty and inappropriate advice provided by well-meaning but often uninformed, biased, and ethnocentric international “expert” advisers from developed-country assistance agencies and multinational donor organizations. These experts are said to offer complex but ultimately misleading models of development that often lead to inappropriate or incorrect policies. Because of institutional factors such as the central and remarkably resilient role of traditional social structures (tribe, caste, class, etc.), the highly unequal ownership of land and other property rights, the disproportionate control by local elites over domestic and international financial assets, and the very unequal access to credit, these policies, based as they often are on mainstream, merely serve the vested interests of existing power groups, both domestic and international.

*The Dualistic-Development Thesis*

Implicit in structural-change theories and explicit in international-dependence theories is the notion of a world of dual societies, of rich nations and poor nations and, in the developing countries, pockets of wealth within broad areas of poverty. **Dualism** is a concept widely discussed in development economics. It represents the existence and persistence of substantial and even increasing divergences between rich and poor nations and rich and poor people.

*Human Capital Theory*

During the post war period, social scientists became interested in studies related to the economic value of investment in education. This interest was generated by the human capital theorists’ notion that the most productive course to national
development of any society lies in the advancement of its population that is its human capital. In other words, human capital theory contends that because an educated population is a productive population, education contributes directly to the growth of the national income of societies by enhancing the skills and productive abilities of employees. Human capital theorists argue that economic growth and development should only take place when technology becomes more efficient and when societies utilize human resources in the use of technology. Theorists assume that improved technology leads to greater production and that employees acquire the skills for the use of technology through formal education. Thus, when societies invest in education, they invest to increase the productivity of the population and welfare of a nation. In an important empirical study, it was found that, primary education reveals the highest social and private returns and all rates of return to investment in education exceed the rates of return in alternative investment in capital. Accordingly, from the early 1960’s up to the mid 1970’s, governments in developed and less developed countries encouraged investments in education to enhance human productivity.

2.3.4 The Neoclassical Counter-revolution

In the 1980s, the political ascendancy of conservative governments in Europe and America led to the emergence of a neo-classical counterrevolution in economic theory and policy. In developed nations, this counterrevolution favored supply-side macroeconomic policies, rational expectations theories, and the privatization of public corporations. In developing countries, it called for free markets, and the dismantling of public ownership, statist planning, and government regulations.

The central argument of the neoclassical counterrevolution is that under development results from poor resource allocation due to incorrect pricing policies and too much state intervention by overly active developing-nation governments. Rather, the leading writers of the counter-revolution school argued that it is this very state intervention in economic activity that slows the pace of economic growth. The neoliberals argue that by permitting competitive free markets to flourish, privatizing state-owned enterprises, promoting free trade and export expansion, welcoming investors from developed countries, and eliminating the plethora of government regulations and price distortions in factor, product, and financial markets, both economic efficiency and economic growth will be stimulated. According to them, it is
simply a matter of promoting free markets and laissez-faire economics within the context of permissive governments that allow the “magic of the market place” and the “invisible hand” of market prices to guide resource allocation and stimulate economic development.

Traditional Neoclassical Growth Theory

An important cornerstone of the neoclassical free-market argument is the assertion that liberalization (opening up) of national markets draws additional domestic and foreign investment and thus increases the rate of capital accumulation. In terms of GDP growth, this is equivalent to raising domestic savings rates which enhances capital-labor ratios and per capita incomes in capital-poor developing countries.

It differed from the Harrod-Domar formulation by adding a second factor, labor, and introducing a third independent variable, technology, to the growth equation. Solow’s neoclassical growth model exhibited diminishing returns to labor and capital separately and constant returns to both factors jointly. Technological progress became the residual factor explaining long-term growth, and its level was assumed by Solow and other neoclassical growth theorists to be determined exogenously, that is, independently of all other factors in the model. More formally, the standard exposition of the Solow neoclassical growth model uses an aggregate production function in which

\[ Y = K^a (AL)^{1-a} \]

where \( Y \) is gross domestic product, \( K \) is the stock of capital (which may include human capital as well as physical capital), \( L \) is labor, and \( A \) represents the productivity of labor, which grows at an exogenous rate. Because the rate of technological progress is given exogenously, the Solow neoclassical model is sometimes called an “exogenous” growth model.

