T.C.
YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS
M.A PROGRAMME IN ECONOMICS

M.A THESIS

THE ROLE OF HEALTH IN ECONOMIC GROWTH

ÖZDEMİR TEKE
14729021

THESIS ADVISOR
Ass.Prof. HASAN AĞAN KARADUMAN

İSTANBUL
2017

T.C.
YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS
M.A PROGRAMME IN ECONOMICS

M.A THESIS

THE ROLE OF HEALTH IN ECONOMIC GROWTH

ÖZDEMİR TEKE
14729021

Tezin Enstitüye Verildiği Tarih: 10/08/2017
Tezin Savunulduğu Tarih: 11/09/2017
Tez Oy Birliği ile Başarılı Bulunmuştur.

	Unvan Ad Soyad	İmza
Tez Danışmanı	: Yrd.Doc.Dr. Hasan A.Karaduman	
Jüri Üyeleri	: Yrd.Doc.Dr. Tuna Dinç	
	Doc.Dr. H.Gökhan Akay	

ISTANBUL
September 2017

ÖZ

SAĞLIĞIN EKONOMİK BÜYÜMEDEKİ ROLÜ

Özdemir Teke
Ağustos, 2017

Sürdürülebilir ekonomik büyüme beşeri sermayeye oldukça bağılıdır. Daha iyi sağlık koşulları, beşeri sermayenin de kalitesini etkiler. Sağlık göstergeleri de beşeri sermayesi için iyi bir gösterge olabilir. Bu çalışmanın amacı, sağlığın uzun dönem ekonomik büyüme üzerindeki etkisine ışık tutmaktır. Bu çalışmada, panel en küçük karelerer yöntemi kullanılarak, gelir ve coğrafi bölgelre göre sınıflandırılan seçilmiş ülke gruplarında sağlığın uzun dönem ekonomik büyüme üzerindeki etkisi çeşitli kontrol değişkenleri de dikkate alınarak incelenmiştir. İlk modelde ortalama yaşam beklentisi 1960-2014 arası dönemler için sağlık göstergesi olarak kullanılmıştır. İkinci modelde ise kişi başına düşen sağlık harcamaları büyümesi 1995-2014 arası dönemler için sağlık göstergesi olarak kullanılmıştır.

Anahtar Kelimeler: Ekonomik Büyüme, Sağlık Ekonomisi

ABSTRACT

THE ROLE OF HEALTH IN ECONOMIC GROWTH
Özdemir Teke
August, 2017

Sustainable economic growth depends heavily on human capital. It is also well-established that higher quality of health affects the quality of human capital. And health indicator can be considered as a good proxy for human capital. The purpose of this study is to shed some light on the empirical nature of the health role on the long-run economic growth. In this study, two different models are used to see health role on the long-run economic growth using panel least squares method with fixed effects by considering various control variables for the selected group of countries that are classified by income group and geographic region. In the first growth regression, life expectancy is used a health indicator over the period from 1960 to 2014 with 10-year average. In the secong growth regression, health expenditure per capita growth is used as a health indicator over the period from 1995 to 2014 with 5-year average.

Key Words: Economic Growth, Health Economics

ACKNOWLEDGEMENTS

I would like to thank the people who have helped and supported me not only throughout my thesis but also for making my work in the university more pleasant. I am grateful to my thesis advisor, Dr. Hasan A.Karaduman, Department of Economics, Yıldız Technical University for his continuous support and encouragement. He always carefully reads numerous drafts of my thesis, and assess them with many excellent suggestions.

I would also like to thank Dr.Tuna Dinç for their valuable comments and suggestions. I am also grateful to all resarch assitants of the depatmant of Economics, Yıldız Technical University for their patience and their help at vaious stages of my thesis.

Finally and most importantly, my speacial acknowledgement and sincere thank go to my family, my son Cihangir and my wife Seda who found countless ways to suppor tmy efforts to be an academician. None of this accomplishment would be possible without their understanding, encouragement, devotion and love. Without doubt, this thesis will be dedicated to them.

Istanbul; 29 July, 2017 Özdemir Teke

CONTENTS

Page No

ÖZ ..... **iii**

ABSTRACT ..... **iv**

ACKNOWLEDGEMENTS ..... **v**

CONTENTS ..... **vi**

LIST OF TABLES ..... **viii**

LIST OF FIGURES ..... **ix**

LIST OF ABBREVIATIONS ..... **x**

1. INTRODUCTION **1**

2. HEALTH AND ECONOMIC GROWTH: CONCEPTUAL AND THEORETICAL FRAMEWORK **4**

2.1. Health and Economic Growth: Conceptual Framework 4

2.1.1. The Effect of Health on the Economic Growth 4

2.1.2. International Comparison of Health Expenditures 8

2.1.3. International Comparison of Life Expectancy and Preston Curve 14

2.2. Health and Economic Growth: Theoretical Framework 17

3. HEALTH AND ECONOMIC GROWTH: EMPIRICAL LITERATURE REVIEW **21**

4. HEALTH AND ECONOMIC GROWTH:EMPIRICAL FINDINGS **37**

4.1. Data and Empirical Methodology 37

4.1.1. Data and Empirical Methodology for Model 1 38

4.1.2. Data and Empirical Methodology for Model 2 41

4.2. Empirical Results 44

4.2.1. Empirical Results for Model 1 44

4.2.2. Empirical Results for Model 2 49

5. CONCLUSION **55**

6. REFERENCES 57
7. APPENDIX 62
7.1. Country List for Model 1 and Model 2 62
7.2. Descriptive Statistics by Geographic Region for Model 1 63
7.3. Descriptive Statistics by Geographic Region for Model 2 65
8. RESUME 68

LIST OF TABLES

Page No

Table 1: Comparative Statistics of Health Expenditure Per Capita in 2013 9

Table 2: Literature Review 21

Table 3: Descriptive Statistics for All Countries for Model 1..... 38

Table 4: Descriptive Statistics for High-Income Countries and Upper-Middle Income Countries for Model 1 38

Table 5: Descriptive Statistics for Low-Income Countries and Lower-Middle Income Countries for Model 1 39

Table 6: Descriptive Statistics for All Countries for Model 42

Table 7: Descriptive Statistics for High-Income Countries and Upper-Middle Income Countries for Model 2 42

Table 8: Descriptive Statistics for Low-Income Countries and Lower-Middle Income Countries for Model 43

Table 9: Regression Results for Model 1 44

Table 10: Regression Results for Model 1 by Income Classifications 46

Table 11: Regression Results for Model 1 by Regions 48

Table 12: Regression Results for Model 2 49

Table 13: Regression Results for Model 2 by Income Classifications 51

Table 14: Regression Results for Model 2 by Regions 53

LIST OF FIGURES

Page No

Figure 1: The Relationship Between Health and Economic Factors… 5
Figure 2: Average Health Expenditures Trends by Income Groups 10
Figure 3: Average Per Capita GDP Trends by Income Groups 11
Figure 4: Average Health Expenditures Trends by Regions 12
Figure 5: Average Per Capita GDP Trends by Regions 12
Figure 6: The Relationship Between HEPC and Per Capita GDP 13
Figure 7: The Original Preston Curve 15
Figure 8: 1990 Preston Curve 16
Figure 9: 2010 Preston Curve 16

LIST OF ABBREVIATIONS

EAS : East Asia
ECS : European and Central Asia
GDP : Gross Domestic Product
GDPPC : Gross Domestic Product Per Capita
GFCF : Gross Fixed Capital Formation
GMM : Generalized Method of Moments
GNP : Gross National Product
HEPPC : Health Expenditures Per Capita
LCN : Latin America
LFP : Labor Force Participation
MEA : Middle East annd North Africa
NAC : North America
OECD : Organization for Economic Co-operation and Development
OLS : Ordinar Least Square
PLS : Panel Least Square
SAS : South Asia
TFP : Total Factor Productivity
WDI : World Development Indıcators
WHO : World Health Organization

1. INTRODUCTION

Having a healthy workforce and population is crucial for the survival and development of the communities and nations. Societies and countries that are composed of healthy individuals become the propulsive force of development and growth. Health status is directly linked to both human welfare and whole population welfare. Health status is also an important source of better income. Because other production factors have an absolute limit. For example, the land is limited in the world. Capital can be increased with the current capital scale. Human power is the easiest factor to possess, but it is the most costly factor for effectiveness. At this point, the health of the individuals becomes very important. Because community's health passes through individual health. So, human capital is also a production factor. For this reason, production factors especially human capital need to be improved. In the past, the abundance of human power was enough for production, but today human power requires additional features. So, these characteristics can be obtained with health and education. Moreover, health can affect growth with many mechanisms such as worker productivity, education, demographic structure of a country, labor supply, savings and investment, and longer lifespan. The countries which have higher human capital are more developed and prosperous. The importance given to human capital is the importance attached to education and health in developed countries.

Hence, the relationship between economy and health is the center of numerous research. In these studies, it is observed that improvements in economic indicators affect health indicators positively, besides it is also noted that the improvements in health indicators contribute economic growth. In the related literature, the most common economic and health indicators are gross domestic product, gross domestic product per capita, life expectancy at birth, fertility rate, crude death rate, infant mortality, health expenditures, and health expenditures per capita. So, in this study health expenditure per capita and life expectancy are used as health indicators.

Health expenditure per capita is used as a health indicator because sufficient health expenditure per capita is one of the prerequisite for all countries to have

sustainable economic growth. All of the developed countries allocate a significant percentage of their resources to health investment and health care sector for its vital role in economic development and economic growth. Because improving health services also means that improving human capital. In a sense, health expenditures or health investments are considered a productive investment. However, according to WHO (World Health Organization) statistics, total World health expenditure was US$ 6.9 trillion. In OECD countries the average health expenditure per capita was estimated $4735 in 2014. Whereas, in low and middle countries the average health expenditure per capita was estimated $267 in 2014. Also, 9.9 % of the gross domestic product was spent on health in 2014 in the all of World. There exist significant differences between countries total expenditure on health as a percentage of GDP. In underdeveloped countries, this rate was around 3-5 %, in developed countries ranges from 8 to 12%.

Life expectancy is used as a health indicator in this study. This measure it is used in the most of the studies of cross country comparison because of its corrections and accuracy in the measurement of the health level. As Preston (1975) noted first, there is a great correlation between life expectancy and per capita GDP. So, countries with having higher life expectancy also have higher per capita GDP. Life expectancy at birth has been increasing for the last 60 years, but there is still a gap in life expectancy between high-income and low-income countries. For example, life expectancy at birth is 71 in all over the world, 82 in Australia, 81 in Denmark whereas it is 52 in Cote D'Ivoire and 55 in Mozambique in 2015.

My study attempts to investigate the relationship between economic growth and health indicators such as life expectancy and health expenditures, by considering measures of various control variables and by using panel data methods, in the selected group of countries are classified by income and geographic regions.

The organization of this study is as follows. In chapter 2, the conceptual and theoretical relationship between health and the long-run economic growth is discussed and the international comparison of health expenditures and life expectancy are explained in detail. The Solow growth model, the theories of human capital growth models, and other essential growth models are presented in also chapter 2. The literature review which contains empirical studies of health-economic growth relationship is discussed in chapter 3. The data and the econometric method of this

study and the econometric results of the estimated regressions are discussed in chapter 4. Last chapter 5 is conclusion part. Some extra information about data and countries used in this study are also found in Appendix part.

