T.C.

TURKISH-GERMAN UNIVERSITY

INSTITUTE OF SOCIAL SCIENCES

INTERNATIONAL FINANCE DEPARTMENT

THE EFFECT OF EDUCATION ON ECONOMIC GROWTH IN TURKEY

MASTER'S THESIS

Hayrullah Can ÖZCAN

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Prof. Dr. Kersten KELLERMANN

ISTANBUL, December 2022

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TÜRKİYE'DE EĞİTİMİN EKONOMİK BÜYÜME ÜZERİNDEKİ ETKİSİ

Bu tez, eğitimin ekonomik büyüme üzerinde bir etkisinin olup olmadığı sorusuna Türkiye örneği üzerinden cevap vermeyi amaçlamaktadır. Bu nedenle eğitimin beşeri sermaye artırıcı etkisi ve bu artışın üretkenlik üzerindeki etkisini belirlemek amacıyla literatür taraması ve Cobb-Douglas üretim fonksiyonundan türetilen model ile ampirik analiz yapılmıştır. Çeşitli araştırmacılar tarafından beşeri sermayeyi ölçmek için kullanılan ortalama eğitim süresine ek olarak, Birleşmiş Milletler tarafından yayınlanan İnsani Gelişme Endeksi beşeri sermaye ölçüsü olarak alınmıştır. 1990-2019 yılları arasında Türkiye örneğinde İnsani Gelişme Endeksi'nin ortalama eğitim süresine göre istatistiksel olarak daha anlamlı sonuçlar verdiği sonucuna varıldı. Sonuç olarak eğitimin ekonomik büyüme üzerinde olumlu bir etkiye sahip olduğu söylenebilir ancak elde edilen bulgulara göre beşeri sermaye ölçümünde kullanılan verilerin tahmin sonuçları üzerinde anlamlı bir etkiye sahip olduğu sonucuna da varılmıştır.

Anahtar Kelimeler: Beşeri Sermaye, Ekonomik Büyüme, Üretkenlik, Eğitim, Türkiye, Üretim Fonksiyonu

ABSTRACT

THE EFFECT OF EDUCATION ON ECONOMIC GROWTH IN TURKEY

This thesis aims to answer the question of whether education has an effect on economic growth with the case of Turkey. For this reason, a literature review and empirical analysis with the model derived from the Cobb-Douglas production function in order to determine the human capital-increasing effect of education and the effect of this increase on productivity were made. In addition to the mean years of schooling which is used by various researchers to measure human capital, the Human Development Index published by the United Nations was taken as a measure of human capital. It was found that the Human Development Index gave statistically more significant results compared to the mean years of schooling in the case of Turkey between the years 1990-2019. As a result, it can be said that education has a positive effect on economic growth, however according to the findings it has also been concluded that the data used in the measurement of human capital has a significant effect on the estimation results.

Keywords: Human Capital, Economic Growth, Education, Turkey, Productivity, Production Function

LIST OF ABBREVIATIONS

GDP: Gross Domestic Product

R&D: Research and Development

OECD: Organization for Economic Co-operation and Development

UNESCO: United Nations Educational, Scientific and Cultural Organization

HDI: Human Development Index

UNDP: United Nations Development Programme

MRW: Mankiw-Romer-Weil

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1. INTRODUCTION

The concept of considering the knowledge and skills of the individual as an asset -as human capital- can be observed back to the 18th century. Yet human capital is challenging to define and difficult to put into words, so that despite its long history, measuring human capital has continued to exist as an issue. Understanding and quantifying human capital and its effect on productivity is becoming increasingly important for scholars, policymakers to better understand what drives economic growth and the functioning of labor markets in order to assess the long-term sustainability of a country's development way and its performance and to measure productivity performance of the education sector (UNECE, 2016).

The role and impact of human capital in economic development differs depending on the level of development of the countries considered. For this reason, the aim of this study is to evaluate the suitability of the empirical analysis for Turkey, after examining the role of human capital in economic development theoretically. When the literature in Turkey is examined, the studies have been aimed at measuring the effect of human capital on economic growth. The effect of human capital in economic development has remained in the background and generally of a theoretical nature. Accordingly, our work in line with our aim becomes important because the impact of human capital in economic development is measured by empirical analysis.

Hypothesis is that education, as an important contributor to the society, has a positive impact on human capital and therefore on economic growth is a widely discussed topic in economics. Many empirical studies are supporting that hypothesis (Schultz, 1961). This master's thesis aims to make a contribution on the effect of education through human capital on economic growth with the help of increased productivity.

This master thesis focuses on the positive effect of an increase in human capital on labor productivity and economic growth in Turkey. Human capital especially that accumulated through education has been assessed as a vital driver of economic growth. Increased level of education leads to more qualified and efficient labor, which in return increases an economy's GDP per capita and its productivity. A great amount of human capital

enables all labor force to use and utilize advanced technology and innovation during production. The increase in human capital in an economy will attract an increase in physical capital and lead to an increase in production. The main aim of this study is to demonstrate that education through human capital influences significantly the labor productivity in a country within the context of a Cobb-Douglas production function. Findings of this study suggest that higher education level therefore human capital enhances the productivity following economic growth. Economic growth, education including human capital has been theoretically discussed in this thesis. A multiple regression analysis has been applied in order to investigate how and in which direction education affects the economic growth.

2. DEFINITION AND CONCEPT OF HUMAN CAPITAL

Many definitions of human capital have been made. Human capital is generally defined as the contribution of the sum of the knowledge and skills of the people participating in production in a country to the production power (Barro, 2001). According to Jim Saxton (2000), human capital is defined as the skills and knowledge acquired by individuals to increase their value in the labor market. Bartolo (2000), on the other hand, defined human capital as an evaluation of an individual's ability to generate income. According to the OECD (1998), the concept of human capital consists of the scope of knowledge, skills and other qualities that occur in individuals in relation to economic activities. In a broad sense, human capital can be defined as the total value of all skills and other skills that have cost an individual. In this context, human capital can be expressed as an indicator of the knowledge and skills of individuals, and the ability of individuals to learn from other individuals and adapt to changing conditions (Bartolo, 2000). After the concept of human capital emerged as a theory, Schultz (1961) defined human capital as one of the necessary and important factors for the economic growth of a country. Basically, the concept of human capital is defined by Barro (2001) as the sum of all positive values such as knowledge, ability and experience, which belong to the labor involved in the production process and enable both to obtain more efficiency from the remaining production factors and to use them more effectively.

The concept of human capital, which did not have much importance until the middle of the 20th century and had not developed enough arguments, became more and more

understandable with this period and started to take place in many studies. The inadequacy of the economic policy practices put forward by the generally accepted theories in solving the problems has also paved the way for new approaches with human capital to be considered. Until the 1800s, it was thought that only physical capital was productive in terms of economic development, but with the 1950s, the concept of human capital began to come to the fore in solving the problems faced by economies in terms of development. The endogenous growth theories, which emerged in almost the same period, also stated that human capital is a concept that supports economic development (Lucas, 1988).

Human capital is defined as the whole of positive values such as knowledge, skills, experience and dynamism, which belong to the labor force participating in the production process and allow other production factors to be used more efficiently and effectively. These values become a factor that increases economic growth by causing the invention, effective use and adoption of new technologies. In other words, these values contribute to the faster development of the country's economy (Sweetland, 1996). There are different approaches on the function and the significance of human capital in socio-economic development assumptions made in the literature, methods used and findings attained. For instance, according to Schultz (1961), who is one of the first theoretical contributors to human capital theory, human beings attain useful knowledge and skills over their lives. Still, it is not plain that these attained knowledge and skills are an element of capital that can be used in production. In western societies, human capital is defined as capital that is not specific to human beings, i.e. capital in the classical sense, which leads to faster and higher growth rates than capital in the classical sense. To put it another way, a significant portion of the growth rate in developed countries is justified by increases in human capital. This explains the humanitarian importance of capital more clearly (Schultz, 1961).

Saxton (2000) defines the of the concept of human capital; in order to increase the market value of the wages earned by individuals as a result of their work in the labor market, all kinds of skills, experience and knowledge they have gained. According to Bontis (2007), this concept is the sum of all the knowledge, skills, abilities and experiences that the company employees acquire individually and which includes the performance functions required for production. According to another definition, human capital; It is the most important production stock in an economy that produces and uses technology with the existence of a preventive and curative health system where social expectations are met, human rights are

developed, in other words, it has completed its development to a large extent (Van den Berg, 2013).

Frank and Bernanke (2007) define human capital as education, experience, in-service training, intelligence, energy, work habits, reliability and taking initiative sees it as a combination of factors affecting the marginal product value of the employee.

2.1. Fundamental Approaches and Contributions in the Literature

The history of the concept of human capital traces back to 1776, when classical economics emerged and later on, the concept has become a scientific theory. The first introduction of the concept of human capital to the economics literature was realized with the studies of Smith (1776), Mill (1848) and Marshall (1890). Today's concept of human capital was developed by Denison (1962), Schultz (1968) and Becker (1962).

Smith (1776), while defining the concept of human capital, made a distinction between unskilled labor and human capital, Smith (1776) stated that talented individuals not only earn income but also benefit society. In addition, emphasizing that labor is classified in two groups, one of them consists of labor force lacking education and experience, and the other consists of educated and skilled labor force, and it is suggested that uneducated and inexperienced labor force should be assigned to jobs that require physical power, and educated and skilled labor force should be hired to jobs suitable for their education and skills. Smith (1776) stated that the unskilled and skilled workforce should not be treated equally and their jobs should be properly separated, and emphasized that this is the only way to benefit from the productive power of labor. Smith (1776) defined human capital as a dynamic that produces and develops the capitalist system. He characterizes the division of labor and the law of accumulation, which constitutes human capital, as the primary factors of capitalist development. Before the industrial revolution, he views the division of labor as having a limited effect on sectors. While a product is produced by only one person, the production sector develops as a result of the factorization that emerged after the industrial revolution. These developments reveal the specialization of people in the production sector and the division of labor among people. With the development of the division of labor over time, the amount of output in production increases. According to Smith (1776), human capital, which is the source of technological development, division of labor and specialization, positively affects economic growth. As human capital accumulates and production increases, economic

growth will sustain.

Human capital can be classified in different ways according to the perspectives of academic fields. The very first of these classifications takes individual aspects into account. Schultz (1961) characterizes human capital as a kind of property, as opposed to the classical view of labor power, and makes human capacity a more important concept than all other forms of wealth. Many researchers accept this view because they see human capacity as the knowledge and skill that an individual has. The second classification is based on human capital itself and its accumulation. This perspective emphasizes the knowledge and skills obtained from compulsory education, education levels outside the scope of compulsory education, and activities such as vocational education or training. The most important shortcoming of this perspective is that people neglect the knowledge they have gained through their own experiences (Dae-Bong, 2009).

The third classification is based on the production-oriented human capital view. Romer (1990) mentions human capital as the main source of economic productivity. While Rosen (1999) states that human capital is an investment that people make in themselves in order to increase their productivity, as a result, human capital includes both an instrumental concept that produces certain values and an internal meaning that expresses self-renewal at the same time (Dae-Bong, 2009). In this context, human capital can be viewed as the sum of talent, knowledge and individual characteristics, which are considered to be of vital importance for producing economic value. In other words, human capital is the characteristics acquired by the workforce as a result of education, in-service training and experience that determine its quality.