According to traditional neoclassical growth theory, output growth results from one or more of three factors: increases in labor quantity and quality (through population growth and education), increases in capital (through saving and investment), and improvements in technology.
2.4 Endogenous Growth Theory

The mixed performance of neoclassical theories in illuminating the sources of long-term economic growth has led to dissatisfaction with traditional growth theory. According to traditional theory, there is no intrinsic characteristic of economies that causes them to grow over extended periods of time. The literature is instead concerned with the dynamic process through which capital labor ratios approach long-run equilibrium levels. In the absence of external “shocks” or technological change, which is not explained in the neoclassical model, all economies will converge to zero growth. Hence rising per capita GNI is considered a temporary phenomenon resulting from a change in technology or a short-term equilibrating process in which an economy approaches its long-run equilibrium.

Any increases in GNI that cannot be attributed to short-term adjustments in stocks of either labor or capital are ascribed to a third category, commonly referred to as the Solow residual. This residual is responsible for roughly 50% of historical growth in the industrialized nations. In a rather ad hoc manner, neoclassical theory credits the bulk of economic growth to an exogenous or completely independent process of technological progress. But, by using the neoclassical framework, it was impossible to analyze the determinants of technological advance because it is completely independent of the decisions of economic agents. And the theory also failed to explain large differences in residuals across countries with similar technologies. These factors along with other factors provided the required impetus for the development of the concept of endogenous growth theory or, more simply, the new growth theory.

The new growth theory provided a theoretical framework for analyzing endogenous growth - persistent GNI growth that is determined by the system governing the production process rather than by forces outside that system. They hold that GNI growth as a natural consequence of long-run equilibrium. The principal motivations of the new growth theory are to explain both growth rate differentials across countries and a greater proportion of the growth observed. More succinctly, endogenous growth theorists seek to explain the factors that determine the size of Solow residual, the rate of growth of GDP that is left unexplained and exogenously determined in the neoclassical growth equation.
Models of endogenous growth bear some structural resemblance to their neoclassical counterparts, but they differ considerably in their underlying assumptions and the conclusions drawn. The most significant theoretical differences stem from discarding the neoclassical assumption of diminishing marginal returns to capital investments, permitting increasing returns to scale in aggregate production, and frequently focusing on the role of externalities in determining the rate of return on capital investments.\textsuperscript{vii}

By assuming that public and private investments in human capital generate external economies and productivity improvements that offset the natural tendency for diminishing returns, endogenous growth theory seeks to explain the existence of increasing returns to scale and the divergent long-term growth patterns among countries. And whereas technology still plays an important role in these models, exogenous changes in technology are no longer necessary to explain long-run growth.

New Growth Theory is a view of the economy that incorporates two important points. First, it views technological progress as a product of economic activity. Previous theories treated technology as a given, or a product of non-market forces. New Growth Theory is often called “endogenous” growth theory, because it internalizes technology into a model of how markets function. Second, New Growth Theory holds that unlike physical objects, knowledge and technology are characterized by increasing returns, and these increasing returns drive the process of growth.

Paul Romer is credited with stimulating New Growth Theory, but as Romer himself notes, there is really nothing new about the theory itself. The central notion behind New Growth Theory is increasing returns associated with new knowledge or technology. The cornerstone of traditional economic models is decreasing or diminishing returns, the idea that at some point as you increase the output of anything (a farm, a factory, a whole economy) the addition of more inputs (work effort, machines, land) results in less output than did the addition of the previous units of input into production.

Decreasing returns are important because they result in increasing marginal costs (that is, at some point, the cost of producing one more unit of production is higher than the cost of producing the previous unit of production). Decreasing returns
and rising marginal costs are critical assumptions to getting the mathematical equations economists use to describe the economy to be settling down to a unique equilibrium.

