HUMAN CAPITAL APPROACH: HISTORICAL DEVELOPMENT AND MODERN APPROACHES[1]

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Abstract

Although the concept of human capital was formally developed in the 20th century, its origins date back centuries. Human capital refers to individuals' productive capacity and their role as income-generating agents. Introduced into professional use in the 1960s, the concept extends the principles of capital theory to the human elements of production. During this period, prominent economists laid the foundations of human capital theory, establishing it as a central component of economic analysis. Human capital is crucial in modern growth theories, contributing significantly to economic development. This study examines human capital theories and conceptual definitions proposed by leading economists and provides a detailed analysis of selected human capital approaches. In this context, it emphasizes the importance of education and the development of labor force skills in economic growth. The findings demonstrate that human capital theories will continue to evolve, further enhancing their economic contributions over time.

Keywords: Human Capital, Human Capital Approaches, Economic Growth

Jel Codes: E24, J24, O4

BEŞERİ SERMAYE YAKLAŞIMI: TARİHSEL GELİŞİM VE MODERN YAKLAŞIMLAR

Özet

Beşeri sermaye kavramı 20. yüzyılda teorik olarak geliştirilmiş olmakla birlikte, kökenleri yüzyıllar öncesine dayanmaktadır. Beşeri sermaye, bireylerin üretken kapasitesini ve gelir yaratma süreçlerindeki rollerini ifade eder. 1960'lı yıllarda akademik ve mesleki kullanıma giren bu kavram, sermaye teorisinin ilkelerini üretim sürecinin insan unsurlarına uyarlamaktadır. Bu dönemde önde gelen iktisatçılar, beşeri sermaye teorisinin temellerini atarak onu ekonomik analizlerin merkezî bir unsuru haline getirmiştir. Günümüzde beşeri sermaye, modern büyüme teorilerinde önemli bir yer tutmakta ve ekonomik kalkınmaya büyük katkılar sağlamaktadır. Bu çalışma, beşeri sermaye teorilerini ve önde gelen iktisatçılar tarafından ortaya konulan kavramsal tanımları inceleyerek seçili beşeri sermaye yaklaşımlarının ayrıntılı bir analizini sunmaktadır. Bu bağlamda, eğitim ve iş gücü becerilerinin geliştirilmesinin ekonomik büyüme üzerindeki önemine vurgu yapılmaktadır. Çalışmanın bulguları, beşeri sermaye teorilerinin zamanla evrilerek ekonomik katkılarını daha da artıracağını göstermektedir.

Anahtar Kelimeler: Beşeri Sermaye, Beşeri Sermaye Yaklaşımları, Ekonomik Büyüme

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[1] Bu çalışma Bursa Uludağ Üniversitesi Sosyal Bilimler Enstitüsü İktisat Anabilim dalında Prof. Dr. M. Ozan BAŞKOL danışmanlığında tarafımdan yazılan "Beyin Göçü ve Beşeri Sermaye İlişkisi: Türkiye Örneği" başlıklı doktora tez çalışmasından türetilmiştir.

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Makalenin Türü (Article Type): Derleme Makale (Compilation Article)

Makale Geliş Tarihi (Received Date): 26.02.2025 **Makale Kabul Tarihi (Accepted Date**): 16.04.2025

DOI: 10.56337/sbm.1647692

Atıf (Cite): Akyıldız, İ. E. (2025). Human Capital Approach: Historical Development and Modern Approaches, *Sosyal Bilimler Metinleri,* 2025(1), 65-84.

Jel Kodları: E24, J24, O4

1. Introduction

Since the early 1960s, human capital has been a central theoretical and empirical focus in economics. Over time, it has become a core subject in neoclassical growth theory (Langelett, 2002, p. 1). The origins of human capital research can be traced back to the late 18th century, though its theoretical and empirical foundations were significantly established in the 1960s. The concept has a longstanding historical background and is rooted in various methodological approaches. Studies in this domain frequently integrate education and its empirical measurements, yielding substantial implications for educators and education policies. The recognition of human capital's importance has grown, particularly following contributions from Nobel Prize-winning economists, further expanding research on the future role of education (Sweetland, 1996, p. 341).

Human capital plays a pivotal role in modern growth theories, as its accumulation substantially contributes to a nation's economic development. Numerous studies have examined the extent to which education influences total economic output. The prevailing consensus suggests that individuals with higher levels of education enjoy better employment prospects, higher earnings, and a greater contribution to overall economic output than those with lower educational attainment. Given the magnitude of this effect, both governments and individuals allocate considerable resources to education. From a macroeconomic perspective, human capital accumulation enhances labor productivity, fosters technological innovation, increases capital returns, and promotes sustainable economic growth, thereby aiding in poverty reduction. At the microeconomic level, education enhances employability and increases an individual's earning potential. Consequently, human capital is regarded as a fundamental determinant of firm productivity and an essential factor in improving individual efficiency and income. In essence, human capital embodies individuals' capacity to transform raw materials and capital into goods and services, thereby boosting overall productivity (Son, 2010, pp. 2-3).

This study provides a comprehensive examination of the significance and historical evolution of the human capital concept while comparing various theoretical perspectives within the field. It draws on primary academic articles and empirical studies as key references. By offering an in-depth evaluation and comparative analysis of classical and modern human capital theories, this study contributes to the literature by systematically bridging historical roots with contemporary approaches—something that is often treated separately in the existing scholarship. Moreover, the paper highlights how evolving human capital theories continue to influence both macroeconomic development and individual economic outcomes. The remainder of the paper is organized as follows: Section 2 explores the historical background of the human capital concept; Section 3 presents and discusses the major theoretical approaches to human capital from leading economists; and the final section offers concluding remarks and discusses the theoretical implications of the findings.

2. Human Capital and Its Historical Background

Human capital refers to the productive capacities of individuals as income-generating agents within the economy. While the concept itself has a longstanding history, its professional application gained prominence in the 1960s. During this period, significant progress was made in extending capital theory to encompass the human elements of production. As capital is generally regarded as a valuable stock that generates current and future income flows, human capital similarly represents the stock of skills and productive knowledge embodied in individuals (Rosen, 1989, p. 136).

Although formal human capital theories were developed in the 20th century, the conceptualization of the idea dates back several centuries. Prominent economists who addressed human capital-related issues include Adam Smith, John Stuart Mill, and Alfred Marshall. Additionally, Irving Fisher played a crucial role in bridging early economic thought with modern human capital methodologies by articulating foundational arguments in this domain (Sweetland, 1996, p. 343). While the notion of human capital is not entirely new, economists have approached the subject from various perspectives, particularly in examining how individuals can be valued as capital. Despite Marshall's scepticism regarding the realism of human capital as a concept, it gained substantial recognition in economic

thought. Economists who conceptualized individuals and their skills as forms of capital include Bagehot, Ernst Engel, Fisher, List, Petty, Roscher, Say, Senior, Smith, Sidgwick, von Thünen and Walras. Two primary methods have historically been employed to determine the value of human capital: the cost-of-production approach and the capitalized earnings procedure. The former estimates the actual costs incurred in "producing" an individual, while the latter calculates the present value of an individual's expected future income flows. These approaches underscore the notion that individuals have been treated as capital and assigned a quantifiable economic value (Kiker, 1966, p. 481).