Becker (1964), one the founder of the human capital theory, argues on the assumption of decreasing marginal utility of capital and land, growth through technological know-how expansion, which increases the productivity of work. This know-how is generated through human capital investments.

In classical economics, while capital covers real assets being used in production, the concept of capital has been redefined with human capital. With the influence of human capital, any material or non-material resource that provides a positive effect on production is accepted as capital. The creation of physical and human capital requires high costs. However, the investment on human capital is not only related to the production process, but also to

increase the quality of life through the quality of the individual. Another feature that distinguishes human capital from physical capital is that human capital is in a constantly changing structure and cannot be stockpiled. Any time that human capital is not used is considered as a loss. While physical capital is neutral to questions such as where or when it will work, human capital answers these questions itself (Schultz, 1972).

In addition to many theoretical researches, many analyzes have been made on this subject through various models in hundreds of empirical studies by using data such as education, health and GDP, by considering the relationship between human capital and economic growth in the literature process. Human capital plays an important role in macroeconomic models. The relationship between human capital investment and economic growth has been studied by Romer (1990) and Lucas (1988), among others. In its extension of using the Solow model, Romer (1990) shows that the rate of growth increases with the level of human capital economy increases. Human capital is the most important input factor to generate technological progress. Lucas (1988) also came to the conclusion that human capital investments lead to long-term growth. Human capital plays a crucial role in the theory of endogenous growth during the growth process. A neoclassical growth model is expanded to include human capital as an important input factor in the production process. Here, an increase in human capital can lead to a permanently higher level growth rate and the growth and development opportunities of an economy improve. Increased human capital leads to increases in productivity and improves the ability to innovate, for example by discovering new technologies or more efficient production processes (Sianesi & Van Reenen, 2003).

However, there is also a differentiated view here, which leads to contradictory results in certain sub-sectors. A recent study shows that that despite the increasing number of researchers, productivity in the scientific sector is decreasing. Despite the increasing intensification of research work, the growth rates of total factor productivity in the USA have been declining since 1940. It also suggests different 'thresholds' in individual countries have different levels of human capital stock (Bloom et al., 2020).

2.2. Education and Human Capital

The main factors in the formation and increase of the human capital stock are considered as human capital factors and these factors are expressed in five groups. Accordingly: (1) health services that have an impact on the life expectancy and vitality and

energy of individuals; (2) In-service training events organized by companies; (3) formal education at basic and higher education levels; (4) work programs for adults that include agricultural development programs, not organized by companies; (5) individual or family migrations to adapt to variable job opportunities. In fact, education and health are the most important of these categorized elements. The reason for this is that healthy, educated and well-equipped labor constitutes comprehensive and productive capital. Education is a key criterion in the development of human capital and is at the forefront. Therefore, it is a necessity to inform individuals, in other words, to educate them in terms of economic development and sustainability. Among the factors used in determining the level of education in a country; education records, education level, financial and physical criteria, and literacy status (Schultz, 1961).

Investment in people has three dimensions: nutrition, health and education. Health and nutrition are also important components of human capital, and a healthier worker can contribute more to the production process. When all other factors are taken into account, a society with a healthier workforce can produce more. The fact that a healthy person can learn more and more easily is an indication that health plays an important role in determining the return of education. In this way, health, on the one hand, will increase physical endurance; on the other hand, it will be able to increase the amount of production by obtaining more learning from education. Nutrition strongly linked to productivity, output, and economic growth and is considered a human capital investment. Especially from the point of view of economic growth, education and health support each other and being healthy, like being educated, is an important factor for economic growth (Qadri, 2011).

2.3. Education and Economic Performance

Education is the first service that comes to mind when it comes to investment in people, since it forms the basis of the development of human capital. Education investments, which are at an important point for developed and developing countries, increase the literacy rate of societies and increase their level of knowledge (Afşar, 2009).

Among one of the leading studies in education-economic growth literature, Barro (1990) stated the presence of a robust positive correlation between education and economic growth. Barro and Sala-i-Martin (2004) demonstrated that access to the education variable, measured by the mean years in secondary and high school, has a tendency to indicate a

significant relationship with growth. Pursuing formal education (early childhood, formal school system, adult training programs) but also informal and on-the-job learning and work experience all represent investment in human capital studies carried out in the 1980s reveal the importance of human capital on economic growth of knowledge and technology-intensive production (Barro, 2001).

Despite several studies expressing the relationship between education and economic growth, some studies have come into conclusion that there is no robust association between these two variables. Griliches (1997) emphasizes that there is none relationship between education and economic growth with his sensational insights. Although it is claimed that these contradictory results are derived from the low data set quality and measurement errors, however Griliches (1997) denies these claims. The reason given for this conflict is the absorption of human capital growth by the public sector the study.

There are many direct or indirect relationships between education and economy. Societies establish a relationship between the level of education and productivity, and argue that an individual can contribute to the society in which he lives according to the level of education he receives. According to the education they receive, individuals benefit the society by producing qualified goods and services (Çakmak, 2008). Education, which determines the economic, political and social development levels of countries, needs human capital to form the basis of economic growth.

Modern Theory accepts human capital as a factor that contributes significantly to economic growth. While defining human capital, it is striking that education has a fundamental role in the formation of human capital. Human capital accumulation is formed by formal education including primary, secondary and higher education, non-formal or on-the-job training. Informal education is possible by being employed in various organizations, participating in adult education programs or participating in various cultural, political and social groups and self-development is possible by using one's own initiative, attending various courses, reading and establishing informal communication channels (Awan, 2012).

2.3.1. Spillover

Educational economics, which has grown rapidly since the 1960s, has a history as a sub-discipline of economic theory and economic research. Many classical economists,

including Smith (1776), Marshall (1890), and Mill (1848), called education a national investment in the 18th and 19th centuries. However, the expression of investment in human capital and the relationship between education and the economy resumed in the United Kingdom and the United States in the late 1950s and early 1960s. The contribution of education to economic growth, the return of investment in education, the role of skilled labor in economic development, publications in the field of educational economics on extraordinary growth are studied on education, financing of education, income distribution and welfare level. Advanced economies such as Japan, Germany and the USA have reached the current level of development with their investments in human capital elements. As a consumption and investment, education contributes significantly to the economic growth. The positive effect of education on human capital which improves economic growth and productivity cannot be omitted. Education contributes to the growth of the economy by increasing the productivity of the workforce. The increase in productivity results in differentiation in the earnings of the workforce at different levels of education. Because of the positive relationship between education and wages, most policy makers see education as an impressive device that alleviates injustices and stimulates growth to improve the qualifications of the least educated population (Cholezas & Tsakloglou, 2005).

In addition to the benefits it provides to individuals, education contributes to economic growth with the externalities it creates socially. The level of education in a country is directly correlated with the qualified workforce. As the education level of individual's increases, the amount of qualified labor force in the country also increases. With the increase in the amount of qualified labor, the level of national income rises and justice is provided in the distribution of income. Countries with higher education levels are more stable politically and economically and have lower crime rates socially. Education expenditures, as investment expenditure, affect societies in the long run. In the long term, it increases economic growth by accelerating scientific and technological innovations in countries (Berger & Fisher, 2013).

Overall, education is a critical component of a country's human capital, increasing the productivity of each employee and helping economies move beyond the tasks undertaken in the value chain or simple production processes. In today's world, human capital is accepted as the most distinguishing feature of the economic system (WEF, 2016).

The importance of knowledge and learning has been recognized since the beginning of time. Plato said the importance of education "If a man neglects education, he will be crippled

until the end of his life.” Education refers to the development of human skills and knowledge of people or workforce. Expenditure on education, human capital and education of people due to their important contribution to economic development has been named as investment in human or human capital (Guru, 2020).

It is clear that without education, the necessary human capital for the material progress and enlightenment of a nation and citizen cannot be obtained. This makes it agreeable that the quality of a country's education determines its national level of development. It emphasizes that a nation develops in relation to its success in education. This explains why the contemporary world's attention is focused on education as a means of introducing nations to the world of science and technology and, as a result, in the hope of human progress in terms of living conditions and the development of the environment. Education is the basis of both the industrial development and moral renewal of economies. Education also fosters a culture of productivity. Individuals will also increase social efficiency by discovering the creative potentials within them, by applying existing skills and improving the technique of performing certain tasks. Education educates people to be useful to them and to the society in which they live. Education also develops values that ensure good citizenship in individuals such as honesty, self-sacrifice, tolerance, self-sacrifice, hard work and personal integrity, all of which form the rich structure in which good leadership potential is developed. Education trains an individual to be contributive to society (Kingdom & Maekae, 2013).

Another issue that should be mentioned about the characteristics of human capital is that “human capital” the concepts of “deepening of capital” and “expansion of human capital” have different meanings from each other. Here, "human capital deepening” means the increase in schooling rates in the education levels of the country, without the number of teachers per student decreasing. Human capital deepening provides higher quality education for individuals with smaller class sizes. The “expansion of human capital” means the schooling of the country. In order to increase the rates of education, higher number of students should be admitted to the existing education levels without consider the quality of education. What should be done for the countries is to deepen their human capital not expanding it. As a result, in terms of the characteristics of human capital, firms will invest in human capital in order to be more competitive. From the countries point of view, education policy is important both in terms of deepening and expanding human capital, especially in developing countries where the level of education is very low. While the expansion of human capital is more

important in the beginning process, as the level progresses, deepening the education becomes relatively more important. Undoubtedly, the deepening of human capital will be more on the agenda as countries and firms develop (Cypher, 1997).

Overall, education is a critical component of a country's human capital, increasing the productivity of each employee and helping economies move beyond the tasks undertaken in the value chain or simple production processes. In today's world, human capital is accepted as the most distinguishing feature of the economic system (WEF, 2016).

2.3.2. Turkish Education System

Pre-primary education is usually for children aged 36 to 72 months and is voluntary. Due to the voluntary participation in pre-school education, the participation rate is correspondingly very low. Nevertheless, it is advisable to enroll your child in pre-school, as it could be an advantage for a successful school education (Sirelo.de, 2022).

General education lasts 8 years and at the age of 6 the children are enrolled in a primary school. Compulsory education in Turkey starts from this point. Primary education is divided into two parts, elementary school and middle school. In the first part, subjects such as Turkish, math, a foreign language and a subject called knowledge of life (Hayat Bilgisi) are taught. Later, however, this is replaced by science subjects. In the second part of primary education, social sciences and Turkish history are added (Sirelo.de, 2022).

After successfully completing secondary school, secondary education begins. In general, this section is intended for young people aged 14-18 years. The high schools in Turkey try to give the students a high level of general knowledge and thus prepare them for their future professional or university life. At the end, all students have to take a final exam. If this exam is passed with good grades, it is considered admission to university (Sirelo.de, 2022).