A useful way to contrast the new (endogenous) growth theory with traditional neoclassical theory is to recognize that many endogenous growth theories can be expressed by the simple equation $Y = AK$, as in the Harrod-Domar model. In this formulation, $A$ is intended to represent any factor that affects technology, and $K$ again includes both physical and human capital. But there are no diminishing returns to capital in this formula, and the possibility exists that investments in physical and human capital can generate external economies and productivity improvements that exceed private gains by an amount sufficient to offset diminishing returns. The net result is sustained long-term growth.

The centerpiece of New Growth Theory is the role knowledge plays in making growth possible. Knowledge is subject to increasing returns because it is a non-rival good. Non-rival goods are very different from those considered in most economic textbooks. Economists generally focus their analyses on the production and allocation of ordinary goods and services. Two key properties of ordinary goods and services are rivalry—only one person can use them or make use of them at a given time—and excludability — one has the ability (often established in law) to exclude others from using the goods that are yours. The non-rival quality of ideas is the attribute that drives economic growth. We can all share and reuse ideas at zero, or nearly zero cost. As we accumulate more and more ideas, knowledge about how the world works, and how to extract greater use out of the finite set of resources with which the world is endowed, we enable the economy to develop further.

### 2.4.1 Implications of Increasing Returns

The increasing returns associated with the non-rival aspect of ideas have a number of important implications for economic theory and how economies work. Some of these implications are a cause for optimism. For example –

- **Opportunities for Growth May be Almost Limitless.**
- **Knowledge-Based Economies Tend Toward Monopolistic Competition.**
- **Economic Outcomes are Indeterminate and Multiple Equilibria are Possible.**
Firms compete with one another, not based on the price of similar products, but, based on their monopoly position with a particular differentiated product or service.

At the end of the 1980s, two influential papers by Romer \textsuperscript{viii} and Lucas \textsuperscript{ix} have led to a re-awakening of interest in determinants of economic growth. The breakthrough to studying technological change and growth was achieved by Romer \textsuperscript{x}, building on Grossman and Helpman \textsuperscript{xi} from modeling point of view. Important early contributions were also made by Rebelo, Grossman and Helpman \textsuperscript{xii} and Aghion and Howitt \textsuperscript{xiii}.

\section*{2.4.2 Endogenous Growth examples (EGT)\textsuperscript{xiv}}

Three important themes of EGT models - assumed scale mechanism, spillovers, increasing returns- can be illustrated with reference to some specific influential models. The approaches are horizontal innovation (expanding the range of products); vertical innovation (improving existing products); heterogeneous innovation (research v learning by doing); and “lumpy” innovation (general purpose technologies).

\textit{Horizontal innovation—Romer} \textsuperscript{xv}

Romer’s introduced, what is probably the most influential early model of endogenous growth. It is a model of “horizontal” innovation, which means that innovation takes the form of developing new varieties of goods. For the model as a whole, the growth rate depends on the size of the research sector, both in terms of how much labour is used there, and how large the stock of accumulated designs is.

\textit{Vertical innovation - Aghion and Howitt}\textsuperscript{xvi}

A second strand of EGT models a different pattern of innovation—one in which innovation takes the form of improvements in existing products. Innovation thus creates new products or technologies, as well as destroying the value of old products or technologies by making them redundant. These models are referred to as “vertical innovation” or “quality ladder” models. The approach is much closer in spirit to the process of “creative destruction”. Version of this model abstracts completely from capital accumulation. However, still there is a spillover in the
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research sector, this time modeled as a positive relationship between research employment and the rate at which new innovations are made.

**Heterogeneous (two-stage) innovation**

In these models, growth is enhanced by the right mix of fundamental and secondary research, and the role of intermediate goods becomes important. Fundamental research produces new intermediate goods that have the potential to be more productive than the previously developed intermediate goods. The value of the research output is zero, however, until there is a secondary innovation that applies the new knowledge. Secondary innovations are achieved as a result of learning by doing. The general knowledge that is built up by the combined effect of fundamental and secondary innovations increases the value of subsequent research of both types.