This section emphasizes key economists who have contributed to the human capital concept, summarizing their core perspectives. Below, the views of Smith, Mill, Marshall, and Fisher on human capital are evaluated.

In 1776, Adam Smith, in introducing The Wealth of Nations, emphasized that all wealth is fundamentally rooted in human effort. He articulated this notion as follows: *"The annual labor of every nation is the fund which originally supplies it with all the necessaries and conveniences of life which it annually consumes, and which consist either in the immediate produce of that labor, or in what is purchased with that produce from other nations. (Smith, 1977, p. 12) ... The number of useful and productive laborers, it will hereafter appear, is everywhere in proportion to the quantity of capital stock which is employed in setting them to work, and to the particular way in which it is so employed."*(Smith, 1977, pp. 12-13). Smith highlighted two fundamental aspects as the foundation of all productive and efficient human capital frameworks. The first, as stated in the introduction of his work, is the skill, dexterity, and judgment applied in labor. Labor input is not only quantitative but also qualitative, comprising the useful abilities acquired by members of society. The second aspect is that such abilities, gained through education, training, or apprenticeships, always entail a real cost (Smith, 1977, p. 368).

In 1848, John Stuart Mill, in his book Principles of Political Economy, argued that human abilities are intrinsically fixed within an individual and, in a strict sense, cannot reasonably be considered as wealth. He expressed this idea as follows: "*A country would hardly be said to be richer, except by metaphor, however precious a possession it might have in the genius, the virtues, or the accomplishments of its inhabitants; unless indeed these were looked upon as marketable articles, by which it could attract the material wealth of other countries, as the Greeks of old, and several modern nations have done."* (Mill, 1926, p. 48). This statement has, at times, been misinterpreted as an attempt to undermine or discredit human capital theory. However, it is crucial to recognize that before adding anything to his definition of wealth, Mill required a market exchange to determine value. This does not imply that Mill disregarded the importance of human abilities or that his views should be dismissed by economists (Sweetland, 1996, pp. 343-344). On the contrary, Mill considered human abilities as economic benefits that lead to wealth—not merely as wealth in themselves, but as crucial contributors to the creation of wealth.

In 1890, Alfred Marshall, in his work Principles of Economics, adopted a pluralistic approach to human capital. Following the Smithian tradition, Marshall stated: *"We may define personal wealth so as to include all those energies, faculties, and habits which directly contribute to making people industrially efficient; together with those business connections and associations of any kind, which we have already reckoned as part of wealth in the narrower use of the term."* (Marshall, 1920, p. 48). Marshall broadened the concept of capital, defining it as: "*By Capital is meant all stored-up provision for the production of material goods, and for the attainment of those benefits which are commonly reckoned as part of income. It is the main stock of wealth regarded as an agent of production rather than as a direct source of gratification."* (Marshall, 1920, p. 115). While Marshall largely followed Smith's perspective, he expanded the definition of capital to include personal wealth. Despite aligning with the Smithian tradition, he also acknowledged the role of human abilities in economic discourse, treating them as fundamental components of wealth generation, similar to Mill's concept of economic benefits. However, Marshall's emphasis on market exchange as a prerequisite for determining value led him to empirically reject the inclusion of human capital in the traditional definition of capital (Sweetland, 1996, p. 344). Nonetheless, Marshall also recognized that the most valuable form of capital is investment in human beings (Marshall, 1920, p. 469; Tan, 2014, p. 2).

While J. S. Mill and A. Marshall typically adhered to empirically rigorous and strict definitions of wealth and capital, Irving Fisher (1906) argued that the value of human capital extends beyond its market-determined worth. Additionally, while Fisher encouraged economists to seek practical solutions, he also acknowledged the empirical challenges associated with assessing human abilities (Sweetland, 1996, p. 344). In The Nature of Income and Capital (1906), Fisher articulated his human capital approach as follows: *"...Where a sale of the article is scarcely conceivable, an appraisement is almost out of the question. To estimate the value of the Yellowstone Park is impossible, unless we allow ourselves a range of several hundred per cent. Similar wide limits must be allowed when we try to value free human beings. We can often give a lower limit, but seldom an upper one... It would be wrong, however, to conclude, as some writers have, that because we cannot value them accurately, public parks or freemen cannot be called wealth."* (Fisher, 1906, p. 17). Furthermore, Fisher (1906, p. 51) clearly asserted that wealth, in its most comprehensive definition, encompasses human beings and suggested that human involvement in production processes represents a type of capital.

3. Human Capital Approaches

Since the early 1960s, human capital approaches have emerged as one of the most influential theoretical frameworks in modern economics. In recent years, the growing prominence of the knowledge economy and the well-established link between education and economic growth have further underscored the significance of this concept. In economies where knowledge and intellectual labor play a more substantial role than physical work, education becomes a pivotal driver of national economic development. Human capital theories emphasize education as a fundamental mechanism for both individual financial gains and broader economic progress. The greater the quantity and quality of education individuals receive, the higher the economic returns, ultimately contributing to national prosperity and wealth accumulation (Gillies, 2011, p. 224).

3.1. Gorseline's Approach to Human Capital

One of the earliest 20th-century studies on human capital was conducted by Eugene Gorseline (1932), whose research was considered nearly three decades ahead of its time. His study focused on 185 pairs of male siblings with differing educational backgrounds. To control for variations in intelligence, he administered an IQ test to each pair, examining the impact of education on income levels. Gorseline found that the higher-educated group had an average IQ score of 80.9, while the less-educated group scored 67.5. Furthermore, he reported that the higher-educated group had an average annual income of $2,015, compared to $1,500 for the less-educated group (Langelett, 2002, pp. 5-6). His findings emphasized the substantial positive effect of formal education on income levels. He further argued that education reflects an individual's decision to enhance their abilities, contingent on their innate talents and motivation.

3.2. Mincer's Approach to Human Capital

In 1957, Jacob Mincer pioneered the empirical analysis of human capital and earnings distribution through his groundbreaking doctoral dissertation, which later formed the basis for his influential paper, Investment in Human Capital and Personal Income Distribution. In this work, Mincer systematically examined the effects of labor market experience and on-the-job training on earnings determination and distribution (Chiswick, 2003, p. 345). In another key study, Mincer (1958) analysed how variations in human capital investment influence income distribution and sought to explain income inequality through differences in human capital accumulation. His model assumed that all individuals enter their professions with equal abilities and opportunities. However, occupations vary in educational requirements, which in turn affect lifetime earnings. Education requires time, and each additional year of schooling delays workforce entry, thereby reducing an individual's total working lifespan. Put simply, an additional year of education shortens an individual's overall earning period by one year. To compensate for this investment, Mincer argued that individuals' lifetime earnings' present values should be equalized at the time of career selection. By assuming that income flows remain constant throughout an individual's working life, he estimated compensatory income differences arising from variations in education costs. These costs are linked to the duration of education in two primary ways. First, longer schooling postpones earnings, reducing income in the early working years. Second, education entails

direct financial costs, including tuition fees, books, and learning materials, excluding general living expenses (Mincer, 1958, p. 284).

For Mincer's human capital model, it is first assumed that the cost of education services is zero.