If a private school is preferred, parents are obliged to bear the financial expenses themselves. Education in private institutions usually has a higher standard than in public schools but tend to be more expensive. In addition, the private schools are divided into:

- Any kind of private schools
- Private professional and technical training courses

- Private tutoring schools
- Study facilities for private students

If a student would rather do vocational training after general school education and has decided against going to school (high school), then the vocational training usually lasts between 3 to 5 years (Sirelo.de, 2022).

There are over 150 universities in Turkey and numerous courses are offered entirely in Turkish, German, French or English (Sirelo.de, 2022).

3. MEASURING THE PRODUCTIVITY AND GROWTH EFFECT OF HUMAN CAPITAL

Measuring the productivity and growth effect of human capital is **a** challenging topic in economics. Productivity can be defined as the relationship between the output and the use of input. In other words, it measures how efficiently production inputs such as labor and capital are used in an economy to produce a certain level of output such as GDP in economies. Productivity is considered a significant source of economic growth, welfare and competitiveness and provides therefore basic statistical information for many international comparisons and country performances assessments. Productivity growth is an important element for modeling the production capacity of economies (OECD, 2001).

Classical production factors required to obtain output at the end of the production process; physical and human capital, labor and natural resources. The inputs are brought together by the entrepreneurs at different rates and with the use of different technical knowledge. In addition, the increase in the quality of labor in working life through the trainings given both in schools and in the workplaces also supports the increase in the human capital of the individuals and therefore countries. With this dimension, the concept of human capital is all the knowledge and skills that labor utilizes.

Investments in the development of human capital can also have a positive effect on the growth process, as they also increase physical capital investments by creating a spillover effect. At the same time, investments in human capital protect the health of individuals first and then increase their income and support their education and skills with a chain effect. Thus, an in increase in the abilities of individuals brings along an increase in quality and efficiency in the production (Barro, 2001).

Theoretical contributions state different mechanisms regarding the effects of education on economic growth.

- First of all, education increases the human capital of the labor force, which results an increase in the labor productivity and economic growth for higher steady GDP levels.

- Secondly, education increases the innovative ability of the economy, know-how of new technological advancements, products and processes and therefore this increase stimulates growth according to internal growth theories (Hanushek & Woessmann, 2008).

When measuring productivity OECD uses “GDP per hour worked” as an indicator for productivity. “GDP per hour worked is a measure of labor productivity. It measures how efficiently labor input is combined with other factors of production and used in the production process. Labour input is defined as total hours worked of all persons engaged in production. Labor productivity only partially reflects the productivity of labor in terms of the personal capacities of workers or the intensity of their effort. The ratio between the output measure and the labor input depends to a large degree on the presence and/or use of other inputs (e.g. capital, intermediate inputs, technical, organizational and efficiency change, economies of scale). This indicator is measured in USD (constant prices 2010 and PPPs) and indices (OECD, 2022).”

Human capital and productivity is related with each other, according to Thurow (1970); human capital is an individual's productive ability, skills and is knowledge. Human capital is measured by the value of goods and services produced. The value of an individual's human capital is equal to the consumption value of the goods and services that an individual produced. While the accumulation of human capital especially increases the efficiency of physical capital, it also plays a stimulating role on technological developments. The technical knowledge that emerges with the combined use of physical and human capital accumulation will positively affect the increase in productivity and economic growth in the long term, and will contribute to the more functional economic policies to be implemented. However, in today's production conditions, physical capital investments, while still maintaining their importance, are a necessary but not sufficient factor on their own. In addition to the positive contributions of the qualified workforce/human capital reached as a result of the knowledge and experience gained throughout the working life and production process, to the economic activities, the remarkable increase in theoretical and empirical studies aimed at evaluating the effects of the said concept on development and this The results obtained from the studies reveal that human capital is an important criterion in the realization of economic development. The concept of human capital can be defined as all of the knowledge, skills and experiences that economic agents can use in production, supporting both their individual and

social development. Human capital, which has become one of the indispensable elements of the production function in recent years, has enabled the positive development of output quality in terms of both quantity and productivity. For the positive development of human capital; Investments made in the fields of education and health have also brought about increases in the speed of development. The realization of such investments in the private sector as well as the public sector contributes to the emergence of positive externalities in the economy (Thurow, 1970).

United Nations Development Programme (UNDP), measures the relationship between human capital and development of countries using the Human Development Index (HDI). The structure of the index includes; health, knowledge and life expectancy at birth, adult literacy rate, gross enrollment rate, and GDP per capita. Considering that the HDI index has quality aspects, the HDI approach focuses on the quality of life and economic status of all individuals. Moreover, the International Labor Office (ILO) tends to take advantage of the similar index, taking into account quality aspects such as the key indicators of the labor market. Therefore, assuming that the concept of development includes both quantitative growth and qualitative progress, the concept of 'human development' needs to be taken into account in the measurement of human capital (Kwon, 2009)

3.1. Main Empirical Studies

Several prominent empirical studies on the relationship between human capital and economic growth are included in this section.

In the Lucas (1988) growth model, private investments in human capital are the engine of economic growth. Countries with strong human capital show more economic growth than countries with weak human capital. Lucas growth model argues that unlike physical capital as the time devoted to human capital increases, the growth rate of human capital will increase continuously, and therefore human capital accumulation will not be subject to diminishing returns. Thus, the endogenous growth model based on human capital predicts that output per worker will increase at a rate equal to the growth rate of human capital without being subject to decreasing productivity (Lucas, 1988).

The concept of capital includes both physical and human capital. In terms of being an example of physical capital, it is possible to exemplify the establishment of a business, the

tools to be used in production, all kinds of valuable paper and money-like securities. What is meant by human capital, however, should be understood as the contribution made to the individual and all kinds of education provided. From this point of view, we can understand that it is not possible to achieve economic growth only by improving physical conditions. Becker, Murphy and Tamura (1990), in their article titled "Human Capital, Fertility and Economic Growth", stated that compared to physical capital, other human capital indicators and returns from education are higher in developed countries than in developing countries. According to Malthusian evaluations; the positive and stable relationship between GDP per capita and population growth explains the stable situation. Studies conducted in the following periods have shown that human capital has caused countries to grow faster, but the population growth rate of countries has been reduced (Becker et al., 1990).

The MRW model of growth expands Solow's growth model by adding the human capital concept (Mankiw et al., 1992). In this new form, the model is referred to as the expanded Solow growth model. Under a given human capital, the growth rate will increase at larger and smaller values of the savings rate (s) and population growth rate (n), respectively, which will pave the way for faster growth of human capital. Additionally, since human capital accumulation may be related to s and n, removing human capital from the model will make the estimation values of these variables biased. According to Mankiw et al. (1992), economies with different savings rates and population growth rates will have their own unique steady-state equilibrium and per capita income levels. Therefore, income differences are stable. The convergence process, on the other hand, can be achieved by keeping the determinants of the growth process of the countries under control. This is defined in the economic growth literature as conditional convergence (Barro & Sala-i-Martin, 2004). According to MRW (1992), if the capital in the original Solow (1956) model is redefined in the form of physical capital and human capital, a model that better fits the data of the world countries, except for the OECD countries, can be reached. For example, for 98 non-oil producer countries, the Solow model can explain 60%, while the MRW model can explain about 80% (Mankiw et al., 1992).

Jones (1996) brought together the Nelson and Phelps (N-P) (1966), Romer (1990), Mankiw-Romer-Weil (MRW) (1992), Benhabib-Spiegel (B-S) (1994) models and presented this model based on human capital, knowledge formation, economic growth and Research & Development relations. According to Jones (1996), Romer (1990) takes the technology

transfer that integrates knowledge and imperfect competition markets, N-P (1966) human capital and backwardness as the engine of growth. Mankiw et al. (1992) argues that the differences in the growth rate between countries are due to human capital differences, B-S (1994) is the relationship between human capital and growth with single or multiple regressions. Focusing on the relationship has helped to explain economic growth. However, when these models, which seem to be different branches according to the researcher, are combined in a single model, its primary role in growth and development can be better understood (Jones, 1996).

In Nonneman and Vanhoudt (1996) model, the MRW model is expanded by internalizing technological know-how. In a sense, the growth model is endogenous and the assumptions of the model are the same as in the MRW model. However, different capital inputs (such as infrastructure investments, equipment, other physical capital, human capital, and technological knowledge stock - know-how) are internal in the model. The assumptions such as externalities, diffusion process, imperfect competition or increased returns from technology in the new endogenous growth models are not included in this model. According to the test using OECD data, the Nonneman and Vanhoudt (1996) model can significantly explain the GDP differences in OECD countries as approximately 75% based on these three variables; physical capital, human capital and technological knowledge. However, this result was obtained around the steady state for each country. Relaxing the assumption that countries are close to their steady state, the results are almost the same as for the MRW. Unlike the MRW model Nonneman and Vanhoudt (1996) model, concluded that human capital is not very important in OECD countries (Nonneman & Vanhoudt, 1996).

In the Arrau (1989) model, households' incomes in limited time (lifetime) and human capital as a main element of the growth process are examined; however it neglects the intergenerational analysis. The model is created in a way that provides the basic facts of the long-term development process shaped by Kaldor (1957). According to Arrau (1989), human capital is the main driving engine of economic growth. As seen above, in some human capital models of the relationship between human capital and economic growth, it has been concluded that the effect of human capital on economic growth is positive, significant and strong. It is predicted that countries with strong human capital will show more economic growth than weak countries (Arrau, 1989).

Denison's (1962) growth approach was based on the Cobb-Douglas production

function and from this point of view; he investigated the relationship between development and education. In the growth accounting method used by Denison (1962), if economic growth is completely related to physical capital and labor, it will be possible to separate the growth rates into the components of these two variables. Denison (1962), who tried to explain the growth in the US economy between 1910 and 1960 with these two components, realized a large surplus value that could not be explained by physical capital and labor force. Denison's research has concluded that 23% of US economic growth can be explained by the increase in the education level of the workforce (Denison, 1962).

Barro (2001) also stated that human capital has a very important effect on economic growth and he has proven this with empirical evidence. Barro (2001); based on the initial level of GDP per capita and the policies of that country, he argued that those countries would grow faster if the duration of the individuals' school attendance is longer. According to Barro (2001), a low-income country tends to develop faster than a high-income country if it has more human capital than such countries usually do because there is a positive relationship between growth rate and human capital. Accordingly, the path for developing countries to catch up with developed countries is to invest in human capital since developed countries make high human capital investments per capita (Barro, 2001).

The growth effects of physical capital investments have been empirically investigated by Romer (1986). In his studies, it has been tested whether the share of investments in national income can be used to explain the growth rate. Since such a relationship does not exist in the neo-classical growth model, the presence of such a relationship will indicate the existence of positive externalities arising from physical capital investments, and the result is interpreted as physical capital determines growth. This kind of a relationship would be inconsistent in the context of the neo-classical growth model if the analyzes were made by assuming the economies were in steady state equilibrium. Because the increase in savings and investment rates in economies can create a growth effect only if the economy is not in steady state equilibrium. The growth rate increase that occurs in this way will stop and disappear after convergence occurs, that is, after the steady-state value is reached (Mankiw et al., 1992).