2. HEALTH AND ECONOMIC GROWTH: CONCEPTUAL AND THEORETICAL FRAMEWORK

2.1. Health and Economic Growth: Conceptual Framework

2.1.1. The Effect of Health on the Economic Growth

Education and health are two important factors that play a major role in the development of human capital qualitatively. Besides education is the primary element of the human capital, the level of health of the society is also another important source for development and protection of the community. There is a close relationship between population health and economic development. Countries that have reached economic development at a certain level allocate more and more their resources to health. With the higher health level of societies, the workforce is used efficiently, and it has a positive effect on the development of the country because of the increasing total output. So, health is a direct impact on income and welfare of society, workers productivity, labor force participation, saving rates and other human capital indicators.

A society with a higher level educational attainment, and as well as improving health status, uses more actively their qualified workforce for the development and the growth of their country. The skilled workforce brings an increase in productivity and production, so the income of the country begins to grow. An increase in income leads to increase in saving, economic and social development, and all of these increase the welfare of the society. With the increasing income, the quality of life increases significantly. Although they are low-income countries, there are significant results regarding life expectancy and life quality in these countries where regular health services are provided. This is an important indicator of how crucial health is for communities.

Many empirical studies state that simultaneous investment in education and health have positive effects on the course of economic development. Mushkin (1962) states that health and educated individuals are more active as producers and consumers in the society. However, when a healthy person is educated, the effect of education is

becoming more evident. Another important point is that it is possible to benefit from these education investments for a long time. Because, a healthy people have a longer life span, and they have longer working life, and they will not lose much of their productivity. Mushkin (1962) also states that education and health are complementary with each other, so countries have to invest health as well as they do for physical capital and education investments. However, this is a little bit complex issue to assess education effect on health. Because children education and health have long run effect on productivity. This effect will have occurred may be 40 years later, so it is hard to construct a successful macroeconomic relationship between indicators.

Bloom and Canning (2000) state that better population health means increased national income. Because higher income provides better health via good nutrition, safe water, and sanitation. Moreover, also people access quickly to qualified health care. They also state that health could be not only an outcome but also a cause of high income.

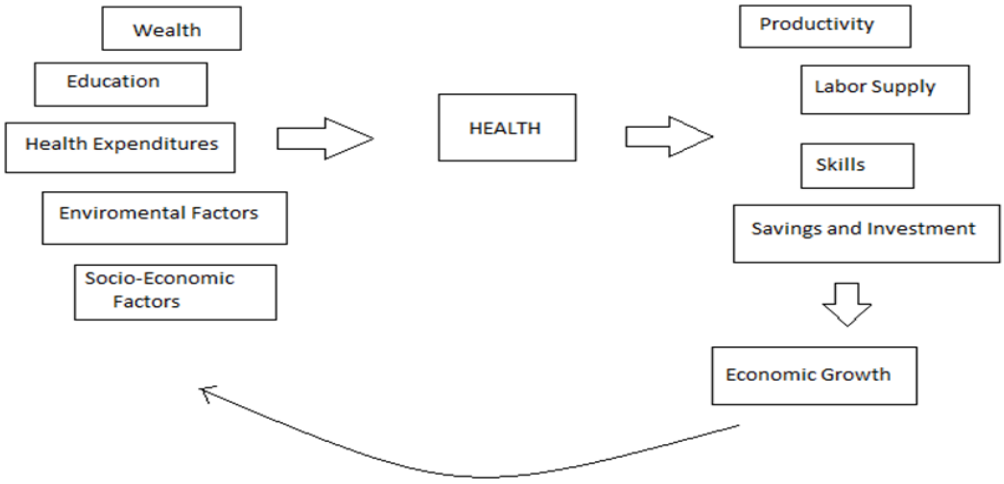

Figure 1: The Relationship Between Health and Economic Factors

Source: Suhrcke, Marc, et al. *The contribution of health to the economy in the European Union*. Luxembourg: Office for Official Publications of the European Communities, 2005.

Bloom et al. (2001) suggest that health can be useful for economic growth in high-income countries by way of using four channels: higher productivity, higher labor supply, higher labor skills and greater savings for the investment of physical and intellectual capital. These four channels are shown in right-side of above Figure 1. As it is shown on the left side of Figure 1, the health status of people depends on many factors such as wealth, education, health expenditures, environmental factors, socio-

economic-factors. Most of these factors are dependent on public policy. The increase in per capita income and increase in GDP refers mostly to economic growth and economic development. However, in the real sense, besides these indicators, other social indicators have to be investigated and evaluated together. These are indicators such as a level of education, employment, human rights, and the health status. Today, while economic development occurs, the relationship between human factors and economic factors have been gaining importance. Health indicators in human-capital indicators are one step ahead of other indicators because of their close relationship between economic development. So, improved health status may not effect on wages or job status directly, but it increases life expectancy. Then, people's perpetuity consumption needs will rise, and this increment leads to more labor supply. Good health has also effect on education. For example, cognitive abilities of children and capacity to learn of children can be improved by better health as well as school attendance. However, while adult mortality rate and morbidity rate is decreased by better health conditions, people increase their incentives to invest in education.

While the economic situation of the society is revealed, national income health expenditures are used. Several factors like economic, genetic, social, cultural and environmental factors affect health status, but the health of society or health status of the population affects the economic situation. For example, healthy people are expected to produce more efficiently per hour worked. So, with their increased productivity, their mental and physical activity will increase. However, these mentally and physically active workers can make better result on technology and machinery using. Moreover, these healthier workers are expected to adopt some changes like changes in job tasks, or changes in organization structure.

Improvement in health status has also effect on the demographic structure of the population. Lower mortality and higher adult survival rate affect positively to population number. Moreover, better health also leads to decreasing in infant death rate, and this drop also increases the young population. So, all of these changes may have significant effects on economic growth. Lee (2003) investigates demographic transition that begun in Europe than spread out all over the world from 1800 to 2000s. He states that population boom in the twentieth century mostly depends on high rates of fertility and low levels of mortality concerning better health conditions. The changes

in demographic structure may show its effect on economic growth when more and more infant and young enter the workforce.

The health status of people or workers could also affect labor supply. Healthy workers become to get less sick, so good health condition reduces the number of days an employee spends on his sickness. So, good health status increases the number of healthy days for work. Health status also affects the labor supply decision of individuals because of its impact on wages and expected life span. We can talk about substitution and income effects of health effect on labor supply. As wages are affected by productivity and healthier workers are supposed to be more productive, and health improvements will increase wages, then people begin to increase the labor supply incentives. This incentive is the substitution effect of health status on labor supply. On the other hand, healthier workers have the higher life span, and higher work life, so being healthy could provide higher earnings. This is the income effect of health status on labor supply. The health status of people affects not only the income level of them but also its effects their savings and consumption rate and investment decisions. Healthier people are expected to have longer life span, so their saving ratio could consequently be higher than the saving rate of unhealthier people. Besides, health decreases illness duration of people so that people can have more time for working or leisure.

All other things remain same, a population, which their life expectancy increases, is willing to have more savings. This increase in life expectancy and health status also result in more investment in intellectual or physical capital. It is also believed that better health status decreases to infant and maternal mortality rates, this cause to increase the population. However, better health can reduce fertility rate, provide stabilization of population growth. So, a genuine demographic distribution can be occurred because of better community health. On the contrary, this population growth that comes from the better health of the community can be dangerous for low-income countries. A high level of population is a serious problem especially in underdeveloped countries, then the benefit from better health can be destroyed by the decrease in per capita GDP. The bad health status also affects the saving incentive of people. Because with the higher incidence of sickness, people may have higher out-of- pocket health expenditures. This is an important issue for mainly developing and underdeveloped countries because they have a lack of improved public and private

insurance systems. For example, in OECD countries, public sector spent 6,64% of its GDP on health expenditures, but private sector paid only 4,23% of GDP to health expenditures in 2014. So, it can be said that health expenditures mostly come from the public sector in high-income countries. On the contrary, in low-income countries, public sector spent only 2,16% of its GDP on health expenditures in 2014. Health expenditures mostly come from the private sector in low-income countries. So, people in low-income countries have less money to save for their plans. Bloom et al. (2003) investigate the relationship between life expectancy and saving decisions of people using a cross-country data. They find that higher life expectancy will result in a higher saving rate at each age.

Besides, when people's health is deranged, various consequences can arise. First, people become weak because of illnesses, and they cannot work. That is why people lose money. Otherwise, the costs of treatment for these diseases can lead to loss of income for people. Countries consisted of such people are also affected, because the national income and growth of that country may slow down. As a result, the health level of the population is a major factor for the human capital of that country. Having healthy individuals raises the quality of human capital of that country.

However, there are some difficulties for the assessment of health. Bloom and Canning (2009) state that there are too many health indicators to measure health status. So, it is hard to compare different studies. They also state that causality is a problematic issue for the relationship between health and growth. Because growth or income can affect health status, and also health status can affect growth.

2.1.2. International Comparison of Health Expenditures

The strength of an economy and the sustainability of its growth are ensured by having a healthy population. However, having qualified health services are essential for having a healthy population. For the provision of these services, all expenditures are called health expenditures.

While health expenditures spent by countries are compared at the national level, internationally accepted standard definitions are defined. The most commonly used of these standard indicators are health expenditures per capita, health expenditures of pharmaceutical expenditures, public health expenditures, private health expenditures, health expenditures ratio to GDP. Because of these indicators,

changes and trends in health expenditures of different countries can be compared. International comparison of health expenditures is a substantial issue for policy makers to observe health and growth level against other countries with similar and varying levels of development. Today, developed and developing countries or countries that have reached a certain degree of wealth allocate more resources to improve the quality of health services. Besides, countries of different income group or countries of the various regions have different health expenditures. Because they have differences in economic structures, nature of diseases, geographic areas, institutions and support from private health care sector.

There is a huge gap in health expenditure per capita (HEPC) and its share of per capita GDP between various income groups and regions. Four different income groups and seven different regions are analyzed for the year 2013. Below table shows the comparative statistics on health expenditure per capita, and health expenditure share on per capita GDP.