**Lumpy innovation (general purpose technologies)**

Another strand of EGT, relates to the fact that in most countries, growth is uneven, and appears to occur in spurts. Aghion and Howitt provide a good discussion of EGT insights into growth and cycles. The positive scale effects that are built into EGT models would have the effect of magnifying the growth impact of temporary fluctuations. A temporary increase in output, by raising scale, would increase productivity, generating a more sustained increase in output growth. This line of reasoning has been pursued in the related field of “real business cycle” theory. Fluctuations in growth are an implication of the vertical innovation. The prospect of high research effort next period raises the likelihood that current research will be rendered obsolete, and reduces current research efforts.

A more significant and direct treatment of uneven growth comes from the modeling of the impact of “general purpose technologies” (GPTs). GPTs are innovations that have the potential to improve technologies in many sectors. Commonly cited examples of GPTs are computers, the steam engine, and electric dynamos. Because of the potential applicability to a wide range of firms, the appearance of GPTs raises the return to applied research (learning by doing) across the economy, at the same time as it renders many current methods obsolete. There can be a decline in growth while the system adapts to a new range of technologies.
Cyclical downturns under this sort of model reflect a transition to a new, more productive, set of technologies.

2.4.3 The Romer Model

To explain the endogenous growth approach, we examine the Romer endogenous growth model. It addresses technological spillovers (in which one firm or industry’s productivity gains lead to productivity gains in other firms or industries) that may be present in the process of industrialization.

The model begins by assuming that growth processes derive from the firm or industry level. Each industry individually produces with constant returns to scale, so the model is consistent with perfect competition; and up to this point it matches assumptions of the Solow model. But Romer departs from Solow by assuming that the economy-wide capital stock, positively affects output at the industry level, so that there may be increasing returns to scale at the economy-wide level. It is valuable to think of each firm’s capital stock as including its knowledge. The knowledge part of the firm’s capital stock is essentially a public good, like A in the Solow model that is spilling over instantly to the other firms in the economy. As a result, this model treats learning by doing as “learning by investing.” In this simplification, we abstract from the household sector, an important feature of the original model, in order to concentrate on issues concerning industrialization. Formally,

\[ Y_i = AK_i^{\alpha}L_i^{1-\alpha}K^\beta \]

We assume symmetry across industries for simplicity, so each industry will use the same level of capital and labor. Then we have the aggregate production function:

\[ Y = AK^{\alpha+\beta}L^{1-\alpha} \]

To make endogenous growth stand out clearly, we assume that A is constant rather than rising over time; that is, we assume for now that there is no technological progress. With a little calculation it can be shown that the resulting growth rate for per capita income in the economy would be \(^{xviii}\):
where \( g \) is the output growth rate and \( n \) is the population growth rate. Without spillovers, as in the Solow model with constant returns to scale, \( b = 0 \), and so per capita growth would be zero (without technological progress).

However, with Romer’s assumption of a positive capital externality, \( b > 0 \), we have that \( g - n > 0 \) and \( Y/L \) is growing. This will explain endogenous growth, not driven exogenously by increases in productivity.

2.5 Economic Development and Education

For an economy, education can increase the human capital in the labor force, which increases labor productivity and thus leads to a higher equilibrium level of output. It can also increase the innovative capacity of the economy—knowledge of new technologies, products, and processes to promote growth. And it can facilitate the diffusion and transmission of knowledge needed to understand and process new information and to implement new technologies devised by others, again promoting growth.

Centuries ago Adam Smith\textsuperscript{xix} identified “the acquired and useful abilities of all the inhabitants or members of the society,” what is now called “human capital,” as one of the four types of fixed capital that contribute to production in a national economy. But subsequently factories replaced skilled artisans as the principal means of production, and economists, however, concentrated on the role of physical capital in development, and they forgot about human capital.

After World War II the International Bank for Reconstruction and Development (IBRD) was created to finance physical capital projects in countries damaged by the war and in poor countries. At the time economists believed that countries were poor because they lacked physical capital. The presumption was that due to adverse institutional conditions, private individuals in poor countries either did not have the wherewithal or lacked the confidence to invest in capital projects. The
IBRD proceeded to provide financing for physical capital projects, but many of these projects were unsuccessful.