$l =$ For all individuals, working time $+$ *schooling time*
$= the\ total\ working\ life\ duration\ of\ individuals\ without\ education$

$a_n = Annual\ earnings\ of\ individuals\ with\ n\ years\ of\ education$

$V_n = Present\ value\ of\ lifetime\ earnings\ at\ the\ beginning\ of\ education$

$r = Discount\ rate\ for\ future\ earnings$

$t = time\ (in\ years), where\ t = 0,1,2\ \ldots\ldots, l.$

$d = difference\ in\ schooling\ duration\ (years\ of\ education\ obtanied)$

$e = base\ of\ natural\ logarithms$

Later; $V_n = a_n \sum_{t=n+1}^{l} \left(\frac{1}{1+r}\right)^t$ (1)

When the discounting process is discrete and the process is continuous;

$V_n = a_n \int_{t=n+1}^{l} (e^{-rt})\, dt = \frac{a_n}{r}\left(e^{-rt} - e^{-rl}\right).$ (2)

Similarly, the present value of lifetime earnings for individuals with (n - d) years of education is given by:

$V_{n-d} = \frac{a_{n-d}}{r}\left(e^{-r(n-d)} - e^{-rl}\right).$ (3)

The ratio of annual earnings for individuals differing by $(k_n, n-d)$ years of education is calculated using the equation $(V_n = V_{n-d})$.

$k_n, n-d = \frac{a_n}{a_{n-d}} = \frac{e^{-r(n-d)} - e^{-rl}}{e^{-rn} - e^{-rl}} = \frac{e^{r(l+d-n)} - 1}{e^{r(l-n)} - 1}$ (4)

From this, it is easily observed that $k_n, n-d$ is greater than one, a positive function of r, and a negative function of *l*. In other words:

(i) Individuals with more years of education tend to earn higher annual wages.
(ii) The greater the earnings gap between individuals with a schooling difference of d years, the higher the discounting of future income; in other words, the opportunity cost of postponing earnings increases.
(iii) Since education costs must be compensated within a relatively shorter period, a shorter overall working life results in a greater earnings gap.

Jacob Mincer assumed a linear relationship between earnings and age, developing the experience-earnings profile to illustrate this dynamic. He distinguished between age and labor market experience, emphasizing that the experience-earnings profile follows a concave shape. He further noted that formal education is more easily measurable compared to informal on-the-job training. Through this analysis, Mincer demonstrated that earnings inequality within an occupation increases with the steepness of the lifetime earnings profile[3]. This profile is steeper for occupations requiring higher skill levels, regardless of whether these skills are acquired through formal schooling or workplace training. Moreover, both theoretically and empirically, Mincer established that income inequality increases with age, level of education, and occupational status (earnings level). He further argued that the greater the average years of education within a particular group, the higher the degree of income inequality (Chiswick, 2003, pp. 345-346).

[3] For higher-educated worker groups, the steeper earnings profile implies that income differences between any two members of such a group, based on age, will be greater than the income differences between peers in occupations requiring less education (Mincer, 1958, p. 288).

In 1962, Mincer sought to estimate the magnitude of on-the-job training, its rate of return, and its effects on earnings distribution. He observed that earnings profiles indicate a decline in on-the-job training investments with age, which he attributed to the shortening of the remaining working lifespan as individuals grow older. Mincer also estimated that the rate of return on on-the-job training investments ranged between 9-13%, varying across different occupations. He later examined gender differences in on-the-job training investments and found that women were less incentivized to invest in such training than men. He attributed this disparity primarily to the expectation that the average woman would spend less than half of her lifetime in the workforce and was more likely to leave employment for child-rearing responsibilities. As a result, Mincer suggested that employers would be less inclined to invest in firm-specific training for women than for men (Chiswick, 2003, p. 347; Mincer, 1962).

3.3. Becker's Human Capital Approach

Becker (1960) postulated that an increase in the proportion of qualified individuals attending university would enhance the average returns from higher education. He examined the incomes and economic impacts of individuals with varying educational backgrounds. To estimate the direct returns of university education, Becker utilized Census Bureau data, controlling for factors such as ability, race, unemployment, and mortality rates among high school and university graduates. In the United States, the average earnings gap between university and high school graduates remained relatively stable at 40% to 50% until the early 1960s. However, this gap widened between 1960 and 1970 before subsequently narrowing. The sharp decline observed in the 1970s led some economists and media commentators to raise concerns about an oversupply of highly educated individuals. During this period, the concept of human capital also experienced a decline in academic and policy relevance. However, as Becker (1994) reported, Murphy and Welch (1989) found that monetary returns to university education reached their highest levels in five decades during the 1980s. Consequently, concerns about an excess of highly educated individuals shifted towards discussions on the quality and quantity of education provided in the United States.

In his seminal work Investment in Human Capital: A Theoretical Analysis (1962), Becker explored the factors influencing future income through the allocation of resources to individuals, such as obtaining a university education— a process he termed investment in human capital. The primary objective of his study was to estimate the financial returns of college and high school education in the United States. To provide a suitable theoretical framework, Becker formulated a concise human capital investment theory model.

There are multiple avenues for human capital investment, including formal education (schooling), on-the-job training, healthcare services, vitamin intake, and gaining an understanding of the economic system. While the relative effects of these investments on earnings and consumption vary based on resource allocation, return magnitude, and the perceived link between investment and returns, all contribute to enhancing individuals' physical and cognitive abilities. Consequently, expectations regarding real income tend to increase. Economic well-being varies both across countries and among families within a given country. Traditionally, most economists attributed these differences to variations in physical capital, assuming that wealthier individuals possessed greater physical capital than others. However, over time, research has demonstrated that income disparities are not solely dependent on physical capital but also on intangible assets, such as knowledge. Consequently, investments in human capital have redirected the emphasis toward these intangible assets, establishing a more effective framework for understanding income inequality (Becker, 1962, p. 9).

The human capital approach provides key insights into income disparities, earnings patterns over the life cycle, and the impact of specialization on skills and abilities. Becker argued that earnings inequality arises because individuals invest in themselves at different rates. Talented, capable, and skilled individuals tend to allocate more resources to self-investment (i.e., human capital), leading to unequal and skewed earnings distribution. He further emphasized that on-the-job learning and other human capital-enhancing activities affect earnings similarly to formal education and training (Becker, 1962, pp. 48-49). Becker also underscored the distinct nature of human capital, differentiating it from financial and physical capital. He argued that education, computer training courses, healthcare

expenditures, and even lessons on virtues such as punctuality and honesty constitute capital investments that enhance earnings. Unlike physical and financial assets, which are transferable, an individual's knowledge, skills, health, and values are inherent and inseparable attributes. Thus, while these investments generate human capital, they do not produce physical or financial capital in a conventional sense. Nonetheless, Becker asserted that referring to them as capital investments remains entirely consistent with the traditional definition of capital.

G. Becker sought to explain variations in returns through the concept of human capital in his studies. He argued that an individual's decision regarding education is analogous to an entrepreneur's investment decision in the market. Individuals assess the returns and costs of education, weighing the potential benefits against the expenses. In investment decisions related to education, costs and expected future returns serve as key determinants in the decision-making process.

$$\sum_{t=1}^{T-E} \frac{W_E - W_{E-1}}{(1+i)^t} > W_{E-1} + C_E \qquad (5)$$

G. Becker attempted to explain the relationship between human capital investment and its returns using Equation (5). In this equation, the left-hand side represents the potential return from education, while the right-hand side denotes the cost of education. Specifically, W_E indicates the present value of education, whereas W_{E-1} represents the earnings that could be obtained at the previous education level. The term *T-E* refers to the time an individual dedicates to education instead of participating in the labor market, C_E denotes the direct costs of education, and i signifies the market interest rate (Aslan, 2019, p.12). If the expected return from education exceeds its cost, individuals will opt for education, leading to an investment in human capital.