Table 1: Comparative Statistics of Health Expenditure Per Capita in 2013

Group	HEPC	MIN	MAX	% of HEPC on GDP
Low-Income Countries	87	20.753(Eritrea)	92.404(Sierra Leone)	5.7
Lower-Middle Income Countries	261	26.994(South Sudan)	311.160(Ukraine)	4.4
Upper-Middle Income Countries	505	186.640(Fiji)	1023.903(Russia)	6.1
High-Income Countries	5127	530.204(Seychelles)	9471.535(Switzerland)	12.1
World	1041	12.532(Central African Rep.)	9719.988(Norway)	9.8
East Asia & Pacific	625	1022.86(Brunei Darussalam)	6258.46(Australia)	6.9
Europe & Central Asia	2403	2643.95(Spain)	9719.98(Norway)	9.5
Latin America & Caribbean	714	673.81(Mexico)	7934.64(Brazil)	7.2
Middle East & North Africa	267	6.835(Syria)	206.508(Qatar)	5.1
North America	8650	5619.37(Canada)	8987.90(USA)	16.3
South Asia	61	336.39(Pakistan)	8601.53(Maldives)	4.3
Sub-Saharan Africa	98	16.079(Congo,Dem.Rep)	601.372(South Africa)	5.6

Source: World Development Indicators http://data.worldbank.org/data-catalog/world-development-indicators

From the above table, it is derived that the average health expenditure per capita of high-income countries is about 5127$ with a maximum of 9471$ and a minimum of 530$. On the other hand, the average health expenditure per capita of low-income countries is 87$ with a maximum of 92$ and minimum of 20$. Besides, the percentage share of health expenditure per capita on GDP is also different from low-income countries to high-income countries. For example, lower-middle income countries spend only 4.4 % of their GDP on health expenditure, but high-income countries spend

about 12.1% of their GDP on health expenditure. North American countries have the highest health expenditures, they spend about 16.3 % of their GDP. Moreover, Word average is 9.8 %.

Health expenditures trends by income groups between 1995-2015 can be seen in figure 2.

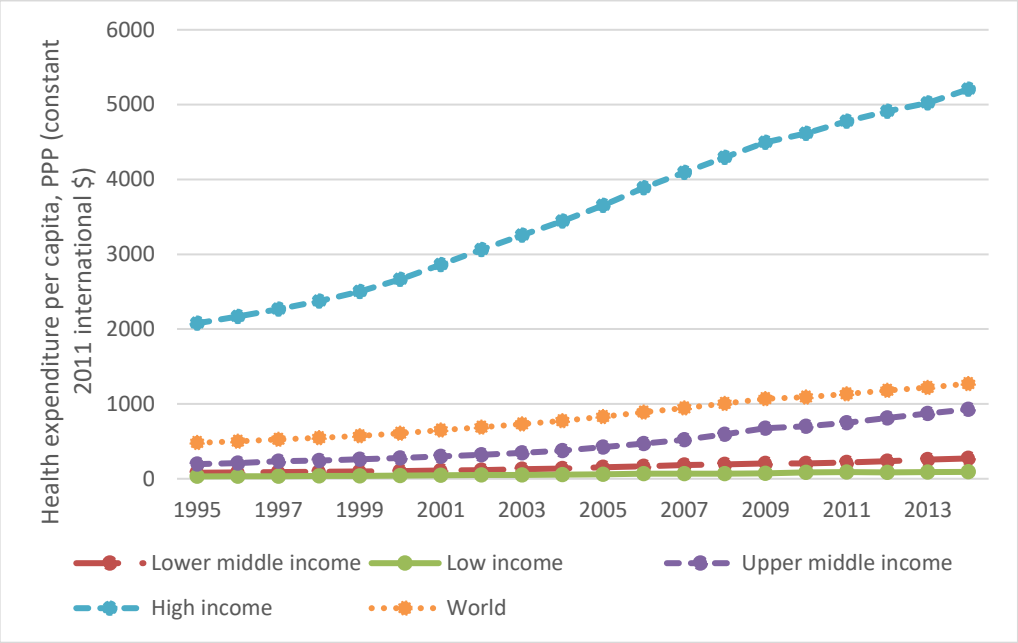

Figure 2: Average Health Expenditures Trends by Income Groups

Source: World Development Indicators

It can be easily seen in Figure 2, there is a positive trend for health expenditures per capita for each of the income groups. High-income countries have the highest health expenditures per capita between income groups. In high-income countries, HEPC was about 2077$ in 1995 then it rose to 5204 in 2014. Whereas HEPC is about only 32$ in low-income countries, then it rises to 92$ in 2014. There are not any significant differences in HEPC between low-income and lower-middle income countries. Moreover, HEPC reached to 1000$ level just in 2013 in upper-middle income countries. However, average HEPC in the World is 480$ in 1995, and it increased 1271$ in 2014. So, there are still huge gaps in HEPC between income groups.

GDP per capita trends by income groups between 1995-2015 can be seen in figure 3.

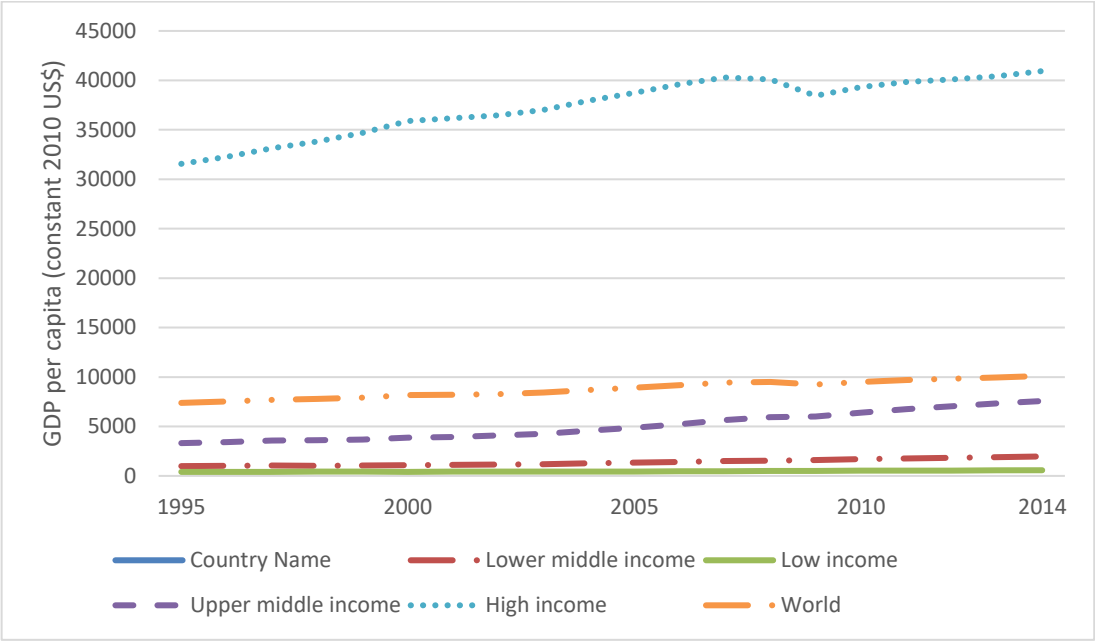

Figure 3: Average Per Capita GDP Trends by Income Groups

Source: World Development Indicators

As shown in Figure 3, there is a positive trend for GDP per capita for each of the income groups except a severe decline in 2008. Because there was a global economic crisis in 2008, and this crisis effect can be seen especially for high and upper middle-income countries' in GDP per capita series. GDP per capita significantly differs as well as health expenditures in high and low-income countries. For this period, the average per capita GDP in high-income countries increases from 31557$ to 40939$. Whereas the average per capita GDP in low-income countries increases from 404$ to 572$. GDP per capita was about 4000$ level in 1995, then it reached to 8000$level in 2013 in upper-middle income countries. GDP per capita for lower-middle income countries was only about 988$ in 1995, then it doubled and reached to 1888$ in 2013. So, income differences even between low-income and lower-middle income countries scale up. Moreover, average GDP per capita in the World is about 7383$ in 1995, then it rose to 10108$ in 2014. So, there is still huge income gaps between income groups.

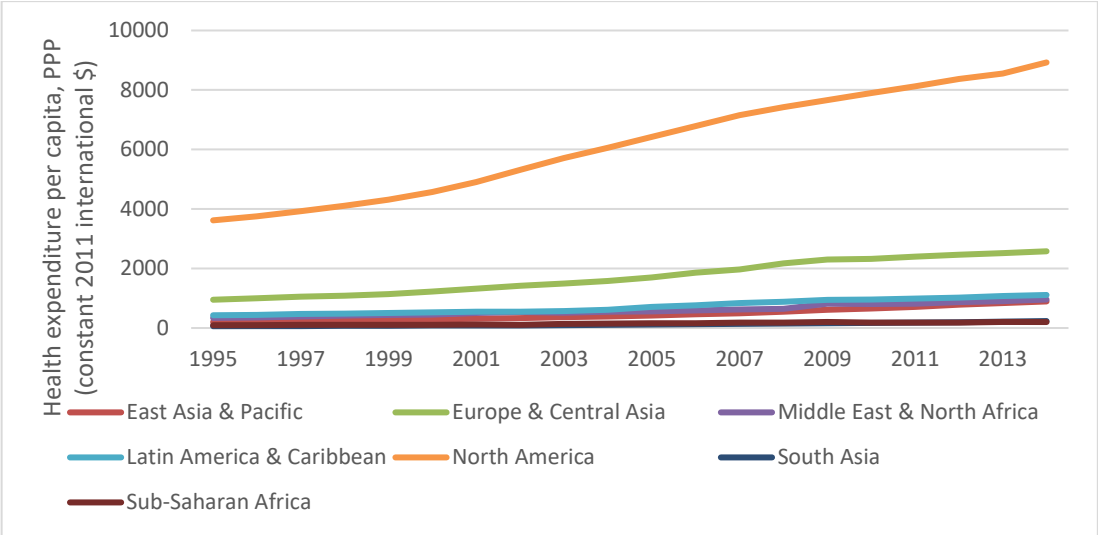

Figure 4: Average Health Expenditures Trends by Regions

Source: World Development Indicators

Figure 4 shows that health expenditures per capita have been increasing for each geographic region. North American (NAC) region have the highest health expenditures per capita between income groups. In NAC regions, HEPC was about 3618$ in 1995, then it rises to 8924$ in 2014. HEPC is about only 60$ in one of the poorest region South-Asia, then it increased to 233$ in 2014. HEPC in another poor region Sub-Saharan African (SSF)was 94$ in 1995, then it increased 200$ in 2014. However, average HEPC in the Europe & Central Asian (ECS) region is 950$ in 1995, and it rises to 2578$ in 2014. So, there are still tremendous differences in HEPC between regions.

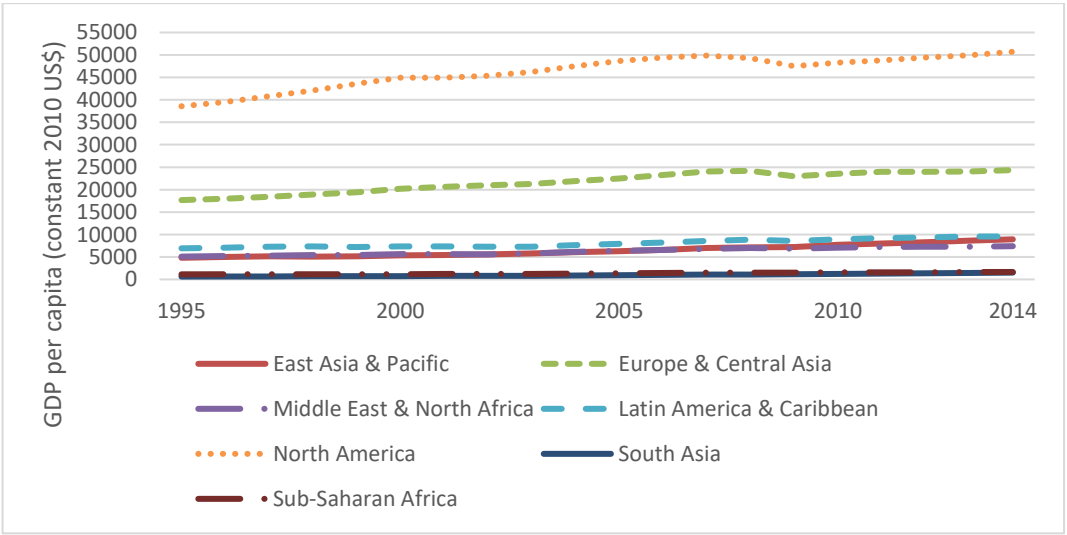

Figure 5: Average Per Capita GDP Trends by Regions

Source: World Development Indicators

As can be seen in Figure 5 that GDP per capita (GDPPC) has been increasing for each of the regions except a sharp decline in 2008. GDP per capita significantly differs between regions. For this period, the average per capita GDP in the richest region NAC increases from 38573$ to 50716$. But, GDP per capita was 629$ and 1130$ in 1995, 1510$ and 1651$ in 2014 in poor regions SAS and SSF, respectively. So, there exist big differences for per capita GDP between regions.