Economists and social scientists by that time realized that poor countries might be poor because they lacked human capital. Schultz observed that rich countries devastated in World War II were able to quickly employ massive amounts of new physical capital, while the poorest countries seemed unable to successfully utilize even small amounts. He theorized that a nation’s capability to productively use physical capital is a function of its level of human capital and that if human capital does not increase along with physical capital, then economic development cannot proceed. Shultz further observed that human capital is more likely to be the constraint to development because foreign investors are eager to invest in physical capital, but not in human capital.

Economists now accept that investment in education, or human capital, is an important element in the economic development process. Econometric studies provide very strong and consistent evidence that more educated workers are more productive and that they earn higher salaries.

Soon many began to accept the view that education was directly linked with socio-economic development. Sociologists and political economist claim that education causes a change that promotes greater productivity and work efficiency in the individual. They believe that education enhances productivity by modernizing the values, beliefs and behavior of people. Inkeles and Smith assert that schooling is possibly the most important agent in transforming a society into a modern one. They argue: “In large-scale complex societies no attribute of the person predicts his attitudes, values and behavior more consistently or more powerfully than the amount of schooling he has received”. So, for development theorists, social and economic development could not take place unless a seemly proportion of the population adopted modern values, attitudes and beliefs about work, quality of life and other related values. So they believed that education is the most powerful factor in bringing about modernity because it develops the individual.

During 1980s, much of the attention of macroeconomist and development economists has focused on long-term issues especially the role of human capital in the
long-run rate of economic growth. Although human capital includes education, health, and aspects of “social capital,” the focus was on education.

Empirical findings on economic growth, by Barro, emphasizes role of education in the overall growth. Growth is positively related to the starting level of average years of school attainment of adult males at the secondary and higher levels. Since educational background is complementary with new technologies, the results suggest an important role for the diffusion of technology in the development process.

Educational quality measured by what people know, has powerful effects on individual earnings, on the distribution of income, and on economic growth. The accumulated evidences from various analyses of economic outcomes of investments in education are that the quality of education measured on an outcome basis of cognitive skills has powerful effects. Individual earnings are systematically related to cognitive skills. The distribution of skills in society appears closely related to the distribution of income. And, perhaps most importantly, economic growth is strongly affected by the skills of workers.

A more educated labor force is more mobile and adaptable, can learn new tasks and new skills more easily, and can use a wider range of technologies and sophisticated equipment including newly emerging ones. It is also more autonomous and thus needs less supervision, and is more creative in thinking about how to improve the management of work. All of these attributes not only make a more highly skilled worker more productive than a less skilled one but also enable a work place that employs more educated workers to organize differently, manage differently, and choose technologies and equipment differently, and adjust better to changes necessitated by competition, by technical advances, or by changes in consumer demand.

What is true for the firm may also be true for the whole economy. Skills beget more skills and new ways of doing business, workers learn from one another, and firms adapt their technology and their use of capital to the skills of the available workforce. The benefits of having a more educated workforce accrue to everyone, not just to the organization where these individuals happen to work. Further, these kinds of indirect or spillover effects for the firm or the economy as a whole may be especially important in an increasingly competitive global marketplace.
2.5.1 Models of education and economic growth

The earliest attempt at modeling the role of education in economic growth occurred in the 1950s. The scale of the process depended upon the process of knowledge accumulation, and its pace on the social preferences between present and future consumption. We can distinguish few different models of education and economic growth\textsuperscript{xxiv}. The feature shared by models of this kind was that economic growth was considered as an endogenous process resulting from improving labor force productivity.

Robert Solow\textsuperscript{xxv} described growth of national income as resulting from three sources: increases in the stock of physical capital (machines and buildings that are used to produce goods and services), increases in the size of the labor force, and a residual representing all other factors. This residual contributed considerably more to per capita growth than the increase in the capital stock. Solow dubbed the residual “technical progress” and noted that increasing levels of education were one of the factors that contributed to its growth.