3.2. Meta-Analysis

Meta-analysis is a method of combining the results of more than one independent study on a specific subject and statistical analysis of the research findings. Meta-analysis

provides for varied researchers with quantitative methods that summarize the results of various studies and enables them to reach consensus by combining the results. In this section we will try to elaborate the meta-analyses finding on the growth effect of education through human capital (Abramson, 1994).

There are also various meta-analyses on the growth effect of education through human capital, which bring together several empirical research results on the topic. This meta-analysis attempted to reassess the growth effect of government spending on education as well as the growth effect of government spending on health.

I will briefly summarize the main results from three meta-analysis submitted by Churchill, Yew & Ugur (2015) and Benos & Zozon (2014). Churchill et al. (2015) uses a sample of 306 estimates drawn from 31 primary studies. Churchill et al. (2015) combined the results of different studies empirically examining the effect of government spending on education or health on economic growth to identify sources of heterogeneity among previous study results and obtain a more accurate calculation of effect size than in a single empirical study obtained. This meta-analysis study is relevant in application given the current debate about how different components of government spending affect economic growth. From a policy perspective, the results of the meta-analysis therefore suggest that education is a more important sector for stimulating growth than health sector. Therefore, to boost growth, education relative to health can be a key sector where public spending should be channeled in the context of severe government budgetary constraints or budget deficits. Furthermore, the positive growth effect of combined government human capital expenditure (i.e., government expenditure on both education and health) identified in this meta-analysis may imply that the positive effect of government human capital expenditure on economic growth may be largely caused by its impact to improved education and the positive spillover effects that public schools create (Churchill et al., 2015).

Churchill et al. (2015) uses a sample of 306 estimates drawn from 31 primary studies. The authors conduct an empirical synthesis of the link between economic growth and government expenditure on education or health. They find that the effect of government education expenditure on growth is positive. They explain the heterogeneity of the empirical results by factors such as econometric specifications, publication characteristics as well as data characteristics. The overall 31 weighted averages for all 237 significant estimates are found to be 0.0828. This result means that government education spending has a positive

effect on economic growth (Churchill et al., 2015).

Another meta-analysis made by Benos & Zotou (2014) which combines 57 studies with 989 estimations demonstrates the positive growth effect of education. The summary statistics of the studies included shows an overall median of 0.0183. This result means that 50% of all studies show total effect of the education variable on growth below 0.0183. Although this meta-analysis indicates publication selection for accepting the papers with positive growth effects of education, nonetheless the results infer the positive effect of education on economic growth. In this study in which researchers identified and listed the publications investigating the association between education and development using meta-analysis, observed that education mostly had a positive effect on welfare (Benos & Zotou, 2014).

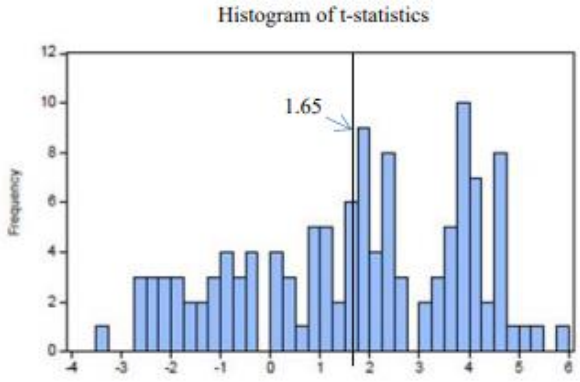

Figure 3.1. Quantitative measures of human capital can be statistically insignificant as well

(Source: Botev et al., 2019)

The Figure 3.1 shows t-statistics of 123 coefficient estimates of quantitative measures of human capital collected from various studies authored or co-authored by Barro. A t-statistic greater than 1.65 indicates that the coefficient estimate for the human capital variable is positive and statistically significant at the 10% level. 67 coefficient estimates are positive and statistically significant at the 10% level. 14 coefficient estimates are negative and statistically significant at the 10% level. The rest 42 coefficient estimates are not statistically significant. Despite the fact that majority of empirical studies regarding human capital are statistically significant, there are also number of empirical studies with insignificant findings that cannot be overlooked (Botev et al., 2019).

3.3. Studies for Turkey

Education's effect on economic growth in Turkey is a subject with various studies and among these studies results generally support the positive growth effect of education. Pata (2020) conducted a study to observe the effect of education on economic growth for Turkey over the period of 1960-2018. In his research it has been found that a 1% increase in the number of university graduates increases economic growth by 0.27%. The coefficient of the number of vocational high school graduates is also positive. However, the coefficient of vocational high school graduates is statistically insignificant and quite low. For this reason, the findings show that university graduates contribute to economic growth in Turkey, while vocational high school graduates are not effective enough in the production process (Pata, 2020).

There are other studies for Turkey that aim to investigate the causality between education and economic growth. This particular study attempts to investigate the relationship with 2006-2015 period data and the education expenditures in Turkey and the economic growth that occurred in the same period. In this study, the effect of education expenditures on economic growth in Turkey was examined within the framework of the data covering between the 2006-2015 years. When the studies on this subject are evaluated, it has been seen that although physical capital is necessary for economic growth, however it is not sufficient on its own, and besides physical capital, investment in human factor also contributes to economic growth by creating a multiplier effect. In the study, it was seen that the developments in education positively affect the economic growth in Turkey and as a result of the tests conducted, there was a bilateral causality between education expenditures and economic growth. Additionally, the empirical results confirmed the positive relationship between growth and education expenditures in the long term. It can be thought that increasing education spending and improving education levels in Turkey can contribute positively to the country's welfare and productivity level and thus to its economic growth (Uçan & Yeşilyurt, 2016).

Yeldan (2012) aims to decompose the growth dynamics of the Turkish economy. With the help of an endogenous growth model, he investigated whether the public policy makers should support human capital costs or they should support R&D investment costs. He found that long-term accumulation of human capital ultimately accelerates R&D activity. Consequently, of such a long-term expectation, with the sufficient increase in the number of

R&D researchers, R&D production increases again and accelerates economic growth. As a result, the most important finding of the model is that the positive results expected from a public incentive program based solely on education investment are weakened in the medium-long term. Under these observations, it seems more appropriate to aim for a hybrid program by combining the government resource support strategy with education incentives in the short-medium term, combined with the subsidies of R&D investments in the medium-long term (Yeldan, 2012).

4. EMPIRICAL APPLICATION FOR TURKEY

4.1. The Production Function Approach

Using aggregate production function approach, early studies of Denison (1962, 1964) and Griliches (1964, 1970) showed that education could enter as an important variable (input) in the production function analysis of economic growth. Later Bowman (1964), Psacharopoulos (1973), Denison (1979), Marris (1982), Tilak (1986), Benavot (1989), Lau et al. (1990), World Bank (1993), Tilak (2003), Fuente and Ciccone (2003), Égert, and Gal (2017) and Botev et al. (2019) found evidence that education is positively associated with productivity and economic growth. This study finds that a strong positive relationship exists between investments in human capital and economic growth. In the cited studies several alternative specifications of functional forms are estimated and most of them gave robust results.

The framework used in this thesis relies on a production function, where GDP depends on the multifactor productivity (MFP), the physical capital stock K, labor L and human capital H.

(1) $$\boldsymbol{Y = AF(K, L) = AK^{\alpha} H^{1-\alpha} = AK^{\alpha} (hL)^{1-\alpha}}$$

MFP is denoted A

The labor productivity y measured as output per labor unit is given by

(2) $$\boldsymbol{y = \frac{Y}{L} = k^{\alpha} (A^{\frac{1}{1-\alpha}} h)^{1-\alpha}}$$

with

(3) $$\boldsymbol{lny = lnA + \alpha lnk + (1 - \alpha) lnh}$$

We are interested in the productivity enhancing effect of human capital. In the following we assume, that human capital h has two properties:

- First, it is a private input.
- But it can simultaneously be considered as one of the determinants of multifactor productivity MFP. The idea behind this assumption is, that human capital leads to spillover effects in the sense, that when the average human capital endowment of workers increases multifactor productivity increases too and all factors become more productive. If higher education is associated with human capital spillovers, a social return to education is generated. The modern theory of endogenous growth emphasizes explicitly the externalities of education.

However, the spillover effect and thus the elasticity of A with respect to h depend potentially on the number of workers. The size of the economy reflects on the overall innovation enhancing environment of an economy in which human capital spillover can take effect:

(4) $$\boldsymbol{A = F(h)}.$$

The productivity effect of human capital is given by the first deviation of the production function with respect to h:

(5) $$\boldsymbol{\varepsilon_{h/y} = \frac{\partial lny}{\partial lnh} = \frac{\partial lnA}{\partial lnh} + \varepsilon}$$

To describe the conditional nature of the mechanism by which the variable h transmits its effect on the variable y a data-analytical strategy is used that was termed by Hayes (2013) "conditional process analysis". It allows, to explicitly showing the mediation effects and thus suggests itself as a handy tool for our analysis. Below we interpret the human capital variable h as the independent variable (IV). The labor productivity $\boldsymbol{y}$ is the dependent variable (DV). The production function describes a direct effect from h to $\boldsymbol{y}$ and an indirect effect from h to $\boldsymbol{y}$ through A – the multifactor productivity (MFP) that can be interpreted as a mediator. The diagram of this direct and indirect effect can be seen below Figure 4.1.

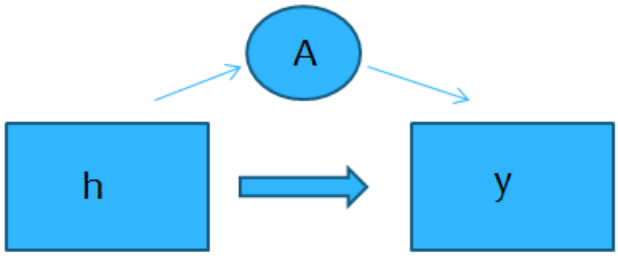

Figure 4.1. Direct and indirect effect diagram of h and y through A

"A" represents the multifactor productivity; "h" represents human capital and "y" labor productivity.

In our case the assumed causal link occurs between human capital "h" (IV) and the average labor productivity "**y**" (DV). An economy with a higher endowment of human capital realizes higher productivity levels with respect to labor productivity. The relevant question is whether the causal effect between two variables operates through a third variable called mediator. Is there any evidence that the productivity effect is (partly) explained by the mediating influence of "A"? In this case the productivity effect can be divided into a direct productivity effect and indirect productivity effect.

(6) $$\varepsilon_{h/y} = \frac{\partial lny}{\partial lnh} = \underbrace{\frac{\partial lnA(h)}{\partial lnh}}_{indirect/mediator\ effect} + \underbrace{(\varepsilon)}_{direct\ effect}$$

The mediation model is depicted in figure 1. It shows that h exerts its effect on labor productivity $\boldsymbol{y}$ via a direct and indirect pathway. The direct effect links h to **y** independent of A and can be measured after controlling for A. The indirect (mediating) effect links h on **y** through the intermediary variable A (MFP).