The relationship between HEPC and GDPPC over the period 1995-2014 can be seen in figure 6.

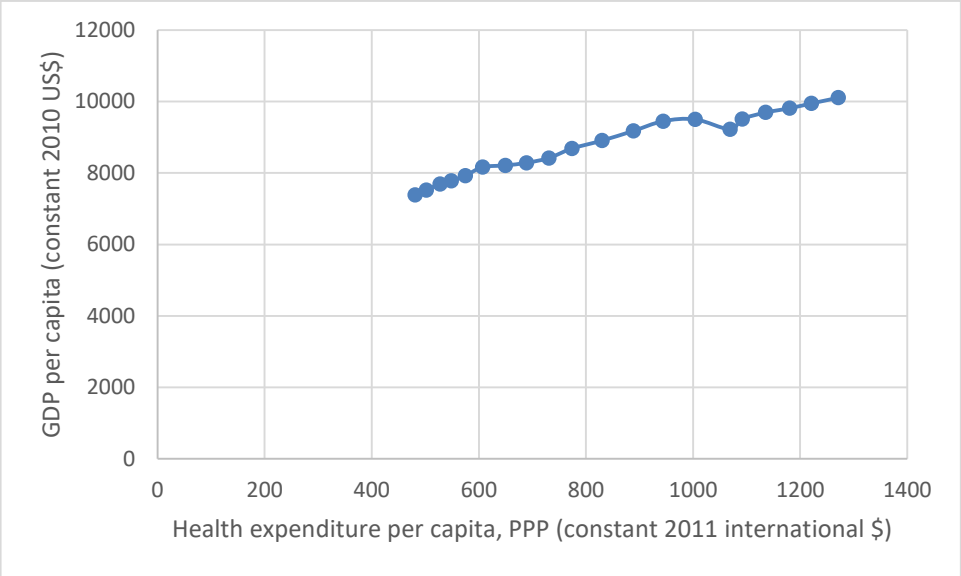

Figure 6: The Relationship Between HEPC and Per Capita GDP

Source: World Development Indicators

As shown in figure 6, there is a positive relationship between the HEPC and the GDPPC. When income level exceeds 6000$, HEPC has increased sharply. So, we can say that people in all over the World allocate more and more share of their budget to health when their income rises. When income level exceeds 8000$, people spend less proportion of their income on health expenditures in the World. It might be explained with the economic crisis that hits in the developed countries in 2008.

Developed countries have higher health expenditures than other countries. Because of the effective allocation of health expenditures and other structural health reforms in developed countries, other countries follow these developed countries. Debates about health expenditures become more and more important for developing and less developed countries. Policymakers should monitor health expenditures more

carefully to make the efficient allocation of scarce resources. However, monitoring of the outcome of these health expenditures such as life expectancy, morbidity rate is also important. For example, in underdeveloped countries, an infectious disease that causes too many deaths have higher incidence rates than high-income countries. So, spending more money to fight against these diseases can improve people's wealth, and it can be useful for future generation's life expectancy and wealth. Moreover, Mushkin (1962) states that the outcome of health expenditure in less developed countries will be more efficient than in developed countries. Besides, there is also a spillover effect for health expenditures. For example, if a country spends their budget to prevent from infectious diseases, it will be useful for its neighbor countries. So, health status will be improved in both countries; then there will be a positive effect on economic growth and development.

2.1.3. International Comparison of Life Expectancy and Preston Curve

Life expectancy, as a robust health indicator, is mostly used in many cross country comparisons, and it is usually found to be significant and positive for economic growth. However, in some studies, there is a negative relation between life expectancy and economic growth. It is also robust indicator like adult survival rate while examining the growth differences between high-income countries and low-income countries.

There is a general acceptance of the idea that human capital is one of the vital factors of economic success on both the country level and the individual level. In health-human capital indicators, life expectancy is considered as one of the important health measurement indicators because of its natural correctness and accuracy in most of the prior studies. There are also other health-human capital indicators like mortality rate, morbidity rate, fertility rate and disability days to measure health status. Lopez, Rivera, & Currais (2005) indicate that good health may be a critical component of overall well-being. Even though average life expectancy at birth has been increasing for the past 60 years in developing and developed countries, people in underdeveloped countries suffer from inadequate health conditions. The gap between in the life expectancy at birth still exist between developed and less-developed countries. For example, life expectancy at birth was 83 in Japan, 82 in Spain in 2013 according to World Bank health statistics. On the contrary, unfortunately, babies born in least-

developed countries hopeless of longer life span. For example, life expectancy at birth was 49 in Lesotho, 46 in Sierra Leone 2013.

Preston drew a striking graph that shows the positive relationship between per capita GDP and life expectancy in the 1930s and 1960s. In the well-known "Preston Curve," the correlation coefficient between life expectancy and per capita GDP was 0.885 in the 1930s, and 0.88 in the 1960s. Following Figure 7 is the original Preston curve that demonstrates relations between life expectancy at birth and national income per head for countries in the 1900s, 1930s, 1960s.

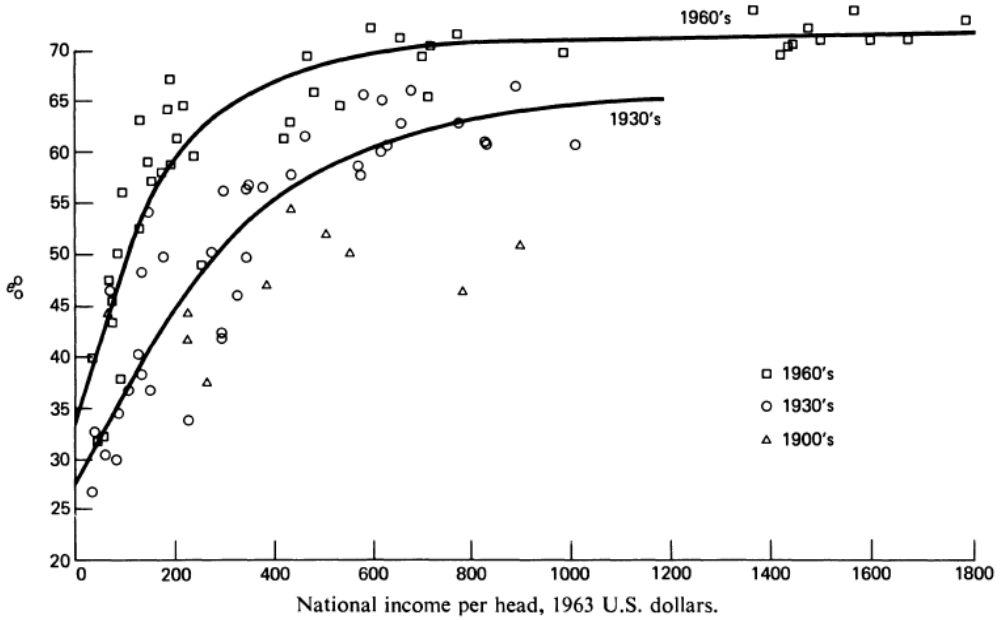

Figure 7: The Original Preston Curve

Source: Preston, S. H. (1975) The Changing Relation between Mortality and Level of Economic Development ***Population Studies***, Vol. 29**,** pp. 231-248.

Following studies also support Preston curve. For example, Deaton (2003) drew the 2000 Preston curve again; He finds that average income increases in low-income countries are strongly backed by increases in life expectancy. However, he also states that as the per capita income increases, the relationship becomes to weaken.

Pritchett and Summers (1996) find that this relationship is also valid for infant mortality. They also state that infant mortality improvements can be explained by the increase in growth rates.

The following curves are redrawn Preston curves for 1990 and 2010. Both curves precisely indicate that there is still a positive relationship between per capita GDP and life expectancy in 1990 and 2010.

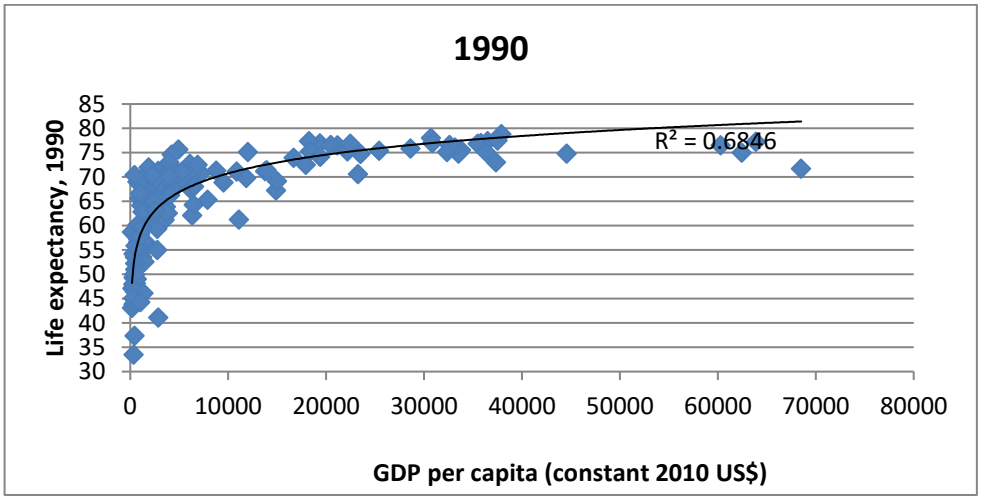

Figure 8: 1990 Preston Curve

Source: Author's figure based on WDI data

As can be seen Figure 8, the relation curve begins to flatten when per capita GDP exceeds to 30000$. So, as the per capita income increases, the relationship become to weaken. The correlation coefficient between life expectancy and per capita GDP is 0.63. The relationship between indicators is weaker than original Preston curve. Besides, there are also low life expectancies less than 40 in some countries.