Becker's studies not only fill a gap in economic theory regarding the analysis of human capital investments but also provide a comprehensive explanation for various empirical phenomena that have surprised researchers. These phenomena can be outlined as follows:

a) Earnings generally increase with age but at a diminishing rate. Both the rate of growth and the rate of deceleration are positively correlated with skill levels.
b) Unemployment rates tend to be inversely proportional to skill levels.
c) Firms in less developed countries tend to exhibit a more paternalistic approach toward their employees compared to those in developed countries.
d) Younger individuals are more likely to change jobs frequently and to receive a greater amount of formal education as well as on-the-job training than their older counterparts.
e) Income distribution is positively skewed, particularly among professionals and other highly skilled workers[4].
f) Individuals with higher abilities are more likely to pursue greater levels of education than others.
g) The extent of labor specialization is constrained by the size of the market.
h) An individual investing in human capital is generally more impatient compared to one investing in physical capital, which increases their likelihood of making errors (Becker, 1962, p. 10; Becker, 1994, p. 30).

3.4. Schultz' Human Capital Approach

In his 1961 work Investment in Human Capital, T. Schultz examined the relative contributions of physical capital and human capital to economic growth. He observed that, contrary to conventional expectations, the capital-to-income ratio declines as economic growth progresses. This finding

[4] This skewness arises from differences in individual abilities and variations in human capital investments, leading to earnings variability. The expression "positively skewed" indicates that the distribution is right-skewed, meaning that lower earnings are more concentrated, while the distribution has a longer tail on the right side (higher earnings). This implies that a small number of individuals earn exceptionally high incomes, whereas the majority of workers fall within lower income levels. Gary Becker's statement highlights that among professional and skilled workers, earnings are predominantly concentrated at lower levels, but a subset of workers attain significantly higher incomes.

challenges the traditional notion that a country accumulating more reproducible capital would utilize it more intensively, leading to greater abundance and lower costs. However, empirical estimates indicate that as economic growth advances, the proportion of capital used relative to income decreases. Schultz argued that these estimates account for only a portion of total capital, notably excluding human capital. In reality, human capital grows at a significantly higher rate than reproducible (non-human) capital. Various estimates suggest that national income increases at a faster rate than national resources. A key motivation behind Schultz's investigation was the observation that income in the United States has grown much faster than the land, working hours, and reproducible capital stock used to generate it. He concluded that the declining capital-to-income ratio reflects the increasing role of human capital in economic growth (Schultz, 1961, pp. 5-6). Schultz focused on the unexplained component of economic growth, noting that this discrepancy widened between 1950 and 1960. He provocatively argued that labelling this inconsistency as "resource efficiency" would be merely a euphemism for ignorance rather than a genuine resolution. Furthermore, he contended that unless this discrepancy is properly addressed, existing production theories that rely on measured input-output relationships will remain inadequate for analysing economic growth—serving as little more than a theoretical curiosity rather than a functional framework.

The rapid expansion of educational investments has since been recognized as a key explanatory factor for a significant portion of the previously unexplained rise in income and earnings. Schultz analysed the total cost of education, including opportunity costs, in relation to consumer income and alternative investments. His study also examined the growth of the educational stock in the labor force, the returns on education, and the contributions of rising educational attainment to national income through earnings. Between 1900 and 1956, the educational stock of the U.S. labor force increased approximately 8.5 times, while the stock of reproducible capital grew only 4.5 times (Schultz, 1961, pp. 11-12).

In his 1971 research, Schultz argued that labor services—comprising both skilled and unskilled workers, as well as technical and specialized professionals—accounted for approximately four-fifths of U.S. economic output, with the remaining portion derived from the productive services of physical capital. His findings indicate that acquired labor skills constitute the majority of workforce contributions, suggesting that the role of raw, unskilled labor in production is relatively small and diminishing over time. In short, acquired skills play an increasingly significant role in explaining the rising abundance of goods and services. Education and higher schooling are generally regarded as sound investments for securing future earnings, with rates of return that often exceed those of non-human capital. According to Schultz (1971, pp. 1–3), these returns have continued to rise over time. Consistent with these differing return rates, the stock of reproducible capital in the U.S. economy has expanded at a significantly slower pace than the stock of educational capital embodied in the workforce. Over time, gradual increases in real wages among workers have been largely attributed to the accumulation of additional skills, while the contribution of total factor productivity appears relatively minor.

T. Schultz outlines five key activities that contribute to the development of human capital:

i) Healthcare facilities and services encompass all expenditures that influence a population's life expectancy, physical strength, endurance, vitality, and overall well-being.

ii) On-the-job training, encompassing traditional apprenticeship programs organized and overseen by firms.

iii) Educational initiatives spanning primary, secondary, and higher education levels.

iv) Adult education programs not administered by firms, including extension programs, particularly in the agricultural sector.[5]

[5] This expression refers to education and development programs designed for adults that are not organized by firms. For example, extension programs, which are commonly observed in agriculture, may be designed to provide farmers with new agricultural techniques and knowledge. These programs aim to help adults better adapt to existing job opportunities and continue their professional development.

v) Migration of both individuals and their families in response to shifting employment opportunities (Schultz, 1961, pp. 8–9).

3.5. Arrow's Human Capital Approach

K. Arrow argued that increases in per capita income could not be explained solely by rising capital-labor ratios, emphasizing that no economist can deny the role of technology in economic growth. His assertion aligns with the neoclassical production function perspective, as technological knowledge is inherently embedded in the growth process. While it is undeniable that knowledge expands over time, Arrow underscored the challenges of measuring knowledge and noted that relying too heavily on such an exogenous variable in an economic growth model is intellectually unsatisfactory. He stressed that the concept of knowledge in the production function requires analytical examination, as knowledge must be actively acquired. Just as educators acknowledge that students exposed to the same educational experiences develop distinct knowledge structures, it should also be empirically recognized that different countries exhibit distinct production functions simultaneously. In this context, Arrow proposed an endogenous theory explaining variations in knowledge acquisition. In his 1962 work, Arrow defined the process of knowledge acquisition as learning, incorporating insights from various disciplines, including psychology. He particularly emphasized the significance of learning by doing, arguing that experience-based learning is fundamental to knowledge accumulation.

In his 1962 article The Economic Implications of Learning by Doing, K. Arrow introduced the concept of learning by doing as a major contribution to the literature, stressing its significance in shaping economic outcomes. He argued that when a firm invests in capital, it not only increases its physical capital stock but also enhances its stock of knowledge (Ünsal, 2007, p. 247). He asserted that experience, technological progress, and knowledge accumulation continuously expand throughout the production process. Moreover, he suggested that a firm's operational returns would be less significant compared to its returns from knowledge accumulation. At the conclusion of his paper, Arrow emphasized the need to establish educational and research institutions to accelerate individual learning. His findings demonstrated that knowledge and expertise can be acquired through on-the-job training and that technological advancements can transform production processes accordingly. Arrow linked knowledge acquisition to experience, providing numerous examples, such as the aircraft industry, to support his theoretical claims. He established a strong correlation between experience and productivity, arguing that knowledge accumulation is not a deliberate production effort but rather an inherent aspect of traditional economic activities. In this framework, experience functions as both investment accumulation and a form of capital stock. In summary, learning is an integral part of the production function. While learning by doing contributes to knowledge accumulation and capital stock expansion, the diffusion of knowledge enables firms to freely access and utilize the expertise accumulated by others (Arrow, 1971; Şerifoğlu, 2020, p. 42). Like many other scholars, Arrow (1962, p. 172) identified improvements in labor quality over time as a crucial driver of increasing productivity.