Using the same basic approach as Solow, but taking explicit account of the role of education, Edward Denison\textsuperscript{xxvi}(1985) estimated that between 1929 and 1982, increasing levels of education were the source of 16 percent of the growth of total potential output in nonresidential business (and 30 percent of the growth per person employed in that sector). Another study by Dale Jorgenson and Kevin Stiroh\textsuperscript{xxvii} puts the contribution of education to economic growth at 8.7 percent of total growth over the recent period 1959 to 1998 and 13 percent of growth in output per worker.

An alternative to treating human capital as a separate factor of production is to take account of the effects of education by assuming that it is not a separate factor of production but instead simply increases the productivity of labor. In this framework an economy with twice as much human capital per worker could produce the same amount with half as many workers. Hirofumi Uzawa\textsuperscript{xxviii} (1965) was the first to propose a model of economic growth with human capital impacts of this sort. In his model a one percent increase in the amount of human capital per worker causes an increase in national income of about two-thirds of a percent. This is because a one percentage point increase in the stock of human capital per worker causes a full
percent increase in the effective supply of labor, which produces an effect on output equal to labor’s share of income.

But Uzawa’s model may still understate the role of education in determining the level of output and growth. Both the Solow and Uzawa models assume that if we double the amount physical capital and human capital per worker we will at most double the amount of output and that each factor will get a fixed share of the increase equal to its average share of existing output. However, many economists have argued that doubling capital inputs more than doubles output and that this accounts for some of the unexplained residual in a Solow-type analysis of the sources of growth. When doubling inputs results in more than a doubling of output, there are said to be “increasing returns to scale”.

Another important model in this strand was developed by R. Nelson and E. Phelps (1966). In their model the role of education is conceived as being primarily that of facilitating the flow of technological information. Nelson and Phelps define education as the process of training the productive actors in the economy to receive and absorb the technological information being transmitted by other sectors in the economy.

Another model was developed by K. Shell in 1969. It is an educational planning model that requires scarce resources to be devoted to the educational sector in order to increase educational attainment, h.

Robert Lucas, building on Paul Romer, proposes a model of economic growth where the effects of human capital are greater than even the Uzawa model. Since the model has increasing returns to scale, increasing all factors of production proportionally can cause a greater than proportional increase in output. Thus the impact of factors need not equal their shares and add up to one. Instead their impact can add to a number greater than one and the impact of human capital can be greater than labor’s share in output.

Another important approach to explain the correlation of human capital growth and output growth can be explained as follows. The larger the sum of the impact coefficients of physical capital and human capital, the longer lasting will be the effect of an increase in investment on growth. If the sum of the impacts is greater
than or equal to one, the increases are self-perpetuating and a one-time increase in the investment rate for either physical or human capital will cause a permanent increase in the rate of growth of output. Thus long-lasting correlations between savings rates and the rate of growth are indicative of models where the impact of education and physical capital are large.

There is a large empirical literature on exogenous versus endogenous growth models, which scholars have used to determine what drives economic growth. As part of this literature, Paul Romer argued that the standard Solow growth model could not account for the high correlation between the growth of capital stocks and the growth of output, or for the sometimes negative correlation of labor force growth with rates of economic growth. He used these facts to argue for the endogenous growth model since they predict both outcomes.

Figure 1 diagrams the flow of cause and effect from a policy change that impacts the level of educational attainment to the final outcome of increasing national income.

![Flow Diagram: cause and effect of education and national income growth](image)

Figure 2.1: Flow Diagram: cause and effect of education and national income growth

The first step in this chain of cause and effect (effect 1 in figure 1) is outside the model. At this point two things happen. First, there is an increase in the number of years of education these students get. Since they are staying in school longer this reduces the size of the labor force and has a negative impact on output (effects 2 and 3
in figure 1). However, when these students graduate they are more productive because of their additional schooling and this has a positive impact on output (effects 4 and 5 in figure 1). As time goes by, and more students who have been in the preschool program graduate, the impact of the program on the size of the labor force remains roughly the same (It grows slightly as each cohort is larger than the last) but the impact on the productivity of the workforce grows as a larger and larger fraction of the population has the extra education. The effect continues to grow until the first cohort to receive the preschool education reaches retirement age. This is the direct effect of the program on output and growth and is displayed on the model output page as the contrast between the baseline simulation (the simulated growth path with no policy change) and the “static” model.