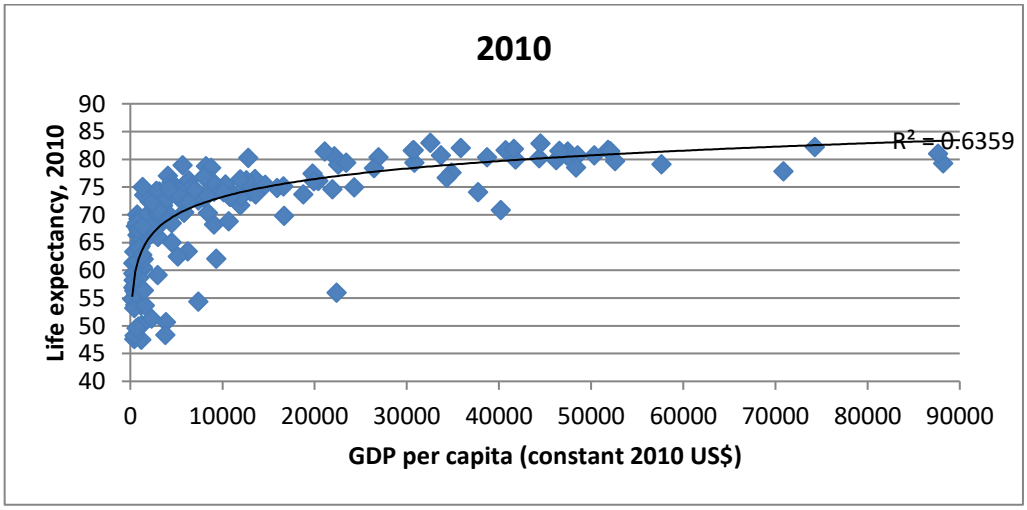

Figure 9: 2010 Preston Curve

Source: Author's figure based on WDI data

As can be seen in Figure 9, the relationship between GDP per capita and life expectancy begins to weaken when per capita GDP exceeds to 60000$. The correlation coefficient between life expectancy and per capita GDP is 0.68 which is lower than original Preston curve. However, life expectancy has increased in all over the world. Especially, life expectancy exceeds 80 years in some developed country like Japan, Norway.

Other following studies also support Preston curve. For example, Deaton (2003) drew the 2000 Preston curve again; He finds that average income increases in low-income countries are strongly backed by increases in life expectancy. However, he also states that as the per capita income increases, the relationship becomes to weaken. Pritchett and Summers (1996) find that this relationship is also valid for infant mortality. They also state that infant mortality improvements can be explained by the increase in growth rates.

2.2. Health and Economic Growth: Theoretical Framework

Economic growth is the steady-state process that the productivity of the economy increases year by year and this increment results in higher level of national income. Economic growth is mostly measured by the rise in GDP. Solow (1956) constructs his popular growth model. This prominent growth model is based on the Cobb-Douglas capital accumulation equation and production function. The model also has the assumption of the diminishing returns in production factors, the constant returns to scale. Production factors are capital and labor. Economic growth also depends on the capital stock, the labor stock, and the productivity. In Solow model, the saving rate of households and population growth are exogenous variables in the context of the neoclassical production function. The level of income per capita is determined by the saving rate and the population growth. Solow also concludes that there is not any long run economic growth, but if technology enters to the model, long-run economic growth can occur. Solow also finds that if countries have higher saving rates, they will reach higher income per capita.

The production function of Solow model in Cobb-Douglas form is:

$$Y = F(K, L) = A.K^{\alpha}L^{\beta}, \qquad 0 < \alpha < 1, 0 < \beta < 1$$

Where,

$$Y = Total\ Production$$

$$A = Total\ Factor\ Productivity$$

$$K = Capital$$

$$L = Labour$$

$$\alpha\ and\ \beta = labour\ and\ capital\ , output\ elasticity$$

The Solow model may be a good pioneer model for understanding growth, but it is insufficient for the other component of growth like human capital. Because human capital is a critical factor for sustainable economic growth. Mankiw, Romer, and Weil (1992) extend Solow model incorporating human capital. Barro (1996) also focus on health and education as human capital. Because he stated that health is a productive asset, and it is an important input for growth to remove obstacles on it. This new growth model is the type of endogenous growth model. According to the endogenous growth model, human capital and innovation as endogenous variables are primary factors for economic growth. This endogenous growth model was constructed by Romer (1986) and Lucas (1988). This model states that technological improvement is the primary factor of long run economic growth. The endogenous growth model is different from neoclassical growth model. Because technological improvement is itself a mechanism in an economic growth process.

Grossman (1972) is one of the pioneer studies that use health capital for representing of human capital. In this study, he set up a demand model for health using human capital theory. He represents health, in two different ways. Health can be a consumption good or a capital good. Health can be added to utility function of consumers if health can be defined as a consumption good. Becker (1964) is also one of the prominent studies of human capital theory. He states that human capital investments increase the productivity of people. If people can invest in themselves by way of health and education, they can increase their lifetime earnings.

Mankiw, Romer, and Weil (1992) constructed a human capital-Solow model by adding human capital variables like educational attainment. Because they wanted to explain cross-country growth differences. They find that countries that have a higher

investment in education reach higher national income than other countries that have less investment in education.

The production function of MRW model in Cobb-Douglas form is:

$$Y_{(t)} = K_{(t)}{}^{\alpha} H_{(t)}{}^{\beta} [A_{(t)} L_{(t)}]^{1-\alpha-\beta}, \qquad 0 < \alpha < 1, 0 < \beta < 1$$

Where,

$$Y_{(t)} = Total\ production\ at\ time\ t$$

$$K_{(t)} = Capital\ at\ time\ t$$

$$H_{(t)} = HumanCapital\ at\ time\ t$$

$$A_{(t)} L_{(t)} = Effective\ labour\ at\ time\ t$$

$$\alpha\ and\ \beta = labour\ and\ capital\ \ output\ elasticity$$

This human capital model is the base for this study. This model will be extended by including other new variables such as life expectancy and health expenditure to affect long-run economic growth in the selected group of countries in this study.

Barro (1991) focuses on the theoretical and empirical determinants of the long-run economic growth using cross-country analysis. The functional form of his well-known Barro-type growth regression is:

$$\gamma_{i,t} = \alpha + \beta \log(\gamma_{i,t-1}) + \emptyset X_{i,t-1} + \mu_{i,t}$$

Where,

$$\gamma_{i,t} = GDP\ per\ capita\ growth\ at\ time\ t$$

$$\beta = the\ speed\ of\ conditional\ convergence$$

$$\gamma_{i,t-1} = initial\ GDP\ per\ capita$$

$$X_{i,t-1} = Determinats\ of\ the\ steady\ state$$

In Barro-growth regression, growth is expressed as a function of initial income and determinants of the steady state. Barro aims to see conditional convergence in the world. So, he finds that there is a similar speed of convergence as in regional studies. He also uses human capital variables such as life expectancy and schooling as

determinants of the steady state. He also finds that life expectancy and schooling have positive and significant effects on the long run economic growth.

Acemoglu and Johnson (2007) also uses Solow growth model to explain the relationship between the relationship between income per capita and human capital. They use life expectancy as a health indicator. Their production function is:

$$Y_{it} = (A_{it}H_{it})^{\alpha}K_{it}^{\beta}L_{it}^{1-\alpha-\beta}, \alpha + \beta < 1$$

Where,

$$Y_{it} = Total\ production$$

$$K_{it} = Capital\ at\ time\ t$$

$$L_{it} = The\ supply\ of\ land\ at\ time\ t$$

$$A_{it}L_{it} = Effective\ labour\ at\ time\ t$$

Also,

$$H_{it} = h_{it}N_{it}$$

Where,

$$N_{it} = Total\ population$$

$$h_{it} = Human\ capital\ per\ person$$

3. HEALTH AND ECONOMIC GROWTH: EMPIRICAL LITERATURE REVIEW

There are mainly two different methods for investigating the relationship between health and economic growth. The first is the production function approach. Normally it is a firm-level production function, but in the literature, it is adapted to national-level. This function is explained in the literature part.

Another approach is the economic growth regression approach. In the literature, most of the growth studies use this method to compare countries including high income, low income, upper-middle income and lower-income countries at the global level.

Table 2: Literature Review: Health and Economic Growth

Study	Data	Dependent Variables	Independent Variables	Effect
Barro and Lee (1994)	N=85 for 1965-75 N=95 for 1975-85	Per capita GDP	Life expectancy	Positive
Knowles and Owen	84 non-oil countries for 1960-85	Per capita GDP	Life expectancy	Positive
Barro(1996)	N=100 for 1965-75, 1975-85,85-90	Per capita GDP	Life expectancy	Positive
Barro(1997)	N=100 for 1960-90	Per capita GDP	Life expectancy	Positive
Caselli et al (1996)	N=97 for 1960-85	Per capita GDP	Life expectancy	Insignificant
Pritchett and Summers (1996)	N=33 for 1960-85	Mortality rate, life expectancy, child mortality	Per capita GDP	Positive
Sachs and Warner (1997)	Sub-Saharan countries for 1965-90	Per capita GDP	Life expectancy	Positive
Sachs and Warner (1997b)	N=83 for 1960-90	Per capita GDP	Life expectancy	Positive but zero for high level of Life Expectancy

Bloom and Malaney (1998)	Russia for 1965-90	Growth rate of per capita GDP	Life expectancy	Positive
Bloom et al (1998)	73 African countries for 1965-90	Per capita GDP	Life expectancy	Positive
Rivera and Currais (1999)	OECD Countries for 1960-90	Per worker GDP	Health expenditure	Positive
Gallup and Sachs (2000)	N=95 for 1965-90	Per capita GDP	Life expectancy	Positive
Bhargava et al (2001)	N=92 for 1965-90	Per capita GDP	Adult survival rate	Positive
Heshmati (2001)	OECD Countries for 1970-92	Per capita GDP	Health expenditure	Positive
McDonald and Roberts (2002)	N=77 for 1960-89	Per capita GDP	Life expectancy	Positive
Chakraborty (2003)	N=95 for 1970-90	Per worker GDP	longevity	Positive
Gyimah-Brempong and Wilson (2004)	21 African countries for 1975-94, 23 OECD countries for 196-95	Per capita GDP	Life expectancy, health stock, healthcare expenditure/GDP	Positive
Bloom, Canning and Sevilla (2004)	N=62 for 1960-1990	Per capita GDP	Life expectancy	Positive
Bloom and Canning (2005)	N=62 for 1960-1995	Labor productivity	Adult survival rate	Positive
Dreger and Reimers (2005)	21 OECD countries for 1975-20001	Per capita GDP	Health expenditure, Life expectancy	Positive
Cole and Neumayer (2005)	52 developed and developing countries for 1965-95	Total factor productivity	malnutrition, malaria and waterborne diseases	Negative
Acemoglu and Johnson (2007)	N=59 for 1940-80	Per capita GDP	Life expectancy	Positive
Wang (2006)	31 OECD countries for 1986-2007	Per capita GDP	Health expenditure	Positive
Taban (2006)	Turkey for 1960-2003	Per capita GDP	Life expectancy, the number of medical institutions.	Positive