3.6. Psacharopoulos' Human Capital Approach

The human capital approach posits that education is an investment for both individuals and society. While individuals decide how much to invest in human capital based on their expected private returns, governments make decisions regarding investing in or subsidizing human capital based on social returns. G. Psacharopoulos demonstrated that education generates social returns by fostering more efficient and productive individuals, thereby establishing a strong link between education and GDP growth (Langelett, 2002, p. 10).

Psacharopoulos' study provided empirical evidence on the returns to educational capital across multiple countries. He calculated the returns on investment in higher education for 25 countries between 1957 and 1968, comparing private returns earned by individuals with social returns accrued to society. The study also examined the effects of public subsidies on higher education. Furthermore, Psacharopoulos compared the returns on physical capital and investments in higher education at different stages of economic development. The findings revealed that in less developed countries, the returns on investment in higher education were significantly higher than the returns on physical capital. In contrast, in developed countries, the returns on university education were found to be either equal to or lower than those of physical capital investment. Psacharopoulos argued that when viewed beyond an

academic perspective, universities resemble manufacturing firms that produce graduates. According to him, higher education functions as a processing system, where students are refined through learning and then delivered to the labor market upon graduation. He regarded this process as comparable to any other economic activity. On average, university graduates earn higher incomes than secondary school graduates, and this additional income serves as an indicator of the value added by the "higher education" production process (Psacharopoulos, 1972, pp. 141-142). Psacharopoulos' research critically examined whether investments in higher education were economically viable for both individuals funding their education and society financing such activities. The study investigated whether the benefits of higher education outweighed its costs, whether society allocated adequate resources to higher education, whether redirecting more resources to education could accelerate economic growth, and how economic returns to higher education differed between developed and developing countries.

Table 1: Rate of Return on Investment in Higher Education and Per Capita Income by Country

Country	Year	Rate of return %		Per Capita Income (in USD)
		Private	Social	
1	2	3	4	5
United States	1959	9.6	----	2.361
Canada	1961	19.7	----	1.774
Mexico	1963	29.0	23.0	374
Venezuela	1957	----	23.0	776
Colombia	1965	----	8 0	320
Chile	1959	----	12.2	365
Brazil	1962	38.1	14.5	261
United Kingdom	1966	12.0	8.2	1.660
Norway	1966	4.5	5.4	1.831
Sweden	1967	10.3	9.2	2.500
Denmark	1964	10.0	7.8	1.651
Netherlands	1965	10.5	5.5	1.490
Belgium	1967	----	8.7	1.777
Germany	1964	----	4.9	1.420
Greece	1964	----	8.0	478
Israel	1958	----	6.6	704
India	1960	14.3	12.7	73
Malaysia	1967	----	10.7	280
Japan	1961	10.0	6.0	464
Philippines	1966	12.5	11.0	250
Nigeria	1967	----	17.0	75
Ghana	1967	----	16.5	133
Kenya	1968	27.4	8.8	111
Uganda	1965	----	12.0	84
New Zealand	1966	14.7	13.2	1.931

Source: (Psacharopoulos, 1972, p. 147).

An examination of Table 1 reveals certain inconsistencies between private and social rates of return. The disparity between the returns on private investment in education and the social rate of return stems from the fact that a significant portion of direct education costs is covered by the government.

Variations in private and social rates of return also serve as an indicator of the extent of public subsidies for higher education across different countries. A closer analysis indicates that this gap is more pronounced in developing countries, reflecting a greater degree of government involvement in financing higher education.

Table 2: Rates of Return on Physical Capital in Selected Countries

Country	Year	Rate of return %
United States	1959	9.7
Canada	1957	12.9
Mexico	1962	14.0
Venezuela	1958	16.7
Chile	1940-61	15.0
United Kingdom	1955-59	8.6
Germany	1955-59	10.4
India	1957	17.5
Japan	1957	20.4
Ghana	1962	8.0
Kenya	1966-67	18.8

Source: (Psacharopoulos, 1972, p. 151).

The findings of Psacharopoulos' (1972) study can be summarized with the aid of Tables 1 and 2 as follows:

(a) The average return on higher education exceeds the return on investment in physical capital. The policy implication is that education investments should be prioritized over other forms of investment that yield lower returns.

(b) The returns on higher education are higher in less developed countries than in developed countries. This suggests that the former group of countries still has untapped opportunities for increasing national income through educational investments.

(c) The subsidization of higher education appears to be greater in developing countries compared to developed ones. This implicit distortion tends to contribute to intellectual unemployment and brain drain. Policymakers in these countries must decide whether to reduce subsidies or increase expenditures on higher education as a profitable investment opportunity.

(d) As economic growth progresses, the returns on investments in higher education decline. Since university graduates serve as complements to the high levels of technology utilized in more developed economies, there is no substantial concern regarding overinvestment in higher education.

3.7. Romer's Human Capital Approach

In his 1986 paper Increasing Returns and Long-Run Growth, P. Romer developed a long-term growth model in which knowledge is treated as an input with increasing marginal productivity. Based on this model, the return on investment and the growth rate of per capita output are anticipated to decline as functions of per capita capital stock levels, ultimately driving the convergence of wage rates and capital-labor ratios across various countries over time. Consequently, initial conditions or economic crises are not expected to have long-term effects on output and consumption levels. For instance, an exogenous reduction in a country's capital stock would lead to an increase in the price of capital assets, thereby inducing a compensatory rise in investment. In the absence of technological advancements, per capita output is expected to converge at a steady-state level. These assumptions are grounded in the concept of diminishing returns to per capita capital in the production of per capita output. However, Romer presents an alternative perspective on long-term growth expectations. His model suggests that under competitive equilibrium, per capita output can grow indefinitely, potentially at a monotonically

increasing rate over time. Unlike traditional models, Romer's framework suggests that returns on capital and the rate of investment may increase with capital accumulation, implying that per capita output across different countries may not necessarily converge. Consequently, growth in less developed countries may persistently lag behind or even fail to occur. These outcomes are not contingent on exogenously determined technological change or country-specific differences. Instead, preferences and technology are assumed to be static and identical across nations. The critical distinction in Romer's model lies in its departure from the assumption of diminishing returns, challenging the conventional view of capital accumulation and convergence in economic growth (Romer, 1986).