There are two types of dynamic effects. First, when there is an increase in output, savings and investment increase as well (effect 6 in figure 1). The model makes the relatively common assumption in growth theory that people save a fixed fraction of their income and that this savings becomes new investment in physical capital (effect 7 in figure 1) or human capital (effect 9 in figure 1). When the stock of physical capital increases, this further increases output (effect 8 in figure 1).

2.6 Correlating ICT-Education and Economic Growth

The new theories of growth state that education and technological innovations play a leading role in economic growth. Lucas and Howitt emphasized the importance of the skills of the human resources and of the educational system in the discovery and adoption of the new technology. The simultaneous analysis of these two growth factors – education and ICT, thus is a major area of interest for both the economists and the decision-makers of the economic policy.

A synthesis of economic studies accomplished by the UNESCO, shows that the level of education has a positive influence:

(i) At the individual level: the more an individual is endowed with an admitted certificate, the less likely he is exposed to unemployment, and the higher the average income he will earn will be when he is employed.
(ii) At the collective level, studies of the OECD\textsuperscript{xxxvi} showed that the effectiveness of the educational system (adequacy of the training with the economic needs, etc.) as well as the number of years of education had positive effects on the income per capita. These effects are borne out at the same time in the developed and developing countries, where the outputs of education are still very important.

Information and communication Technology (ICT) is a necessary tool which facilitates the approval of information as a development tool which meets the essential needs of the emergent countries, both on the qualitative and quantitative level. To make the environment more interactive and more intelligent, ICT offers a lot of opportunities such as the use of software facilitating learning, the access to networks or communicating by video conferencing, technologies facilitating people's functional independence and social inclusion, and also the transfer of knowledge between all the interested parties and collaborative decision making. The challenge for the many countries is to integrate the economy and the knowledge society to accelerate their development process.

The importance of the quality of the workforce is a recurring topic in the studies, especially in the new economy. Since the 1960s, the theory of human capital, which was developed with the work of Becker\textsuperscript{xxxvii}, has emphasized that the knowledge gained by individuals plays a crucial role in the society. According to this theory, education is seen as an investment because it is a factor in improving productivity. On the empirical level, Denison\textsuperscript{xxxviii}, using the growth accounting, has determined the main factors of growth of the United States. He found a high value for the total productivity of the factors attributed to the improvement of the quality of the workforce due to the improvement of the educational level.

The new growth theory adopted an enriched view of the human capital. According to its pioneers; Mankiw, Romer and Weil\textsuperscript{xxxix}, the basic idea is that the human capital plays the same role in production as the physical capital. In this sense, the accumulation of the years of studies comes to multiply the labor force, in other words, to increase the productive efficiency with a constant technology. This increased efficiency limits the falling returns on capital and therefore backs the growth in the long term.
The advent of the endogenous growth theory has encouraged the research on the channels through which the dissemination of technology, especially ICT, can influence economic growth of the nations. Many researches' in this area have shown that the link between the technology transfer and economic growth can be positive and conditioned by the ability of a country to adapt itself to the technological changes. In fact, the increase in the technological factor results in the increase of the infrastructure expenses, the social protection and education which, in turn, help the economic growth of the country.

Thus a strong debate is going on among international experts and analysts about the impact of ICT on education. The interest of promoting the integration of the ICT in education is a part of the goal of broader participation in the new economy. This integration was also supported by several studies\textsuperscript{x\textsubscript{1}}. Despite being flexible and accessible and providing opportunities for increased communication and interaction and being able to vary the teaching and learning modes, the ICT has many advantages over the educational process. Berman, Bound and Thing\textsuperscript{x\textsubscript{11}} were very much interested in the impact of the technological change on the gaps of competence noticed in the labor markets in case when the technological changes have an impact on the skills of the working force. In this respect, it is necessary to mention not only the important role of the knowledge economy, as the foundation of economic growth, but also the importance of skilled labor. The public decision-makers agree even about the fact that highly qualified workers represent an essential strategic resource for the good performance of the economy. Indeed, the notion of a highly qualified worker refers to the one who uses advanced technologies requiring particular skills and a high level of competence. More precisely, many development economists maintain that new technology enables the school students to improve their capacity of solving problems and to use meta-cognitive strategies. On this basis, ICT allows the motivation of the learner and foster school success. The effort of integration of ICT would have an interest elsewhere only when technology helps either the teacher to improve his pedagogy or the learner to establish a better link with knowledge.