Taban and Kar (2006)	Turkey for 1969-2001	Life expectancy index	Per capita GDP	Positive
Malik(2006)	India for 1975-80,1985-90,1997-2003	Per capita GDP	life expectancy, infant mortality	insignificant
Yumuşak and Yıldırım (2009)	Turkey for 1980-2005	GNP	Health expenditure	Negative
Lorentzen et al (2008)	N=163 for 1960-200	Per capita GDP	Adult mortality rate	Negative
Erdogan and Bozkurt (2008)	Turkey for 1980-2005	Per capita GDP	Life expectancy	Positive
Narayan et al (2010)	5 Asian countries for 11974-2007	Per capita GDP	HE/GDP	Positive
Cetin and Ecevit (2010)	15 OECD countries for 1990-2006	Per capita GDP	Public HE/Total HE	No effect
Aghion et al (2010)	N=96 for 1960-200, OECD countries for 1960-2010	Per capita GDP	Life expectancy	Positive
Hartwig (2010)	21 OECD countries for 1970-2005	Per capita GDP	Health expenditures	No effect
Mehrari and Musai (2011)	11 OIC countries for 1971-2007	Health expenditures	GDP	Positive
Swift (2011)	13 OECD countries over 200 years	GDP, Per capita GDP	Life expectancy	Positive
Peykarjou et al (2011)	OIC countries for 2001-2009	Per capita GDP	Life expectancy	Positive
Hamoudi and Sachs (2012)	N=78 for 1980-90	Per capita GDP	Life expectancy	Positive
Eryigit et al (2012)	Turkey for 1950-2005	Per capita GDP	Health expenditures	Positive
Gong et al (2012)	China's provinces for 198-2003	Per capita GDP	Health investment	Negative
Ashgar et al (2012)	Pakistan for 1974-2009	Per capita GDP	Life expectancy index	Positive
Cooray (2013)	N=210 for 1990-2009	Per capita GDP	Life expectancy	Insignificant

Almost all studies that have investigated the relationship between health and economic growth employing one of these methods find that health indicators have a positive and significant effect on economic growth. There are also some studies that find a negative relationship between health and economic growth.

Preston (1975) investigates empirical relationship between life expectancy and national incomes for the 1900s, 1930s, 1960s. He finds that there is a positive correlation between the per capita GDP and life expectancy, for example, it was 0.885 in the 1930s, and 0.880 in the 1960s. So, his well-known "Preston Curve" occurred. He also finds that approximately 15% of income growth was caused by life expectancy.

Barro and Lee (1994) provide preliminary evidence on the determinants of economic growth. They observe 85 countries for 1965-75, 95 countries 1975-85, and they use SUR model with random country effects. They find that as the female education reduces fertility rate, population growth decreases. They also find that female and male schooling is positively related to life expectancy. Then, they conclude that if the average life expectancy increases by five years for a country, the growth effect is 0.013 percentage points.

Knowles and Owen (1995) try to examine the relationship between income per capita and health capital. They extend Mankiw, Romer, and Weil (1992) growth model by explicitly adding both the health capital and educational capital components of human capital. In their empirical part, they use school enrollment proxy for educational capital, and they used 1985 levels of life expectancy for health capital. They find that there is a strong and robust relationship between income per capita and health capital.

Barro (1996) tries to develop a model to explain the relationship between health and economic growth. He uses 3 SLS estimator with using lagged values of some regressors as instruments, and also he states that if the average life expectancy increases by five years for a country, the growth effect is 0.042 percentage points. Then, in his other study, Barro (1997) aims to determine factors of economic growth with a panel of 100 countries from 1960 to 1990. He concludes that growth is increased

by higher starting level of life expectancy, lower fertility rates, lower inflation rate, better preservation of the rule of law, higher male schooling.

Caselli et al. (1996) estimate a cross-section regression to find per capita income convergence to their steady-state levels using generalized method of moments estimator. However, their test results indicate an endogeneity problem. Then, to solve this issue, they use panel data set with a 25-year panel at a 5-year interval between 1960-1985. They rearrange the growth regression. They use life expectancy as a health measure with other covariates such as male and female schooling, Investment/GDP, Government expenditures/GDP, black market premium, revolutions. However, the effect of life expectancy on growth is insignificant.

Pritchett and Summers (1996) investigate the effect of income on health indicators such as infant and child mortality and life expectancy. They use five-year intervals data over the period from 1960 to 1985 for 33 countries. The estimation results show that the long-run elasticity of infant and child mortality is between -0.2 and -0.4. They find that almost %40 of mortality rate differences could be explained by cross-country income differences. They also find that if income increases by %1 in developing countries, about 43.000 infant deaths would be prevented.

Sachs and Warner (1997) examine sources of slow growth in Sub-Saharan African countries during the period 1965-90. They use the general Solow growth model to find what is more important in determining steady-state or potential GDP and the level of total factor productivity. All of their explanatory variables openness, tropical climate, landlocked-ness, institutional quality, natural resource abundance and life expectancy, help to determine total factor productivity. So, they use life expectancy as a health indicator or human capital proxy. They state that life expectancy has a substantial effect on lower levels. For example, average life expectancy in Sierra Leone is 32, then if average life expectancy increases to 33, the annual growth rate will increase by 0.24 percentage point. However, life expectancy has almost little effect at higher levels. For example, in US or France, the impact of one year increase of life expectancy is almost exactly zero on GDP growth. In other paper, Sachs and Warner (1997b) employ cross-country regression to investigate the relationship between human capital indicators and economic growth during the period 1960-90 for 83 countries. They use the general Solow growth model for empirical growth analysis again; they used life expectancy, adult literacy rate and years of secondary schooling

as human capital indicators. They find a nonlinear relationship between growth and human capital accumulation. They also find that growth function reaches a maximum level at a life expectancy of about 65 years. So, life expectancy raises growth, but the impact of very high levels of life expectancy is essentially zero.

Bloom and Malaney (1998) estimate a macroeconomic growth model to find the effect of Russian mortality crisis on its economic growth. They employ 25-year mortality data between 1965-90 with ordinary least square method. They use life expectancy as a health measure with other covariates such as population growth, log years of secondary schooling, natural resource abundance, openness, and access to ports, government savings. They find that the decline in the life expectancy decreases the total population growth rate. Then with the larger decline in the working age population, the annual rate of growth of income per capita in Russia falls. However, they also suggest that if life expectancy in Russia increases by 5%, its effect on growth is 0.21 percentage points.

Bloom et al. (1998) try to expose the primary factors of obstacles on African economic growth. They use a standard cross-country specification with OLS method for 73 African and non-African countries from 1965 to 1990. They use life expectancy as a health indicator with some other control variables like schooling, openness, institutional quality and other geographical variables. They state that public health, demographic structure, and conditions of tropical geography are essential for economic growth in Africa. They also indicate that about two-thirds of Africa's growth shortfall come from non-economic conditions like health, demography, and geography. They estimate that growth effect of increasing life expectancy by five years is about 0.29 percentage points.

Rivera and Currais (1999) estimate a growth model to explain income variations for the OECD countries for the period 1960-90. They develop an extended version of augmented Solow growth model with health investment variable. They suggest that health investment variable leads to improving the model performance, so the positive and strong relationship between health and economic growth can be established. They also stated that health, population, saving and education differences can explain roughly %90 of cross-country income per capita differences. In their other study, Rivera and Currais (2003) aim to explore the relationship between economic growth and health expenditures for OECD countries over the period from 1960 to

2000. They also analyze the effect of health investment on productivity with human capital accumulation. They conclude that health expenditures have a positive impact on economic growth. They also find that the countries with low health expenditures gain more benefits.

Gallup and Sachs (2000) try to investigate the relationship between malaria and economic growth using cross-country data for the period from 1965 to 90 for 95 countries. They use geography as an instrumental variable for health because malaria is geographically distinct. They state that countries with high malaria rates have almost weak economic growth, so the effect of geography regarding the distance from the equator on GDP could be evidence of the effect of health on GDP. They also estimate the effect of a 5-year increase in life expectancy on economic growth is 0.24 percentage points.

Bhargava et al. (2001) examine determinants of economic growth at 5-year intervals in 92 countries between 1965-1990. They try to estimate models for growth rates with using adult survival rate as a health indicator. They find that there is a positive effect of adult survival rate on GDP especially in low-income countries, for example, 1% positive change in ASR resulted with 0.05% increase in growth rate.

Zon and Muysken (2001) construct a simple endogenous growth model to explain a slowdown in economic growth. Their model is based on Lucas (1988) model, so a good health is a necessary condition for labor services, and health has decreasing return. They also separate the effect of the active part of the population and the stable part of the population on the economic growth. So, higher stable population increases with longevity. Then, with higher longevity, demand for health services will increase, so they assume that health and human capital are complements. They find that the productivity of health sector and life expectancy are important for economic growth. They conclude that growth rate is low for countries with severe health conditions, unproductive health sector, or high rate of discount.

Heshmati (2001) estimates an extended version of augmented Solow model developed by Mankiw, Romer, and Weil (1992). He adds health capital to the model examining the conditional convergence of OECD countries in GDP and health expenditures per capita. His main findings are that health expenditures have a positive effect on convergence speed and economic growth. The result shows that the rate of

convergence is at 3.7% per year to their income per capita steady state in OECD countries. The causality runs from health expenditures to GDP.

McDonald and Roberts (2002) try to develop an augmented Solow growth model with health and education capital. Their full data sample consists of 77 countries, and there are three sub-samples. They use mean years of total education as a proxy of education capital, and they use infant mortality and life expectancy as proxies of health capital. However, they define life expectancy as the shortfall of life expectancy[1]. They estimate pooled model using a 5-year panel to keep the time series information between 1960 and 1989. They state that ignoring human health capital from augmented Solow growth models lead to occurring misspecification biases, so health capital has a positive and significant effect on economic growth. They also state that education capital are more important for high-income countries, and health capital is more important for low-income countries.

Muysken et al. (2003) construct a growth model to analyze the effect of health on economic growth theoretically. They state that health is a factor in determining labor productivity. So, they define health as the ratio of healthful labor force to the total labor force. They find the long-run effect of health on the steady-state and transitional macroeconomic indicators. Then, Yetkiner (2006) extends this model by added externality effect of health. He states that besides individual health status, the healthful environment is also necessary for economic growth, so he shows that market solution is unsuccessful because of the externality characteristic of health in this model. He also states that public authority has to play a more important role in increasing healthful labor force.

Chakraborty (2003) suggests theoretically how longevity (life expectancy) stimulate economic growth using general equilibrium framework; then he analyzes the effect of longevity improvements on growth and human capital investment for 95 countries between 1970 and 1990 empirically. He uses two-period overlapping generations model for his theoretical analysis. He finds that countries with high mortality rates do not support growth fast because a low level of the life expectancy reduces saving and investment decisions, then development trap occurs in these countries. He also finds that high mortality rate reduces human capital investment and

[1] LE= -ln(80–life expectancy)

returns on education, and countries with different level of health capital do not reach to similar living standards.

Aisa and Pueyo (2004) try to analyze the interrelationship between longevity (longer life expectancy), health and economic growth. They find that longevity leads to increasing savings at first, then labor force participation and with an expansion of the workforce. They also conclude that the primary resource for longevity is increasing of health resources such as health expenditure in reducing mortality. Their model suggests that longer life expectancy effects are highly significant for developing countries. However, these effects may be a negative for developed countries because longer life has too much cost in developed countries.