While exogenous technological changes are disregarded, this model suggests that long-term growth is primarily driven by knowledge accumulation, facilitated by forward-looking agents seeking to maximize profits. It incorporates endogenous technological changes into a general equilibrium framework, modifying the standard growth model to emphasize the role of knowledge. While physical capital can be directly created from sacrificed output, new knowledge is believed to stem from a research process that follows diminishing returns. Given a certain level of knowledge accumulation, doubling research inputs will not necessarily double the amount of new knowledge produced. Additionally, investment in knowledge inherently generates externalities, as a firm's production of new knowledge positively impacts the production possibilities of other firms. Since knowledge cannot be fully patented or kept entirely confidential, its diffusion generates spillover effects. Most importantly, the production of consumption goods—as a function of the stock of knowledge and other inputs—exhibits increasing returns to scale. In this model, knowledge can grow indefinitely and may exhibit increasing marginal productivity. These three elements—externalities, increasing returns in output production, and diminishing returns in knowledge creation—are integrated into a well-defined competitive equilibrium model of growth. Despite the presence of increasing returns, a competitive equilibrium emerges due to externalities, though it lacks Pareto optimality. This equilibrium explains historical growth patterns even in the absence of government intervention. The existence of externalities is crucial for equilibrium while diminishing returns in knowledge production are necessary to prevent excessive increases in consumption and utility. However, the fundamental assumption that reverses standard growth theory results is that intangible capital—knowledge—does not diminish in marginal productivity but instead increases it (Romer, 1986, pp. 1002–1004). Romer contends that economic growth in the model is fuelled by technological advancements arising from investment choices made by profit-maximizing agents. What distinguishes technology as an input is that it does not fit the definition of a conventional good or a purely public good. Rather, it is a non-rivalrous yet partially excludable good. Because non-rival goods can be consumed by multiple agents simultaneously without competition, price-taking competition cannot be sustained in the absence of convexity. Instead, equilibrium takes the form of monopolistic competition (Romer, 1990, p. 71). The main conclusions of the model are that the stock of human capital determines the growth rate, the allocation of human capital to R&D is insufficient, integration into global markets enhances growth rates, and a large population alone is not sufficient for sustained economic growth.

In the 1950s, most economists attributed nearly all changes in output per hour worked to technological advancements. While effective labor and capital were undoubtedly crucial factors, technological change played a pivotal role. The raw materials used in production remained unchanged, but the methods of combining them became significantly more sophisticated through trial and error, experimentation, improvements, and scientific research. Three key arguments emerge from this perspective. First, technological change is central to economic growth, as it stimulates continuous capital accumulation and explains a substantial portion of the increase in output per hour worked. Second, technological change is largely driven by individuals responding to market incentives. As a result, this model prioritizes endogenous technological change over exogenous technological change. Market incentives play a critical role in transforming new knowledge into goods with practical value. Third, and most importantly, the nature of instructions for processing raw materials differs from that of other economic goods. These instructions, essentially a new set of knowledge, can be reused indefinitely at no additional cost once their initial development cost has been incurred (Romer, 1990, p. 72). In short, knowledge accumulation and technological advancements reinforce each other, leading to productivity gains, which in turn contribute to human capital accumulation.

One of the most intriguing results of P. Romer's (1990) model is that an economy with a larger stock of human capital will experience faster growth. This key finding suggests that free trade could serve as a mechanism to accelerate economic growth. The model also provides a framework for understanding how developed economies in the 20th century achieved unprecedented rates of per capita income growth. If a country has a low stock of human capital, it becomes evident why closed, less-developed economies struggle to grow. The model presented here is essentially an enriched version of the neoclassical model, incorporating endogenous technological change to offer an internal explanation for the sources of technological progress.

3.8. Lucas's Human Capital Approach

In his 1988 paper On the Mechanics of Economic Development, R. Lucas proposed three models: one emphasizing physical capital accumulation and technological change, another focusing on human capital accumulation through education (schooling[6]), and a third emphasized the importance of specialized human capital accumulation through learning by doing.

R. Lucas's theory, in contrast to Romer's approach, emphasizes that human capital accumulation is a structured economic process requiring specific resources and involving opportunity costs. Lucas argues that individuals face a fundamental trade-off in allocating their time: they can either participate in production or invest in human capital accumulation. The distribution of time between these alternatives ultimately determines the rate of economic growth. While reducing time spent on production may lead to a short-term decline in output, it simultaneously accelerates human capital investment, which fosters long-term output growth. The distinguishing feature of Lucas's approach is the explicit incorporation of education and human capital into the production function (Sharipov, 2015, p. 770).

According to Lucas, human capital theory illustrates that an individual's time allocation across various activities in the present influences their productivity and human capital accumulation in future periods. Incorporating human capital into the model is crucial not only for understanding its influence on current production but also for analysing how present time allocation affects future human capital growth. In Lucas's model, an individual's human capital is directly linked to their ability to perform tasks. For instance, a worker with a high level of human capital being able to perform the work of two individuals underscores the qualitative aspect of human capital (Lucas, 1988, p. 17).

Robert Lucas's endogenous growth model examines technological changes by integrating both physical and human capital. Since the returns to physical and human capital do not necessarily diminish as economies develop, the spillover benefits of human capital formation contribute to sustained economic growth. More specifically, Lucas's model distinguishes capital into two categories: human capital and physical capital. His two-sector model can be formally expressed as follows:

$$Y = AK^{\alpha}(uH)^{1-\alpha} \quad (6)$$

$Y = Output$

$A = \ An\ exogenous\ technology\ parameter$

$H = Human\ Capital$

$K = Capital\ Stock$

$u = The\ portion\ of\ human\ capital\ used\ in\ output\ production$

$uH = effective\ (productive) labor\ used\ in\ output\ production$

Later, output can either be consumed or used to increase the capital stock.

$$Y = C + \dot{K} + \delta K \quad (7)$$

$C = Consumption$

$\dot{K} = Change\ in\ capital\ stock$

[6] It represents the time allocated to education (schooling).

$\delta = Depreciation\ parameter$

In the other sector, human capital itself is also produced by human capital.

$$\dot{H} + \delta H = B(1-u)H \quad (8)$$

$\dot{H} = Change\ in\ human\ capital$

$(1-u) = The\ portion\ of\ human\ capital\ used\ in\ the\ production\ of\ human\ capital$

$B = Technology\ parameter$

When the differential equations (6) and (7) are solved, the growth rate of output, measured in terms of both physical goods and human capital, is found to be equal to the value of output growth minus the growth rate of the portion of human capital used in physical output production, multiplied by the reduced-form parameter (Equation 8). In this framework, A represents the technological coefficient, K and H denote the physical and human capital inputs that a firm utilizes to produce output (Y), and H also represents the economy-wide average human capital. Additionally, the parameter u captures the strength of the external effect of human capital on the productivity of each firm. According to Lucas's approach, although each firm operates under constant returns to scale, the entire economy experiences increasing returns to scale. Furthermore, on-the-job training, learning by doing, and spillover effects are embedded in the model through human capital. Notably, firms do not benefit from the total stock of human capital but rather from the average human capital level in the economy, implying that economic growth is determined by the overall skill and knowledge level within the economy rather than by individual firms' accumulated knowledge and experience. Following Arrow's (1962) conceptualization of learning by doing within production activities, Lucas (1988) further investigated the role of experience in driving productivity growth, demonstrating that on-the-job training and learning by doing contribute to human capital formation at least as significantly as formal education.

The key insight of R. Lucas' model is that sustained economic growth is possible if the growth rate of human capital offsets the diminishing returns to physical capital. The model explicitly demonstrates that both physical and human capital contribute to economic growth (Langelett, 2002, pp. 21–22). In other words, if conditions are created in which declining profit rates are compensated by unexpected gains from another source, the net profit rate will remain positive and stable. This mechanism requires the design of externalities, and if conditions fostering persistent positive economic externalities can be established, it becomes possible to counteract the tendency of profit rates to decline. As a result, the incentives for sustainable capital accumulation can be maintained, ensuring long-term economic growth. Lucas, in his 1988 study, precisely demonstrated this mechanism (Yeldan, 2010, pp. 207–208).