We apply a specification, with

(6) $$\boldsymbol{lnA = \delta_1 lnh}$$

So that

$$lny = \underbrace{\delta_1 lnh}_{lnA=lnMFP} + \varepsilon lnh + \alpha lnk$$

holds. This productivity effect of human capital is given by the partial output elasticity of h $\varepsilon_{h/y}$. Analytically it is simply derived from the first deviation of the production function with respect to h:

$$\varepsilon_{h/y} = \frac{\partial lny}{\partial lnh} = (\varepsilon + \delta_1)$$

4.2. How to Measure Human Capital?

The measurement and comparison of human capital can be challenging. Therefore, economists rely on some substitutes, such as years spent in the schooling system, rates of enrolment in education and literacy (OECD, 2022). In this study as a measure of human capital both "mean years of schooling" and "human development index" has been used in order to test which variable is more suited to the model. According to the OECD (1998) study, there are generally three approaches in estimating human capital accumulation. In the first approach, the highest level of education completed by an individual is used as a measure of human capital accumulation, and other human capital qualifications are not considered. In the second approach, direct tests are conducted to determine whether individuals have the qualifications prescribed for economic activities. The difficulty in the tests includes qualities that are difficult to measure sum of it, such as attitude and motivation. In the third approach, there are differences between the earnings of individuals in return for quality to estimate the total value of human capital accumulation. It has been suggested to give a monetary value to human capital accumulation by looking at the 12 equivalents of the measured qualifications in the labor market. Because of the difficulty in measurement and calculation, the first approach is generally preferred in applied studies. Meanwhile, it is also stated that in practice, in addition to education, indicators related to health and migration are also used to measure human capital accumulation.

Various indicators are used to measure human capital. In determining the human capital indicators, it is seen that more emphasis is placed on education. Since education is the basis of the knowledge and abilities of individuals, human capital is generally expressed with

education indicators. It is claimed that education is the indicator that most affects human capital accumulation. The main reason for this might be the difficulty in measuring the effect of other factors affecting human capital. However, the increase in knowledge that will be achieved as a result of adding new knowledge to the knowledge of existing labor is possible with investments in human capital. For this reason, the most effective investment that will increase the efficiency of human capital is investments in education. Therefore, among the human capital inputs, the most important one is education (OECD, 2022).

There are some international criteria used in the evaluation of the level of education and this education service given to the society, which is of significant importance in terms of both human capital and economic development. Accordingly, the criteria used in the evaluation of the education level of societies are; mean years of schooling, literacy and enrollment rates, the share allocated to education and training from national income, the number of personnel in educational institutions (such as teachers and technical staff), the number of students, etc. It is possible to list the criteria. When the education indicators are considered, schooling rate, teacher/student ratio per school and education expenditures stand out. These variables are indicators used to show the development level of a country. Education plays a significant role in the economic development of the country. The increase of qualified and educated people in the country is directly proportional to the development of the country, and the return of education is not limited to the economy (Dae-Bong, 2009). We can list these returns as follows:

- With the well-education of people, not only their own time, but also future generations are positively affected by this situation. With better education of current generations, future generations will earn more income and live a more comfortable life.
- A well-trained workforce can be more adaptable to the job and provide professional fluidity.
- While the efforts of those in the employment market to seek better, to research and to increase their skills in this direction, naturally, new developments are emerging in technology.
- It enables individuals to become conscious of their social responsibilities, and this reduces individuals' committing crimes.
- It ensures the transmission and nurturing of cultural values.

- It ensures the dissemination of democratic upbringing and encouraging participation by creating common sense in individuals.

Another important element of human capital is health. The ability of people to receive education and engage in economic activity only depends on their health. Therefore, investments made in the field of health are of great importance in the development of human capital. Birth, death and total fertility rates, infant mortality rate, life expectancy at birth, ratio of health expenditures to GDP and per capita health expenditures etc. It is among the most important health indicators used in international assessments. Although health is also a component of human capital it has not been included in our model (Dae-Bong, 2009).

4.3. Data

The limitation for this study is that, the data used has a narrow range which is from the years between 1990 and 2021. Unfortunately, such an analysis would require more observations to reach significant outcome. In order to exclude the effects of COVID-19, all analyzes were made with data between years from 1990 and 2019. As data we used "mean years of schooling" from the source Global Data Lab that represents "h" and Human Development Index values from the source UNDP that represents "hdi" to measure the human capital. As a measure of productivity that represents "y" OECD's GDP per hour worked has been used. Data measures "K" the capital stock have been collected from IMF. All dataset covers the time period 1990-2019 and is valid for Turkey.

Variables		Description	Data Source	Time Period
GDP per hour worked	y	"GDP per hour worked is a measure of labor productivity. It measures how efficiently labor input is combined with other factors of production and used in the production process. Labor input is defined as total hours worked of all persons engaged in production. This indicator is measured in USD (constant prices 2010 and PPPs) and indices."	OECD	1990-2019

Mean years of schooling	h	“It is the average number of completed years of education of a population.”	Global Data Lab	1990-2019
Capital stock	K	“It is the sum of public, Private and public-private partnership (PPP) capital stock (constructed based on PPP investment flows "ippp_rppp"), in billions of constant 2017 international dollars.”	IMF	1990-2019
HDI value	Hdi	“It is the summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions.”	UNDP	1990-2019

Table 4.1. Variables Used in Analysis

Year	Mean Years of Schooling	GDP Per Hour Worked (Productivity in USD)	HDI	Capital Stock
1990	4,5	22	0,6	1964
1991	4,6	21,3	0,604	2038
1992	4,6	22,1	0,61	2115
1993	4,7	24,8	0,617	2194
1994	4,8	22,1	0,618	2276
1995	4,8	23,1	0,625	2362
1996	5	23,9	0,633	2451
1997	5,1	25,8	0,641	2545
1998	5,3	25,9	0,652	2644
1999	5,4	24,2	0,655	2744
2000	5,5	26,2	0,67	2849
2001	5,6	24,7	0,674	2959
2002	5,7	26,3	0,684	3074
2003	5,8	28,1	0,69	3190
2004	6	30,6	0,695	3312
2005	6,1	32,6	0,7	3436
2006	6	34,1	0,71	3565
2007	6,1	35,9	0,717	3699
2008	6,2	35,8	0,721	3838

2009	6,3	34,3	0,728	3983
2010	6,5	35,2	0,749	4083
2011	6,7	37,1	0,762	4241
2012	7,3	37,9	0,769	4479
2013	7,5	40,5	0,799	4716
2014	7,7	40,4	0,809	5008
2015	7,6	42,1	0,817	5311
2016	7,8	43	0,823	5669
2017	8	45,1	0,833	6022
2018	8,1	46,2	0,839	6406
2019	8,1	48	0,842	6768

Table 4.2. Dataset Used in Analysis

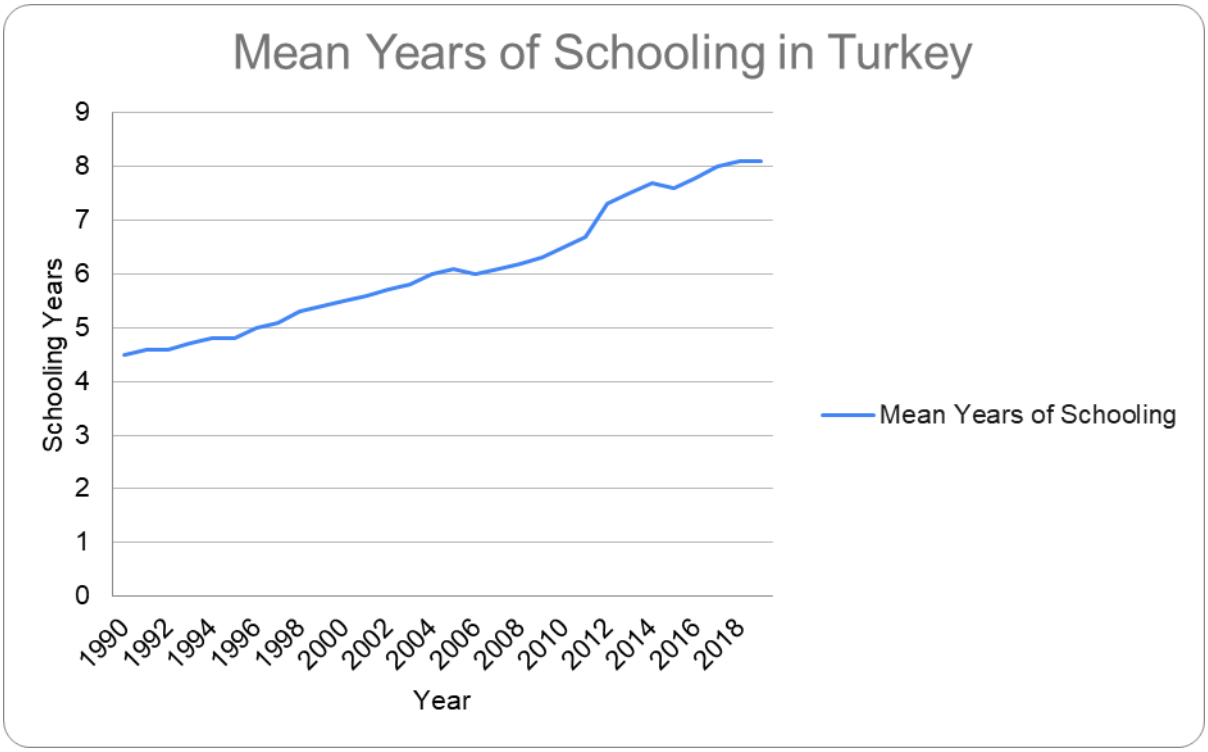

Figure 4.2. Mean Years of Schooling in Turkey

(Source: Global Data Lab)

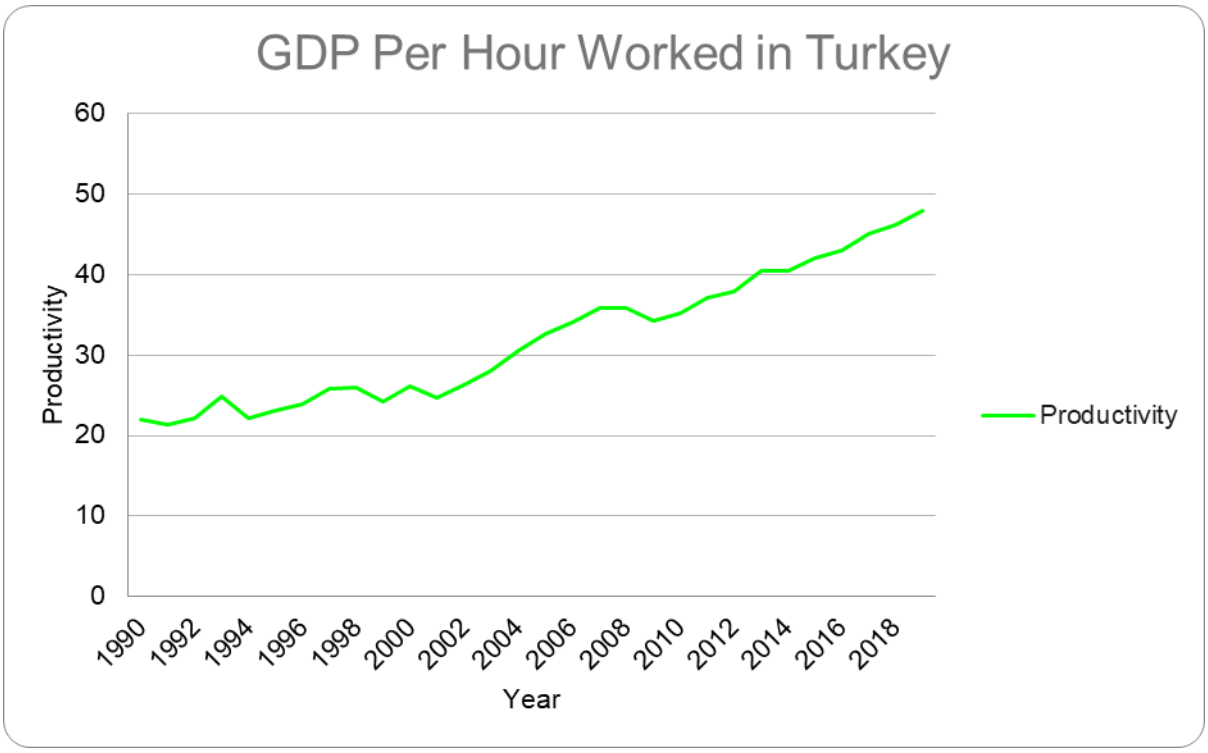

Figure 4.3. GDP per Hour Worked in Turkey

(Source: Global Data Lab)