The UNESCO report shows that education is crucial to the long-term economic and social development since it helps to fight against poverty and automates people by equipping them with the knowledge, competence and confidence they need
to exploit their productive efforts and forge a better future. This report also ensures a high priority to the use of ICT for a fairer and more pluralist development in education, aiming at the improvement of knowledge, the exchange of education as a merchandize and globalizing it in cultural diversity implications. The impact of education on growth passes by technical progress, notably the strong correlation between education and ICT.

The field of education has been affected by ICTs, which have undoubtedly affected teaching, learning, and research. A great deal of research has proven the benefits to the quality of education. ICTs have the potential to innovate, accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change. The previous decade was the decade of computer communications and information access, particularly with the popularity and accessibility of internet-based services such as electronic mail and the World Wide Web (WWW). As a result educators became more focused on the use of the technology to improve student learning as a rationale for investment.

The use of information and communication technologies in the educative process has been divided into two broad categories: ICTs for Education and ICTs in Education. ICTs for education refers to the development of information and communications technology specifically for teaching/learning purposes, while the ICTs in education involves the adoption of general components of information and communication technologies in the teaching learning process. Following are the some of the impacts of ICT in education

- ICT’s is enhancing teaching and learning process
- ICT is enhancing the quality and accessibility of education
- ICT is enhancing the learning Environment
- ICT is enhancing learning motivation
- ICT enhancing the scholastic performance


By the chain rule,
\[ \dot{Y} = \frac{dY}{dt} = \frac{\partial Y}{\partial K} \frac{dK}{dt} + \frac{\partial Y}{\partial L} \frac{dL}{dt} \]

By the exponent rule, we know that
\[ \frac{\partial Y}{\partial K} = (\alpha \beta)K^{\alpha \beta - 1}L^{1-\alpha} \]
\[ \frac{\partial Y}{\partial L} = AK^{\alpha \beta}L^{1-\alpha - 1} \]

Combining these three equations, we have
\[ \dot{Y} = \frac{dY}{dt} - \left[ AK^{\alpha \beta}L^{1-\alpha} \right] \left[ (\alpha + \beta) \frac{\dot{K}}{K} + (1 - \alpha) \frac{\dot{L}}{L} \right] \]

The first term in brackets in the preceding expression is of course output, \( Y \). For a steady state, \( \dot{K}/K, \dot{L}/L, \) and \( \dot{Y}/Y \) are all constant. From earlier discussion of the Harrod-Domar and Solow models, we know that
\[ \dot{K} = I - \delta K = sY - \delta K \]

Where \( \delta \) stands for the depreciation rate.

Dividing this expression through by \( K \), we have
\[ \frac{\dot{K}}{K} = \frac{sY}{K} - \delta \]

For \( \dot{K}/K \) constant in the preceding expression, we must have \( \dot{Y}/K \) constant. If this ratio is constant, we have
\[ \frac{\dot{K}}{K} = \frac{\dot{Y}}{Y} = g, \] a constant growth rate
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So from the expression for $dY/dt$ above, for the aggregate production function, with $L/L = n$, which is also a constant, we have

$$\frac{\dot{Y}}{Y} = (\alpha + \beta) \frac{\dot{K}}{K} + (1 - \alpha) \frac{\dot{L}}{L} + g - n$$

$$= (\alpha + \beta) g + (1 - \alpha) n + \frac{[1 - (\alpha + \beta)] n}{1 - (\alpha + \beta)}$$

which is Equation A3.3.3. This may also be expressed as

$$g = \frac{n(1 - \alpha)}{1 - \alpha - \beta}$$


Nelson, R.R., E. Phelps (1966), Investment in Humans, Technological Diffusion and Economic Growth, American Economic Review, pp. 69-75