3.9. Becker, Murphy, and Tamura's Human Capital Approach

In their 1990 study Human Capital, Fertility, and Economic Growth, G. Becker, K. Murphy, and R. Tamura proposed that as fertility rates and human capital stock increase, the rate of return on human capital also rises. They argued that in societies rich in human capital, the returns to human capital investments exceed those of investments in children. Conversely, in societies with limited human capital, the returns on human capital investments remain lower than the returns on child-rearing investments. As a result, low-human-capital societies tend to favour larger families with lower per-child investments, whereas high-human-capital societies adopt the opposite approach, preferring smaller families with higher per-child investments.

This dynamic leads to two stable equilibrium states:

a) Large families with low human capital
b) Small families with increasing levels of human and possibly physical capital

Economic growth has posed an intellectual challenge since the inception of economic analysis. Adam Smith linked growth to the division of labor, while Malthus developed a formal dynamic growth model, suggesting that every country converges to a constant per capita income. In the Malthusian model, when income exceeds equilibrium levels, mortality rates decline, and fertility increases. Conversely, when income falls below this level, mortality rises and fertility declines. Due to the failure

of the Malthusian model, the neoclassical growth model largely ignored any fundamental relationship between population and the economy, instead attributing adjustments to investment rates in physical capital rather than population growth rates. According to this model, the stock of physical capital grows more slowly when per capita income exceeds its steady-state level and more rapidly when it falls below it. However, neither Malthusian nor neoclassical growth theories explicitly incorporated human capital or assigned it significant importance. Given that human capital embodies knowledge and skills, and economic development relies on technological and scientific advancements, it follows that scientific progress itself is dependent on human capital accumulation. Empirical evidence from 21st-century studies on the U.S. supports this reasoning. Earlier economists, such as Schultz, found that gross investments in education in the U.S. grew at a much faster rate than investments in physical capital. These findings suggest that countries with greater education and skill levels tend to grow more rapidly (Becker et al., 1990, pp. 12-13). Becker, Murphy, and Tamura (1990) recognized the importance of these findings and placed human capital investments at the core of their analysis. As a result, their framework did not align with either Malthusian or neoclassical thought, but rather diverged from both, offering a distinct perspective on economic growth.

3.10. Benhabib and Spiegel's Human Capital Approach

In their 1994 study, Benhabib and Spiegel conducted growth accounting regressions based on a Cobb-Douglas production function, utilizing cross-country data on physical and human capital stocks. Their findings initially suggested that human capital had an insignificant effect[7] on per capita growth rates. However, they later developed an alternative model that examined the impact of human capital stock on a country's total factor productivity (TFP) growth rate. This revised model demonstrated that human capital positively influences TFP growth, highlighting its role in fostering technological progress and efficiency gains.

The relationship between human capital, labor force education levels, and economic growth forms the foundation of Benhabib and Spiegel's study. A standard theoretical framework treats human capital, often measured as the average years of schooling in the labor force, as a direct input in the production function. An alternative approach, rooted in endogenous growth theories, models technological progress or TFP growth as a function of education levels or human capital. The central argument is that a more educated workforce is more effective at creating, applying, and adopting new technologies, thereby driving economic growth. Benhabib and Spiegel's study empirically differentiates between these two approaches. In the literature, gross investments are typically used to measure physical capital stock, while literacy rates and school enrolment rates serve as proxies for human capital. This study employed average years of schooling in the labor force as the primary measure of human capital. Human capital stocks were estimated by analysing the relationship between labor force education levels and historical human capital investment, such as enrolment in primary, secondary, and higher education. To examine cross-country determinants of economic growth, the study modelled labor force, human capital, and physical capital as production factors within a standard Cobb-Douglas production function. The initial findings indicated that human capital growth had an insignificant, and in some cases, negative impact on per capita income growth.

To further investigate the role of human capital, the authors constructed a model in which human capital directly affects total factor productivity (TFP) through two main channels, adapted from Romer (1990) and Nelson & Phelps (1966).

1) Innovation channel – human capital influences productivity growth by enhancing a nation's capacity to develop new technologies suited to local production needs.
2) Technological diffusion channel – The model assumes that a nation's ability to adopt and apply foreign technology depends on the size of its domestic human capital stock. A global technological leader serves as a reference point, while other nations' catch-up speed is determined by their human capital stock.

The interaction of innovation and catch-up dynamics leads to several key findings:

[7] Human capital accumulation does not play a significant role in determining economic growth.

a. Under specific circumstances, especially if the innovation parameter is dominant, growth rates can vary significantly among countries due to variations in human capital stock over extended periods.
b. A country lagging behind the technological leader but with a greater accumulation of human capital is likely to close the gap within a limited period and may even surpass the leader.
c. Ultimately, the country with the most advanced human capital will become the technological leader, retaining its status so long as it maintains its leadership in human capital (Benhabib & Spiegel, 1994, pp. 143-145).

The traditional method of growth accounting, which incorporates human capital, defines a production function for per capita income (Y_t), based on three primary inputs: labor, physical capital, and human capital. When expressed in the Cobb-Douglas production function form, it can be written as follows:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} H_t^{\gamma} \varepsilon_t \quad (9)$$

Subsequently, when taking the logarithmic differences, the long-term growth relationship can be expressed as follows:

$$(logY_t - logY_0) = (logA_t - logA_0) + \alpha(logK_t - logK_0) + \beta(logL_t - logL_0) + \gamma(logH_t - logH_0) + \left(log_{\varepsilon_t} - log_{\varepsilon_t}\right) \quad (10)$$

As stated in Equation (10), one of the key challenges in estimating aggregate production functions is that physical and human capital are accumulated factors, making them potentially correlated with the error term ε_t. This correlation implies the possibility of biased estimates The results indicate an upward bias in the coefficients of labor (α) and human capital (γ), whereas the coefficient of physical capital (β) exhibits a downward bias. These biases may lead to an overestimation of the effects of physical and human capital accumulation in growth equations. Within the framework of standard growth accounting, this equation allows for estimating the logarithmic differences in income by regressing them on the logarithmic differences of factor inputs. If this specification holds, it enables the estimation of the magnitudes of α, β, and γ. This formulation suggests that, in economic models used to explain income variations, additional variables—such as political instability and disruptive activities—should be incorporated alongside fundamental factors to better understand differences in productivity (Benhabib & Spiegel, 1994, p. 146).

3.11. Cohn and Hughes' Human Capital Approach

E. Cohn and W. Hughes, in their 1994 study, estimated the rate of return on university education for the period 1969–1985. Analysing annual earnings differences between high school and university graduates aged 18 to 66, they found that the private return rate for high school and university education was 15% in 1969, 11% in 1974, and 18% in 1985 (Langelett, 2002, p. 12).

Using panel data analysis, they examined the internal rates of return to university education for 1969, 1974, 1978, 1982, and 1985. The sample consisted exclusively of household heads who held either a high school or university diploma and were employed in the non-agricultural sector during the respective years. The findings revealed fluctuations in the rate of return across different years, with some periods showing an increase, while others indicated a decline. Additionally, the results suggested that returns to education are sensitive not only to econometric estimation techniques and assumptions underlying age-earnings profiles but also to broader economic factors (Cohn & Hughes, 1994, p. 109).