Figure 4.2. shows the mean/average years of schooling in Turkey. The increasing trend can be seen. The graph starts with value 4,5 in 1990 and ends with slightly over 8 years in 2019. Figure 4.3. shows the OECD's productivity indicator that is "GDP per hour worked" for Turkey between 1990-2019 time periods. After slightly stagnating in 1990s the increasing trend in productivity can be seen. After the stagnation in 1990s, it can be said that only interruption in the productivity growth in Turkey is the Financial Crisis of 2007-2008. The productivity data that has been used is in terms of US dollars rather than Turkish liras. The reason for taking US dollar data is to exclude the disruptive effect of high inflation in Turkey (especially during 1990s) and in Turkish Lira. The graph above starts with 22 dollars in 1990 and ends with 48 dollars in 2019.

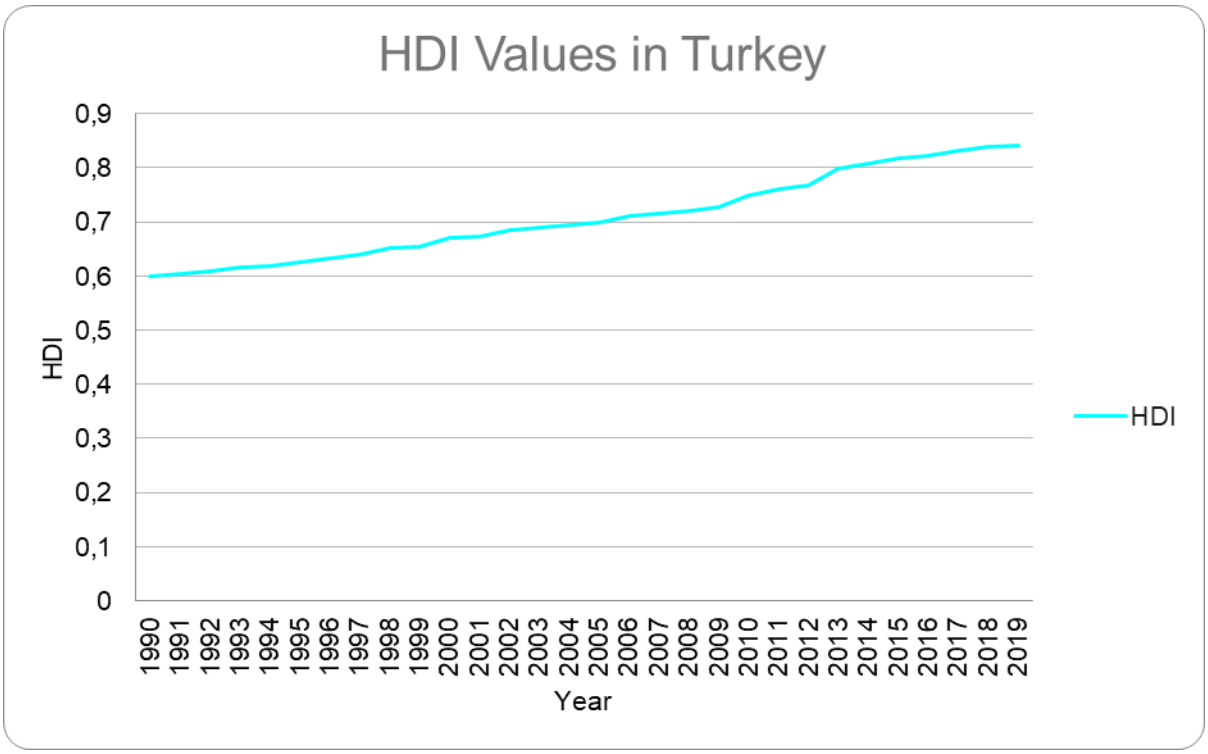

Figure 4.4. HDI Values in Turkey

(Source: UNDP)

Figure 4.4. above shows the UNDP's "Human Development Index" values for Turkey between 1990-2019 time periods. Without any major interruption the increasing trend in HDI can be seen. The graph above starts with value 0,6 in 1990 and ends with value 0,84 in 2019.

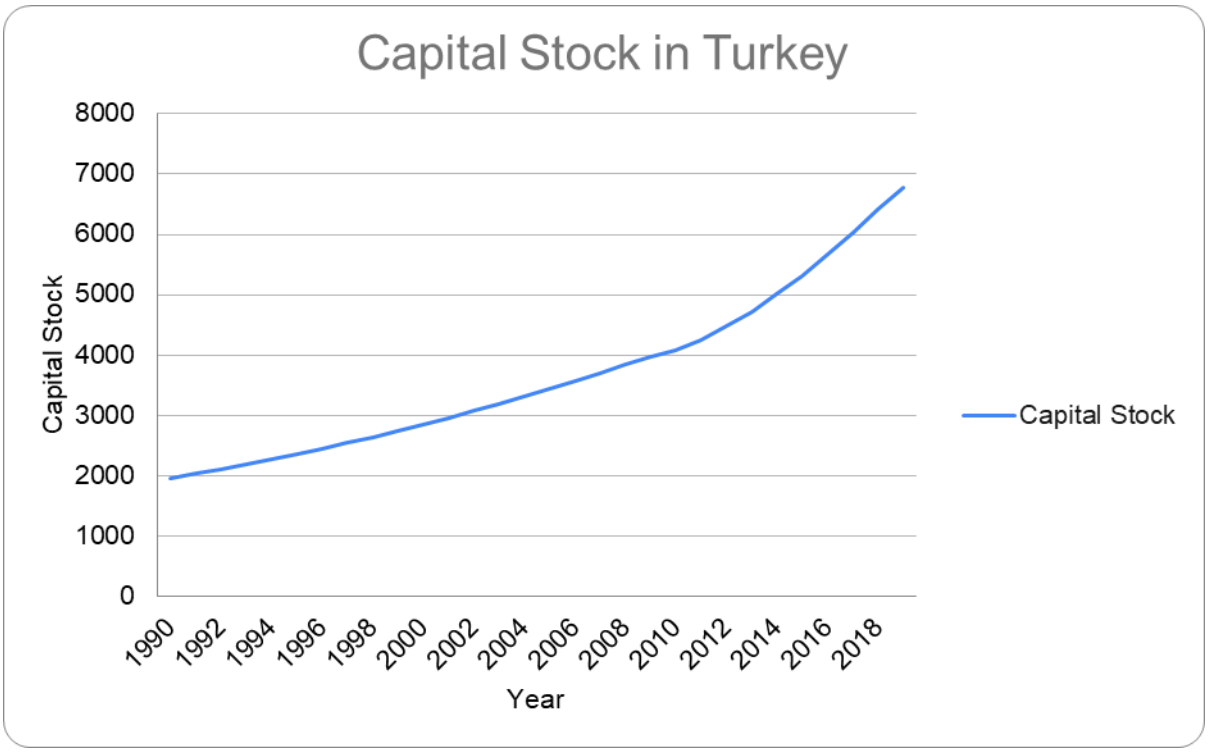

Figure 4.5. Capital Stock in Turkey

(Source: IMF)

Figure 4.5. shows the IMF's "Capital Stock" values for Turkey between 1990-2019 time periods. Without any major interruption the increasing trend in capital stock can be seen. The capital stock data that has been used is in terms of US billion dollars. The reason for taking US dollar data is to exclude the disruptive effect of high inflation in Turkey (especially during 1990s) and in Turkish Lira. The graph above starts with 1964 billion dollars in 1990 and ends with 6768 billion dollars in 2019.

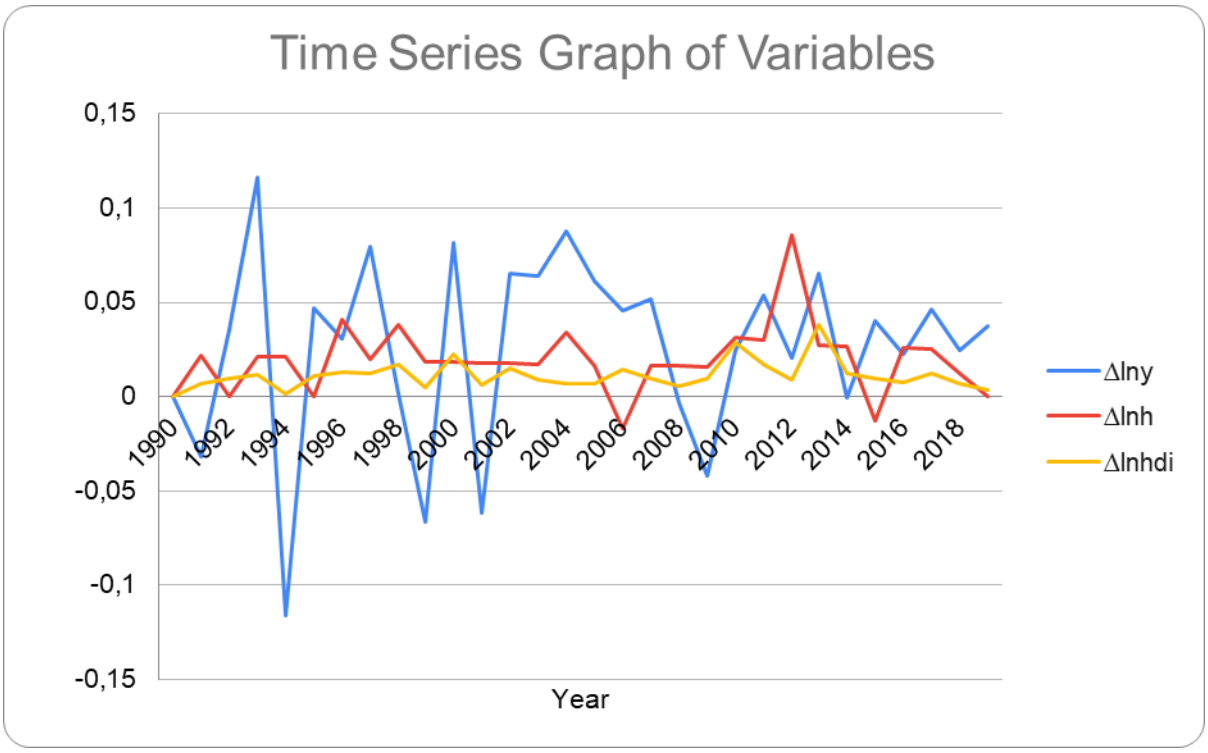

Figure 4.6. Time Series Graph of Variables Used in Our Analysis

(Source: Own Tabulations)

Figure 4.6. shows the variable values, which have been used in our analysis for 1990-2019 time periods. All values are calculated through taking natural logarithm (ln) and first difference of the raw data that has been presented in Table 4.2.