Gyimah-Brempong and Wilson (2004) use an augmented Solow growth model to explain the effect of health indicators on per capita income growth rate. This study consists of 21 African countries data for the period from 1975 to 1994 and 23 OECD countries data for the period from 1961 to 1995. They find that health indicators such as life expectancy, health care expenditures share to GDP, health stock, have a positive and significant effect on per capita income growth rate in both groups of countries.

Erdil and Yetkiner (2004) employ panel VAR model to analyze the causality relationship between economic growth and health for 75 countries for the period 1990-2000. They also classify countries into four groups: low-income, lower middle-income, upper middle-income, high-income countries. They find that the causality runs from economic growth to health for low-income and lower middle-income countries, but the causality runs from health to from economic growth for upper middle-income and high-income countries.

Bloom, Canning, and Sevilla (2004) estimate a production function model for economic growth. Work experience and life expectancy are used as human capital indicators in this model. Their data set consists of a panel of 62 countries average of every ten years from 1960 to 1990. Their main result is that life expectancy has a positive and significant effect on economic growth. They also find that one-year increase in life expectancy increases economic growth by 4%.

Bloom and Canning (2005) try to compare the macroeconomics effects of health on labor productivity with the microeconomics effects of health on wage. They use an aggregate production function with using microeconomic evidence to measure

the impact of human capital on salaries; they also calibrate the effect of adult survival rates on aggregate production. The results show that %one increase in adult survival rate leads to a % 1.68 increase in labor productivity. They also state that a labor who works in a healthier country is 1.7 times productive than a labor who works in the unhealthier country. In macroeconomic part, they estimated an aggregate production function using a panel of 62 countries for every five years from 1960 through 1995. They conclude that adult survival rate has a positive and significant effect on aggregate output and % 1 increase in adult survival rate leads to a % 2.8 increasing in labor productivity.

Weil (2007) aims to analyze health effect on economic growth using microeconomic estimation. He also tries to explain the health effect in explaining income differences between countries. He uses average height of adult men, the adult survival rate for men, and age of menarche for women as health indicators. He finds that if health differences among countries are eliminated, the variance of log GDP per worker decreased by 9.9 percent, the ratio of GDP per worker at the 90th percentile to GDP per worker at the 10th percentile decline from 20.5 to 17.9. He concludes that health status plays a significant role in explaining income variation between rich and poor countries.

Dreger and Reimers (2005) investigate cointegration relationship between health care expenditures and GDP for 21 OECD countries 1975-2001 period using panel cointegration methods. They also take account into healthcare expenditures that are not only determined by income, other variables, like life expectancy, infant mortality and the share of the elderly are also important. They find that there is cointegration relationship between the variables and the income elasticity is a unit, so health is not a luxury good.

Cole and Neumayer (2005) investigates the relationship between health and total factor productivity (TFP) for 52 developed and developing countries using data at five yearly intervals between 1965 – 1995. They construct a production function model to estimate TFP with using three indicators of health such as malnutrition, malaria, and waterborne diseases. They find that poor health affects TFP negatively, and this effect significant and robust across a large variety of specifications, and poor health conditions are one of the primary factors of the existence and permanent underdevelopment in many regions of the World.

Acemoglu and Johnson (2007) estimate the effect of the life expectancy at birth on economic growth and large income differences across countries. They focus mainly on international health innovations and improvements since the 1940s. They state that predicted mortality has a significant effect on changes in life expectancy, and changes in life expectancy have a robust effect on the population. Their result shows that a 1% increase in life expectancy increases population by 15%. They also state that the significant increase in life expectancy has a small initial positive effect on economic growth. However, their results also show that health improvements in less developed countries are exceptionally efficient.

Wang (2006) tries to explore the causality between health care expenditures and economic growth for 31 OECD countries between 1986 and 2007. He uses two approaches for empirical analyses. He uses panel regression at first, then he finds that growth of health care expenditures affects an economic growth positively, but economic growth leads to reducing the growth of healthcare expenditures. He also uses quantile regression analysis in the second part. He finds that growth of health care expenditures affects positively economic growth only for countries with medium and high levels of economic growth. However, the effect of health care expenditure growth on the economic growth is different in countries with a low level of growth.

Taban (2006) investigates the causality relation between health indicators and economic growth with using annual data between 1960-2003 in Turkey. He uses the life expectancy at birth, the number of beds of the medical institutions, the number of medical institutions and the number of persons of the healthcare provider. Test results show that there is bi-directional causality relationship between economic growth and health indicators except the number of medical institutions.

Taban and Kar (2006) try to examine the causality relationship between human capital indicators and economic growth in Turkey. They use some indexes such as human development index, education index, life expectancy index for human capital indicators. They find that there is a long–run relation between life expectancy and economic growth, and the causality runs from economic growth to life expectancy

Malik (2006) investigates to analyze the relationship between health status and economic growth in India. He uses infant mortality rate, life expectancy rate and crude health rate as health proxies. The data set has 1975-80, 1985-90 and 1997-2003, he

uses 5-year averages data to allow time for the effects to emerge and to decrease the effects of long-run distortions. He also uses OLS and 2SLS models to see the macroeconomic impact of health. He finds that life expectancy, infant mortality have not highly significant effect on economic growth in India for both models. However, his inter-country comparisons show that India has to improve health services regarding physical infrastructure for better living standards.

Yumuşak and Yıldırım (2009) analyze health expenditures, life expectancy and GNP series of Turkey between 1980-2005. They employ Johansen co-integration test and error correction model for analyzing. According to the test result, the causality runs from health expenditures to GNP, but this relationship is slightly significant and negative. There is also causality from life expectancy to GNP.

Chang and Ying (2006) investigate the theoretically optimal level of health expenditures for the optimal level of growth rate. They developed a new version of the growth model based on Solow growth model to identify the role of health capital in economic growth, and they tried to find estimated Golden Rule steady-state health expenditures. The new model shows that there is a convergence between poor countries and rich ones when health and physical capitals are considered. Then, they employed empirical analysis for 15 OECD countries to compare the actual health expenditures and estimated health expenditures in the new model. They find that some of the countries have excessive health expenditures.

Ashraf et al. (2008) examine the effect of an exogenous change in population health on output per capita. They run a simulation model to test direct effect of health on worker productivity and indirect impact of health on schooling, the structure of the population, capital accumulation, and crowding of fixed natural resources. They find that the effects of better health conditions on output per capita are lower than expectations of policy-makers. For example, an increase in life expectancy at birth from 40 to 60 lead to 15 percent increase in GDP per capita in the long run, so the health improvements may show its effect on income after a long time. They conclude that the efforts of improving health conditions in developing countries are based on humanitarian reasons, not economic arguments.

Lorentzen et al. (2008) analyze the effect of the adult mortality rate of growth of income per capita in 163 countries at a 10-year interval between 1960 - 2000. In

this study, they use three-stage least squares estimations (3SLS) method with instrument variables such as malaria ecology, climate variables, and geographic features. They find that the adult mortality rate has a significant effect on economic growth. Because when people believe that their life time is small, they begin to save less, or they invest less in physical capital, and they tend to have higher fertility rate. They specifically find that the effect of adult mortality on growth is -6.25 percentage points.

Erdogan and Bozkurt (2008) aim to examine the relationship between life expectancy and economic growth in Turkey. They use annual data from 1980 to 2005 using ARDL model; they find that there is a positive correlation between the life expectancy and economic growth.

Narayan et al. (2010) analyze the relationship between health and economic growth for 5 Asian countries for the period 1974-2007. They use additional control variables such as investment, exports, imports, and research and development (R&D), and they employed panel unit root tests, panel cointegration with structural breaks and panel long-run estimator. They find that all variables are cointegrated, health, investment, exports, and R&D have a statistically significant and positive effect on per capita income, but import has a statistically significant and negative effect on per capita income.

Cetin and Ecevit (2010) analyze the effect of health on economic growth for 15 OECD countries for the period from 1990 to 2006. They used the share of public health expenditures in total health expenditures as a health indicator, and they employed Pooled Regression Model by the panel OLS method. They find that there is no significant relationship between health expenditures and economic growth.

Aghion et al. (2010) investigate the relationship between health and economic growth regarding endogenous growth model. They use two data sets for cross-country regressions: first data set covers 96 countries from 1960-2000, the other data set includes OECD countries from 1960-2010. As health indicators, they use both the initial level of life expectancy and a higher rate of improvement in life expectancy. They find that both health indicators have a significant positive effect on growth, but the initial level of life expectancy is a more robust indicator. They also find that the positive correlation between life expectancy and growth have reduced since 1960 for

OECD countries because only the decrease of mortality rate below 40 age is effective for growth-enhancing.

Hartwig (2010) focus on the question whether health indicators stimulate GDP growth in wealthy countries with the panel Granger-causality framework. The study covers 21 OECD countries for the period between 1970 and 2005. He concluded that there is no evidence that health expenditures or the increase in life expectancy Granger-causes GDP per capita positively.

Mehrari and Musai (2011) investigate the causality relationship between health expenditures, oil revenues, and GDP in 11 oil exporting countries over the period 1971-2007. They find that strong causality runs from GDP and oil revenues to health expenditures but health expenditures do not have any significant effects on GDP in both short- and long-run.

Swift (2011) tries to determine the relationship between health and GDP for 13 OECD countries over the last 200 years. He also attempts to estimate a cointegrating relationship between life expectancy and both GDP and GDP per capita for each country. His results show that there is a bidirectional relation between health and GDP. He finds that a one%increase in life expectancy leads to a 6% increase in GDP in the long run, and %5 increase in GDP per capita. He also finds that the shifts of important causes of death do not affect the relationship between health and GDP.

Peykarjou et al. (2011) analyze the relationship between economic growth and health in Organization of Islamic Cooperation (OIC) member states[2]. They use panel data for the years of 2001-2009 using regression with a semi -log functional form. They obtain that life expectancy the main factor for economic growth for these countries, and they also find that there is a negative relationship between economic growth and fertility rate.

Hamoudi and Sachs (2012) examine the correlation between health and economic performance between 1980-90 for 78 countries. They suggest that geographical, environmental, and evolutionary factors play a major role in determining health status. They use OLS estimator to define health effect on national economic performance with some explanatory variables such as institutional quality, tropics land

[2] (i.e. Indonesia, Iran, Pakistan, Bangladesh, Burkina Faso, Saudi Arabia, Kirgizstan, Kuwait, Mali, Malaysia, Egypt, Somalia, Uzbekistan, Tajikistan, and Turkey).

area, log coastal population density, working-age population rate. They also find that the growth effect of increasing life expectancy by five years was 0.57 percentage points.

Eryigit et al. (2012) aim to examine the long-run relationship between government expenditures and economic growth by using annual data between 1950-2005 in Turkey. Government expenditures are divided into education–health expenditures and defense expenditures. According to their co-integration test results, health and education expenditures affect economic growth positively.

Gong et al. (2012) investigate the impact of health capital and health investment on economic growth and the physical capital accumulation of China's provinces. In this study, they use an extended version of Ramsey model with an Arrow-Romer production function. They conclude that health level affects labor productivity at first, then with higher labor productivity, economic growth increases. However, they also find that there may be a crowding-out effect with higher level health investment because heavy investment on health decreases the economic growth.