Key findings from the probit analysis used in the study include the following:

- All other things being equal, factors such as parental education level and socio-economic status consistently have a positive effect on the likelihood of children completing university. Conversely, an increase in the number of siblings within a family persistently reduces the probability of university completion.
- The ADJERN variable was used to represent the economic conditions at the time when a university enrolment decision was made and was found to be negative and significant for three

out of five years. This suggests that all other factors held constant, university completion rates tend to decline during periods of low national income. This finding contradicts the expectation that lower national income and higher unemployment rates should reduce opportunity costs, thereby increasing the returns to schooling and stimulating demand for higher education. On the other hand, adverse economic conditions may simultaneously weaken a student's and their family's ability to finance university education, offsetting the expected positive effect of lower opportunity costs.

- Holding other factors constant, whites and males generally exhibited a higher probability of completing university. However, the results for whites in 1985 and for males in 1969 and 1974 were not statistically significant. Moreover, the declining coefficients observed for whites over time are particularly noteworthy. This trend suggests that the effect of race on university completion has diminished significantly over time, to the extent that it was no longer statistically significant in 1985.
- Although religious affiliation is generally not considered a significant factor, the 1985 model indicates that Jewish individuals had a significantly higher probability of completing university compared to other groups (Cohn & Hughes, 1994, pp. 112–114).

3.12. Bils and Klenow's Human Capital Approach

M. Bils and P. Klenow, in their 2000 study, examined the relationship between education and economic growth, applying Mincer's returns-to-education model to quantify the impact of schooling on economic expansion. Their findings indicate that only one-third of cross-country growth differences can be attributed to education, and that this relationship is generally weaker than expected. Additionally, they pointed out the possibility of reverse causality, suggesting that economic growth itself may influence education levels, potentially providing a more robust explanation for the observed correlation.

Their model evaluates the role of intergenerational knowledge transfer and human capital accumulation in driving economic growth. However, they argue that the overall impact remains limited and that education's effect on growth is largely temporary. The study further demonstrates that while human capital generates positive externalities in terms of technology adoption and utilization, these effects are relatively modest. Specifically, they found that an additional year of schooling in 1960 contributed to an annual average growth increase of 0.30% between 1960 and 1990, though the overall effect remained restricted in magnitude (Bils & Klenow, 2000, p. 1160).

3.13. Jones' Human Capital Approach

C. Jones introduced a model integrating contributions from various strands of growth literature in his study Human Capital, Ideas, and Economic Growth (1996). This model emphasizes capital accumulation and demonstrates the critical role of idea generation and technology transfer in economic growth. Jones further suggested that cross-country data on education levels should be interpreted in relation to investment rates rather than merely as capital stock. His model has also contributed to resolving a key puzzle in the empirical literature on human capital and economic growth, offering a more comprehensive framework for understanding their relationship.

The model defines the economy as producing three types of goods:

- Consumption goods (output),
- Human capital goods (experience or skills), and
- New varieties of intermediate capital goods (ideas).

Focusing on research and idea generation, the model demonstrates its ability to produce successful international-level regression results, similar to the methods employed by Mankiw and others. The study also provides several key insights regarding human capital. First, data on educational attainment, such as those compiled by Barro and Lee (1993), should be interpreted not as capital stock but as a variable akin to an investment rate. This interpretation aligns with the observation that education levels are asymptotically bounded—unlike physical capital per worker, they do not grow indefinitely over time. Second, following the approach of Bils and Klenow (1996), the model incorporates educational attainment in a manner consistent with Mincer's wage regressions (Jones, 1994, p. 25).

Jones' study yielded significant findings, particularly emphasizing the non-rival nature of knowledge and increasing returns to scale. Knowledge is generated and disseminated through technological advancements, leading to international technology transfer. This diffusion effect facilitates unbounded economic growth, suggesting that human capital accumulation can also continue indefinitely. Furthermore, when the sample size of countries is expanded, key variables such as population growth rate, physical capital investment, and human capital investment account for a substantial portion of the variation in GDP growth (Aslan, 2019, p. 17).

4. Conclusion

This study has aimed to provide a comprehensive overview of the evolution of human capital theory, tracing its roots from classical economic thought to its central role in modern growth theories. In doing so, it highlights how the understanding of human capital has shifted from a philosophical abstraction into a measurable and actionable economic variable. The increasing emphasis on education, skills, health, and knowledge as key inputs in economic productivity underscores the need to revisit human capital from an integrative perspective. One of the central findings of this study is that human capital theory is not a monolithic framework, but rather a multidimensional concept shaped by diverse intellectual traditions. Classical thinkers such as Adam Smith and John Stuart Mill laid the normative foundations by associating labor and human ability with economic value, even if they lacked a formalized model. Marshall and Fisher began to bridge this early thinking with a broader definition of capital that included human abilities yet stopped short of treating it as a fully integrated economic input.

The theoretical synthesis begins in earnest with the work of Becker, Mincer, and Schultz, who developed formal models linking education and on-the-job training to income levels, productivity, and national development. Becker's analogy between education and entrepreneurial investment marks a pivotal shift in how human capital is viewed—not as a passive trait, but as a deliberate and strategic choice with long-term returns. Mincer's earnings function and Schultz's attention to unmeasured growth components further expanded this view. Later approaches—such as those by Arrow, Romer, and Lucas—shift the focus from individual outcomes to macroeconomic structures. Human capital becomes central to endogenous growth, technological innovation, and knowledge spillovers. These models highlight how learning, specialization, and collective education levels produce increasing returns at the societal level, often beyond the control or awareness of individual agents.

Across these diverse approaches, several key themes consistently emerge. First, the investment perspective is central to nearly all models: human capital is conceptualized as a deliberate investment decision, one that entails costs, potential risks, and expected returns—much like any form of capital expenditure. Second, the temporal dimension is emphasized, particularly in models such as those by Mincer and Becker, where individuals incur short-term sacrifices (such as delayed labor market entry) in pursuit of long-term income gains. Third, in modern endogenous growth theories, human capital is understood as both an outcome and a driver of economic growth, creating reinforcing feedback loops that support sustained increases in productivity and innovation. Another critical insight relates to the distributional effects of human capital accumulation. Factors such as gender, socio-economic status, and geographic inequality shape individuals' access to education and skill development, thereby influencing income distribution and social mobility. Lastly, the theoretical literature highlights broad policy implications, positioning human capital as a public good that justifies investment in education, healthcare, and workforce training due to the significant positive externalities these areas generate for society at large. These insights are further expanded by contemporary contributions such as Benhabib and Spiegel's focus on total factor productivity and technological diffusion, Cohn and Hughes' analysis of socio-economic determinants of educational attainment, Bils and Klenow's critical view on causality between education and growth, and Jones' integration of ideas and innovation into long-run growth models.

The synthesis offered in this paper suggests that human capital theories, while rooted in different eras and methodologies, converge on a shared insight: economic growth is increasingly reliant on intangible inputs. What differentiates countries and individuals is not merely access to resources or capital, but the ability to effectively mobilize, nurture, and apply human potential. In this context, the

study reaffirms the urgency of investing in human development—not just as a moral imperative, but as an economic necessity for sustained and inclusive growth.

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