4.4. Estimation Approach

GDP per hour worked (y), physical capital stock (K) and human capital stock (h) data for the period 1990-2019 were used to investigate the effects of physical and human capital on productivity in Turkey and to calculate output elasticity. A multiple regression analysis has been run in order to explain the relationship between the dependent variable and independent variables. All analyzes were performed with the help of IBM SPSS Statistics 26 program.

The depicted mediation process can be translated into a statistical model. The first components of the indirect effect, is represented by the path from h to A. The estimation equation can be derived from equation (7). The second component is the path from A to y, and derived from equation (4):

(8) $$\Delta lnA_{i,t} = \mu_{1,i} + \delta_1 \Delta lnh_{i,t} + u_a$$

(9) $$\Delta \boldsymbol{lny}_{i,t} = \boldsymbol{\mu}_{2,i} + \boldsymbol{\delta}\Delta \boldsymbol{lnhA}_{i,t} + \boldsymbol{\varepsilon}\Delta \boldsymbol{ln}h_{i,t} + \boldsymbol{\alpha}\Delta \mathbf{ln}\boldsymbol{k}_{i,t} + \boldsymbol{u}_{\boldsymbol{b}}$$

The coefficient $\boldsymbol{\delta}$ is restricted, with $\boldsymbol{\delta}$ =1. From (8) and (9) a reduced form regression can be derived. Here, only the total effect of h on y can be deduced.

Here, only the total effect of h and K on y can be estimated. As it can be seen from the equation (1) above the first difference of natural logarithm of all variables (y, h, and K) are taken. In the equation (10) "mean years of schooling" data as a measure of human capital has been used.

(10) $$\Delta \boldsymbol{lny}_{i,t} = \left(\boldsymbol{\mu}_{3,i} + \boldsymbol{\alpha}\Delta \mathbf{ln}\boldsymbol{k}_{i,t}\right) + \boldsymbol{\theta}\Delta \boldsymbol{lnh}_{i,t} + \boldsymbol{u}_{\boldsymbol{ab}}$$

In the equation (11) all data are the same with equation (10) except "h" which is mean years of schooling has been substituted with "hdi" that is an abbreviation for Human Development Index.

(11) $$\Delta \boldsymbol{lny}_{i,t} = \left(\boldsymbol{\mu}_{3,i} + \boldsymbol{\alpha}\Delta \mathbf{ln}\boldsymbol{k}_{i,t}\right) + \boldsymbol{\theta}\Delta \boldsymbol{lnhdi}_{i,t} + \boldsymbol{u}_{\boldsymbol{ab}}$$

4.5. Results

The regression results for equation (10) are presented below in Table 4.3. & Table 4.4.

Tests of Between-Subjects Effects

Dependent Variable: Δlny

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	,000[a]	2	,000	,062	,940	,005
Intercept	,001	1	,001	,223	,640	,009
Δlnk	,000	1	,000	,054	,817	,002
Δlnh	,000	1	,000	,076	,785	,003
Error	,073	26	,003			
Total	,094	29				
Corrected Total	,073	28				

a. R Squared = ,005 (Adjusted R Squared = -,072)

Table 4.3. Univariate Analysis of Variance for Equation (10)

The univariate analysis of variance results for the model of equation (10) can be seen in Table 4.3. The r-squared value for equation (10) is 0,005. It means 0,5% variance in the dependent variable that can be explained by the independent variable. It is a quite low r-squared value for a regression model.

	Coefficient	St. error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	,020	,043	,473	,640	-,068	,109
Δlnk	,225	,963	,233	,817	-1,755	2,204
Δlnh	-,150	,546	-,275	,785	-1,272	,972

Table 4.4. Regression Estimator Results for Equation (10)

The regression estimator results for equation (10) are presented above in Table 4.4. The coefficient of Δlnk is positive with 0,225 and the coefficient of Δlnh is negative with -0,150. However both of these coefficients do not infer any relationship since p-values for Δlnh and Δlnk are both above 0.05 which means both estimators are statistically insignificant.

Tests of Between-Subjects Effects

Dependent Variable: Δlny

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	,012[a]	2	,006	2,607	,093	,167
Intercept	,001	1	,001	,306	,585	,012
Δlnk	,001	1	,001	,234	,633	,009
Δlnhdi	,012	1	,012	5,158	,032	,166
Error	,061	26	,002			
Total	,094	29				
Corrected Total	,073	28				

a. R Squared = ,167 (Adjusted R Squared = ,103)

Table 4.5. Univariate Analysis of Variance for Equation (11)

The univariate analysis of variance results for the model of equation (11) can be seen in Table 4.5. The r-squared value is 0,167. It means 16,7% variance in the dependent variable

that can be explained by the independent variable. Equation (11) model's r- squared value is significantly higher than the model of equation (10).

	Coefficient	St. error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-,024	,043	-,553	,585	-,111	,064
Δlnk	,428	,885	,483	,633	-1,391	2,246
Δlnhdi	2,762	1,216	2,271	,032	,262	5,261

Table 4.6. Regression Estimator Results for Equation (11)

The regression estimator results for equation (11) are presented above in Table 4.6. The coefficient of Δlnhdi demonstrates the positive relationship between human capital and productivity with 2,762. The p-value for the independent variable Δlnhdi is 0,032 and that means the estimator of HDI is statistically significant.

The coefficient of Δlnk shows the positive relationship between capital stock and productivity with 0,428. However, the p-value for independent variable Δlnk is 0,633 that are above 0.05 which means the estimator of capital stock is statistically insignificant.

5. CONCLUSION

In addition to physical capital, human capital is the most important factor behind the world's present achievements. When we examine the development processes of the world throughout history, we see that the human element is always at the forefront. The most important features that distinguish humans from other living things are that they are intelligent and creative. Therefore, human beings have made new inventions and discoveries over time by using their minds, being productive and shape the century we live in at the age of information technology. Today, the peak of the quality of human capital has had a great impact on both the development of information technology and in all areas of social transformation such as education and health.

Human capital with the help of education is recognized to increase the productivity and therefore generates higher income (Bartolo, 2000). Education’s positive impact on human capital, as a stimulator for economic growth is a widely discussed and empirically supported thesis (Schultz, 1961). The key features of OECD and advanced developed countries in terms of competitiveness are their investments in human capital. This shows that as a necessity brought by the 21st century information and technology age, it is important to give the deserved importance to human capital and to educate more qualified, educated and healthy individuals. Investment in education is one the most important element of increasing the quality of human capital. Because the more educated, healthy and longer the people of a country live, the more they can contribute to themselves, their families, the country and the world they live in. Otherwise, the fact that people are uneducated and unhealthy causes great costs for the society and the country in every aspect. Like all developed countries, Turkey also needs qualified human capital for its growth, development and progress. In order to achieve welfare, there is a need for well-trained and capacity trainers as well as well-equipped educational institutions.

The basic element of every phase of life, family, society and states is human. Therefore, people are a country's true wealth and source of human capital. In the measurement of human capital, literacy rate, education in the working process, different education levels of the population, mean years of schooling, school enrollment rates, education expenditures in GDP and education investments etc. Indicators such as these have been used as measurement tools in many studies. In addition to these indicators Human Development Index published

statistically by the United Nations Development Program (UNDP) is an alternative when measuring human capital stock of a population. In this respect, Turkey also needs to establish its public policy in calculating the Human Development Index (HDI), produce and present the statistical data used in an accurate and up-to-date manner, and deliver it to UNDP in a timely manner.

In this thesis the education's effect on economic growth in Turkey with the help of Cobb-Douglas production function approach has been both theoretically and practically investigated. Data from various sources such as IMF and UNDP has been used in order to measure productivity, physical capital stock and human capital stock. Equation (10) and equation (11) models have been derived from the Cobb-Douglas production with a distinction for human capital measure. Equation (10) uses mean years of schooling to measure human capital and equation (11) takes HDI to measure human capital stock to estimate education's effect on economic growth. It has been found that in Turkey's case HDI as a human capital measure is a better statistically significant estimator than mean years of schooling. The effect of education on economic growth is positive from the analysis results that have been generated. The analysis results can be base for further advanced studies that uses a larger data set with more countries, longer time span and more variables or indicators. The limitation regarding this study is the data used has a narrow range which is from the years between 1990 and 2019. Additionally a further analysis with more variables in it would give a more reliable conclusion regarding the effect of education on economic growth in Turkey

However, it would be a controversial conclusion to say that education has no significant effect on economic growth. The analysis concludes that there is a statistically significant positive effect of education through human capital on productivity and economic growth in Turkey when HDI has been used as a human capital measure. As a result, in order to become a more productive and competitive country, it is necessary for Turkey to increase the level of human capital stock by investing in education and health. In a further step, empirical evidence for HDI's economic growth estimation for other countries could be researched.

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APPENDIX

A1. Economic Growth Models

While evaluating growth models as part of the historical process, it is more accurate to count the classical growth models first. However, in the light of the progress in these years, it would be useful to consider the commercialization and physiocracy periods as milestones of classical growth models. Some economics scholars see the classics as protagonists of economic growth, while others endorse the Harrod-Domar model. In the studies conducted in the following years, the neoclassical growth theory is accepted as the basic growth theory and other studies are not taken into account. When evaluated according to various economic writers such as Barro and Sala-i Martin, Aghion and Howitt see classical economists as sources of economic growth. It is widely accepted from contemporary economists, that Adam Smith as the first advocate of endogenous growth theory, which is a high economic miracle model. Solow states that there have been three trends in growth theory in the last 50 years. Former; Harrod-Domar, and the latter are called neoclassical growth models. Finally, growth theory started as a response to the shortcomings of the neoclassical model, which is known today as the endogenous growth model (Solow, 1994).

A1.1 Neoclassical Economic Growth Model

The neo-classical growth model is revealed by Solow's 1956 article, "A Contribution to the Theory of Economic Growth". Solow's growth model assumes the existence of a uniform and stable equilibrium in the capitalist market system and an understanding dominated by individualism, rationality and perfect competition. In the Solow model, the return to measure taken as fixed, the marginal size of capital, the consideration and consideration of equipment made up of technology considered exogenous—requirements of the investment class (Solow, 1956).

In the Solow growth model, the value of capital accumulation per capita in the economy is found by subtracting the depreciation from total investments. All economies reach steady-state equilibrium, where investment equals per capita depreciation. In economies below this equilibrium, investments increase to a state of equilibrium as they will exceed the depreciation. On the other hand, in economies above the equilibrium point, it decreases

towards the equilibrium level due to the increase in the depreciation rate. Regardless of the conditions for all economies, there is a single and stable level of equilibrium at which they will all converge. Savings and technological development increase the productivity of labor and affect capital accumulation positively, while population affects capital accumulation negatively (Solow, 1956).

In the neo-classical growth model, technology is not involved in the model and is thought as external. It is believed that the technological capacity of the countries is equal with each other. The growth rates of the economies of developed and developing countries will approach the same value in the long run and this assumed growth rate is zero. In this convergence hypothesis, it is estimated that developing countries will reach to the same level with developed economies. As convergence hypothesis suggests, there is a capital flow from developed countries with greater capital level to developing countries with fewer capital level. Interest rate differences among various countries encourage the flows of capital from developed to developing countries. Along this process, international capital movements eliminate the differences in interest rates, causing the real growth rates of countries to approach zero and converge to each other with time (Mankiw et al., 1992).

The actualization rate of the convergence hypothesis in the neo-classical growth model seems to be very low, and additionally the fact that the capital flows only between developed countries raised questions about the model's accuracy. Most of the time this model overlooks some factors in perfectly competitive markets, such as lack of competition in the markets, externalities and increasing returns affects significantly the economic growth. Accepting the technological development as an externality raised the arguments towards the model (Mankiw et al., 1992).

According to Barro and Sala-i-Martin a way to increase the capital share is the capital share is to include human capital to the model. In other words, an increase in the human capital contributes positively to the production and thus to the GDP growth (Barro & Sala-i-Martin, 2004). In the augmented Solow model Mankiw, Romer and Weil human capital has been included to the production function additionally to the physical capital. The augmented Solow model estimates that the steady-state level of GDP per capita is positively affected by investment in both physical and human capital (Mankiw et al., 1992).

A1.2. Endogenous Economic Growth Model

Although the neoclassical growth model provides valuable insights into the analysis of the state of emerging economies, some results have been unsatisfactory. While the Solow model minimizes the effect of capital accumulation on growth, it maximizes the effect of technology on development by connecting the technological factor with the phenomenon of economic growth. However, since the concept of technology is assumed to be an external phenomenon in the Solow model, the Solow model could not fully express how economic growth occurs. These remarkable shortcomings in the Solow model have also prepared the ground for a new understanding (Aghion & Howitt, 1998,).

In traditional growth models, factors affecting economic development such as knowledge, human capital, R&D activities and technological development have been accepted from the outside. With endogenous growth models, these factors have been internalized and provided a different perspective on the factors that make up economic growth. These elements were included in the system and endogenous models emerged (Aghion & Howitt, 1998).

It can be grouped under four headings. Endogenous growth theories that bring a different meaning and perspective to economic growth;

- Romer Model (Knowledge Production)
- AK Model (Technology-Capital)
- Research and Development Model (R&D)
- Public Policy Model (Barro).

A1.2.1 Romer Model

In his article published in 1986, Romer did not use the neoclassical production function, but instead used a production function based on increasing yields. He rejected the law of diminishing returns with this function and argued that continuous growth would occur in the long run. In other words, as the stock of physical and human capital increases in the long run, the output (output) ratio also increases. In addition, Romer argued that it is not necessary for the level of output per capita to converge between countries and used the concept of "total capital stock" instead of the concept of "capital per capita". Romer, technological development in his article; It is defined as the increase in new knowledge and knowledge stock that enables a more efficient production (Romer, 1986).

In the model, it is stated that there is an increasing return on the use of existing knowledge and a decreasing return on the emergence of new knowledge. In addition, it has been stated that investments in knowledge will create "positive externalities" in the production of other companies due to the spread of knowledge, there will be a continuous increase in the efficiency of knowledge and knowledge can grow infinitely. “In the model, externalities increasing returns in output production, decreasing returns on production of new knowledge are brought together, and a competitive equilibrium is established in which externalities exist despite increasing returns. The existence of externalities is thought to be a necessity to establish a balance and to assume decreasing returns in the production of new knowledge to prevent the consumption and benefits of individuals from growing too fast” (Romer, 1986).

A1.2.2 AK Model

The first and simplest of the models that emerged upon the examination of economic growth in endogenous growth models is the AK model. The production function of this model, in which there is no technological progress, that is, externally accepted, is expressed as Y=A.K. Y is the amount of output, A is a positive constant representing the level of technology in this model, and K is capital. The law of diminishing returns does not apply in the AK model. Due to the fact that the technology level (A) is fixed, as the amount of capital (K) increases, the marginal efficiency of the capital remains constant instead of decreasing. In the AK model, technological development is considered external, and the factor that increases economic growth is considered to be physical and human capital. Capital investments cause an increase in the marginal return on capital. Therefore, each investment in capital causes a continuous increase in economic growth. AK-type models have linked the economic growth process to factors such as population growth rate, investment and savings rate, and stated that public policies may have an impact on growth as a result of directing them to savings and investments (Lucas, 1988).

A1.2.3 Research & Development Model

R&D Model simply suggests that R&D expenditures are an important variable to the production in an economy. In other words, R&D activities stimulates technology and

innovation on various sectors and with the help of growth the welfare of an economy will be improved. Romer explored the implications for growth adding learning-by-doing in innovation and thus he developed a model that delivers long-run growth at an endogenous rate (Romer, 1990).

A1.2.4 Public Policy Model

Public policy model simply suggests that government expenditures are an important variable to the production in an economy. In other words, public services stimulate the economic growth through various investments such as education and infrastructure expenditures. Barro (1990) explored the implications of government public services for GDP per capita growth can both be lacking or excessive depending whether these public services productive or non-productive.

A2. The Theory of Economic Growth

From the very beginning economic growth theory has been among one of the most discussed topic in the science of economics. In this chapter economic growth theory will be argued under subtopics such as the concept of economic growth, elements of economic growth, and economic growth models.

A2.1 The Concept of Economic Growth

The increase in the amount of goods and services produced in a country over time and the continuous increase in the real gross domestic product are expressed as economic growth. In order for the increase in the GDP to be called growth, this increase should be a continuous increase, not a temporary one. Economic growth is the only way to continually increase the quality of life that people living in an economy. In this context, achieving rapid economic growth is one of the main macroeconomic aims of all countries.

The accuracy for the measurement of GDP has been widely debated on points such as inflated assets effecting GDP or measuring labor services accurately. Additional criticisms regarding that the GDP does not measure the quality of life, sustainability, education quality or equality of opportunities. The GDP, which is accepted as the best possible measure of economic performance, is expressed as the market value of all final goods and services produced in an economy in a certain time period. GDP is measured in two ways: nominal and

real. Nominal GDP is the monetary value of the final goods produced within a country's borders in a given year at the market price of the year in which they were produced. While part of the increase in nominal GDP is the increase in the amount of goods and services produced, the other part may be due to inflation due to the annual price increase. The real GDP, on the other hand, is the value of the final goods produced within the borders of a country in a given year and it is calculated over the base year market prices. Real gross domestic product is nominal gross domestic product after adjusting for inflation. Real product, unlike nominal product, is a size that removes the effect of differences in market prices over time on the market value of produced goods and services, and reflects the change over time in the amount of goods produced in a country in one year (Mankiw, 2009).

Economic growth has meaning and importance for developed countries, developing countries and underdeveloped countries. Although GDP per capita is high in developed countries, it has been observed that GDP per capita is low in underdeveloped countries. When we express economic growth as the increase in national income in a certain period, it becomes important to bring together the production factors that will cause income increase under appropriate conditions. Therefore, the resources required to increase the production volume and the development of policies to ensure the efficient use of these resources, as well as the research of ways to achieve sustainable growth, constitute one of the fields of economics (Ay et al., 2013).

A2.2 The Nature and Elements of Economic Growth

Although there are various opinions about the reasons for the increase in economic growth, the sources that are effective in growth can be grouped under four main headings as population and labor, capital, natural resources and technology. The explanation of economic growth and the sources of economic growth is an important point for decision makers in order to determine economic policies. In addition to providing economic growth, making this growth permanent is an issue that countries should focus on. At this point, firstly in order to achieve economic growth, the variables that make up economic growth should be explained. Since economic growth is expressed as the continuous increase in the amount of goods and services produced in a country, all the factors involved in this process can be shown as the source of economic growth. These factors can be listed as population and workforce, capital, natural resources and technology (Herber & Engel, 1991).

The function of the factors of production involved in the economic growth process is expressed as follows:

$$Y = f(L, K, T)$$

In the function, Y is GDP; L is the amount of labor involved in the production process, K is capital, and T is technology. It is significant to elaborate the two types of capital:

$$\boldsymbol{Y = Ak^{\alpha}h^{\beta}}$$

According to Cobb-Douglas production function "k" is physical capital per unit of effective labor and "h" is human capital per unit of effective labor.

The effects of these factors on the economic growth rate are examined under the following headings.

A2.2.1 Labor

The fact that labor force is a scarce factor of production, it makes it more effective to participation of half of the society's population in production; in other words, female labor force participation. Various empirical researches have examined the positive impact of female labor force participation on economic growth. An increase in the female employment effects positively growth of GDP and GDP per capita (Pimkina, S. & de La Flor, L., 2020).

A2.2.2 Capital

Types of goods, which are generally long-lasting and can be used many times during the production phase thanks to this feature, constitute the capital. The task of capital goods in production is to increase the productivity of the labor factor, and this is possible when workers use capital goods as a tool in production. The amount of goods that societies can use as capital in a certain period of time is limited. The limited amount of goods used in a certain period of time constitutes the capital stock of the society. The size of the capital stock expresses the intensity of use of capital goods per worker as the most important source in the development of national economies. The fact that workers have capital goods at the production stage is important in terms of increasing the amount of goods they will produce per unit time. Capital, which has a great impact on production, plays an important role in the

increase in the welfare, employment and economic growth levels of countries (Saygılı et al., 2005).

It is possible to analyze capital by dividing it into two as physical and human. Physical capital, which is one of the important sources of economic growth, includes real assets such as machinery, equipment, transportation and communication networks, and industrial equipment used in production. It is all of the human-made tools used to facilitate production. Human capital, on the other hand, is defined as the knowledge, skills and experiences emphasizing the human quality in general, enabling the more effective use of the workforce and other production factors. These knowledge and skills play an important role in increasing the welfare level of countries by enabling the development of new technologies. In this way, national economies can develop faster. Since human capital focuses on the quality of human beings, features such as education, health, nutrition and population are also considered among the factors affecting human capital (Easterly & Wetzel, 1989).

A2.2.3 Technology and Innovation Development

Another factor that plays an important role in the development and growth of countries is technology. Technology refers to all the organization, knowledge and techniques required in the production process. In order to provide more production with fewer workers, developed countries have focused on developing qualified individuals who can make progress in technological development by investing in education. Technological development is explained as being able to produce more with the same amount of input or in a shorter time. Technological development enables to use the available input more effectively. While the demand for qualified labor increases as a result of technological development, the national economy gains momentum in growth with the new technology (Ahmadlı, 2020).