Devlin and Hansen (2012) try to test for the presence and direction of Granger causality between health care expenditure Granger and GDP for each of 20 OECD countries for the period 1960-1987. They find that there is no Granger causality in either direction for six countries. They also find that for eight countries - Canada, Denmark, Finland, Iceland, Japan, Netherlands, Norway and Sweden-, health care expenditure Granger causes GDP, also for eight countries -Belgium, Denmark, France, Greece, Iceland, Ireland, Spain, and Switzerland – GDP Granger causes health care expenditure.

Ak (2012) investigates the causality relationship between health expenditures, economic growth and life expectancy at birth in Turkey. She uses Johansen co-integration method and error correction model. She concludes that there is long term causality relationship between health expenditures and economic growth, but there is no short-run relationship between indicators.

Ashgar et al. (2012) analyze the effect of human capital indicators on economic growth of Pakistan between 1974-2009. They use education and health indexes as proxy of human capital[3]. They use Johansen test to check the long-run relationship

[3] Health index= (Le-25/85-65) Le: Life expectancy

between variables, and for causality, they employ vector error correction model based causality and Toda-Yamamoto causality tests. They find that there is a positive and significant relationship between economic growth and human capital indicators.

Yardımcıoglu (2012) aims to examine the relationship between the life expectancy and the long-run economic growth in the 25 OECD countries between 1975-2008. In this study, the Pedroni panel cointegration, Pedroni FMOLS and Canning-Pedroni causality methods are used. He finds that there is a cointegration relationship between life expectancy and economic growth. He also concludes that a 1% increase in life expectancy leads to increase the economic growth of about 0.18%; a 1% increase economic growth leads to increases in life expectancy of about 0.17% in OECD countries.

Cooray (2013) investigates the effect of health capital on economic growth with disaggregated gender data. His panel data covers 210 countries for the period 1990-2009, and also he used both OLS and system GMM. He states that life expectancy has not significant and robust effect on economic growth for the full sample, but if health expenditures and education are added to the model, their impact on economic growth will be positive and significant. He also analyzes these effect for the countries by income group, so he finds that health and education capitals have positive and important effects on economic growth in both high and upper middle-income economies. However, in low and lower-middle-income economies, health capital has a positive and significant impact on economic growth only through its interaction on health expenditure and education, and higher fertility rate tends to decrease the effect of health capital.

Selim et al. (2014) examine the long-run and short run relationship between health expenditures per capita and economic growth in 27 European union countries and Turkey between 2001-2011.They employ panel co-integration method and error correction model. They find that there is a cointegration relationship between economic growth and health expenditure per capita.

4. HEALTH AND ECONOMIC GROWTH: EMPIRICAL FINDINGS

4.1. Data and Empirical Methodology

In this section, it is aimed to describe the structure and the sources of data, the definition of the variables and data transformations using in this study. The general structure of data set is panel data. Baltagi (2008) indicates that studying with panel data is very convenient because it consists of both time series and cross section information, and panel data has advantageous of working with huge observations, lowering collinearity between independent variables and higher the degree of freedom[4].

Two main models are used in this study. In the first model, life expectancy is used as a health indicator, and this model consists of 160 countries over the period of 1960-2014. But instead of using annual data, 10-years average of variables is used. In the second model, health expenditure is used as a health indicator, and this model also consists of 159 countries over the period of 1995-2014 with 5–years average[5] .

However, to make a comparative analysis, these 159 countries are classified by their income level and by their geographic region according to World Bank country classification criteria[6]. So, due to this classification, models are run separately for each group. All data used in this study are collected from World Bank Indicators and Penn World Table 8[7].

[4] For more information about advantageous and disadvantageous of panel data, see Baltagi(2005), Baltagi(2011) and Greene(2003)
[5] Countries that are used in this study are listed in appendix.
[6] This information is also seen at appendix
See at also https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups
[7] http://data.worldbank.org/indicator
http://cid.econ.ucdavis.edu/pwt.html

4.1.1. Data and Empirical Methodology for Model 1

The descriptive statistics of variables for all countries and each income group for model 1 are as follows:[8]

Table 3: Descriptive Statistics for All Countries for Model 1

Variables	For all countries				
	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	826	2.14	3.37	-10.3	34.57
Gross fixed capital formation	760	22.2	8.69	0	138.71
Trade	795	76.96	48.11	0.33	391.94
Labor force participation	594	63.69	10.32	39.2	90.6
Fertility	821	3.82	1.98	1.22	8.37
Life expectancy	821	64.94	11.23	30	83.15
İnitial GDP per capita	770	10483.1	15968.84	140.91	111958.2

Source: WDI

It can be easily seen in Table 4 that 10-years average of the growth GDP per capita and life expectancy are higher in high income and upper-middle income countries than low-income and lower-middle income countries. Whereas fertility rates are low in high-income and upper-middle income countries. The mean values of trade as a ratio of GDP and initial level of GDP per capita are also higher in high-income and upper-middle income countries.

Table 4: Descriptive Statistics for High-Income Countries and Upper-Middle Income Countries for Model 1

Variables	High-Income Countries					Upper-Middle Income Countries				
	Obs.	Mean	Std.Dev.	Min	Max	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	264	2.19	3.14	-6.01	34.5	230	2.77	4.14	-8.63	31.74
Gross fixed capital formation	250	22.9	4.85	5.94	38.24	219	24.61	11.73	0	138.71
Trade	254	93.14	62.73	9.53	391.94	223	80.04	43.35	6.42	334.7
Labor force participation	181	61.17	6.99	47.87	86.64	167	60.56	10.06	39.2	86.98
Fertility	259	2.27	1.19	1.22	7.99	230	3.55	1.67	1.26	7.64
Life expectancy	260	64.94	11.23	30	83.15	229	66.9	7.68	40.77	79.14
İnitial GDP per capita	244	27457.35	19141.79	2616.87	111958.2	215	4898.22	3104.01	140.91	23120.8

Source:WDI

[8] The descriptive statistics of variables by regions for model 1 are given in appendix part.

Table 5: Descriptive Statistics for Low-Income Countries and Lower-Middle Income Countries for Model 1

Variables	Low-Income Countries					Lower-Middle Income Countries				
	Obs.	Mean	Std.Dev.	Min	Max	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	130	0.84	2.6	-10.3	8.85	202	2.21	2.89	-9.78	11.07
Gross fixed capital formation	111	17.53	6.94	4.48	36.87	180	21.15	8.23	7.53	58.99
Trade	126	57.34	27.48	15.78	206.06	192	64.87	31.15	0.33	163.52
Labor force participation	95	74.89	9.86	50.68	90.6	151	63.15	9.56	45.83	82.5
Fertility	130	6.15	1.1	2.34	8.37	202	4.63	1.68	1.28	8.08
Life expectancy	130	49.82	8.02	30	69.01	202	60.01	8.64	39.44	75.39
İnitial GDP per capita	125	543.25	270.48	175.14	1655.85	186	1351.44	809.74	152.49	4047.89

Source: WDI

It is suitable to investigate the role of health on the growth of the real GDP per capita using health indicators and other socioeconomic variables as control variables that are supposed to affect economic growth. The growth of real GDP per capita is used as a dependent variable as well as trade as a share of GDP, labor force participation rate, life expectancy, fertility rate and initial GDP per capita are used as independent variables. These variables are included in model 1 by following empirical literature.

The growth of real GDP per capita reflects the long-run economic growth of countries, and it is the dependent variable of this study. The data is derived from Penn world table.

Life expectancy is used as a health indicator for model 1. Theoretically, life expectancy is expected to have a positive effect on economic growth. In other words, there is a positive correlation between life expectancy and economic growth. Because, as discussed in previous part of this study, better health status and higher life expectancy could increase productivity through increased human capital. This data is taken from World Bank Development Indicators. WDI (2017) also states that:

"Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life."

Gross fixed capital formation (GFCF) is another important control variable for model 1. Formerly, it was named gross domestic fixed investment. So, it includes land improvements, machinery and equipment purchases and the construction of important buildings like hospitals, schools, roads. In this study, its share of GDP is used. This

data also is taken from WDI. It is expected that GFCF has a positive effect on long-run economic growth.

Trade is used as another important control variable for the model 1. Trade is the ratio of import plus export to GDP. This data also is taken from WDI. It can be said that trade has a direct effect on the economic growth because higher trade means higher capacity utilization and increased productivity. So, trade is expected to have a positive impact on the long-run economic growth.

The labor force participation rate is another control variable for model 1. It is the ratio of the population between ages 15 and 64 that is economically active to the overall population. This data is also taken from WDI. Higher labor participation rate is required for sustainable economic growth of countries. As more people participate in the production activity, there will be lower output loss. It is also expected that there will be a positive relationship between labor force participation rate and long-run economic growth.

The fertility rate is also another independent variable for model 1. Many previous studies indicate that as discussed in the literature part fertility rate is a substantial variable for the long-run economic growth, especially for low-income countries. Because, in low-income countries especially in Sub-Saharan African countries, there are higher fertility rates, then their growth rates are low because of increased population and insufficient labor force. This data is also taken from WDI. It is expected that there will be a negative relationship between fertility rate and economic growth.

The initial level of GDP per capita is also included in model 1 as an independent variable. Starting level of every ten years of real GDP per capita values are used. This data is taken from Penn World Table. Barro (1996) states that the coefficient of the initial level of real GDP per capita shows the conditional rate of convergence. So, it is expected that initial level of real GDP per capita will have a negative effect on the long-run economic growth.

This thesis' empirical methods is to estimate equations similar to Barro-type Growth regression using STATA statistical package. Model 1 uses life expectancy as health indicator between 1960 -2014. Panel regression methods are employed for model 1 for 10-years average of the variables. As discussed in the data section, Green

(2003) states that panel data is useful to use empirical analysis because of giving more flexibility with higher observations and increased the degree of freedom. So, panel least square (PLS) method has employed for model 1. PLS is also used for sub-samples that are classified by income level and by geographic region.

First consider the following model 1:

$$y_{it} = \beta_0 + \beta_1 lnGFCF_{it} + \beta_2 lnTrade_{it} + \beta_3 lnLFP_{it} + \beta_4 lnLife_{it} + \beta_5 lnFertility_{it} + \beta_6 lnGDP_{it} + \varepsilon_{it}$$

Where;

$$y_{it} = real\ gdp\ per\ capita\ growth$$

$$lnGFCF_{it} = gross\ fixed\ capital\ formation(\%\ of\ GDP)$$

$$lnTrade_{it} = \text{the ratio of import plus export to GDP}$$

$$lnLFP_{it} = Labor\ force\ partipation\ (\%\ of\ GDP)$$

$$lnLife_{it} = Life\ expectancy\ at\ birth$$

$$lnFertility_{it} = Fertility\ rate$$

$$lnGDP_{it} = Initial\ GDP\ per\ capita$$

$$\varepsilon_{it} = error\ term$$

Independent variables are used in the logarithmic form. Green (2003) log transformation is good at showing important points and correcting skewed variables to the normal distribution. Fixed effects and robust estimation is used for model 1.

4.1.2. Data and Empirical Methodology for Model 2

In model 2, health expenditures per capital growth instead of life expectancy is used as a health indicator. The data consists of 159 countries over the period of 1995-2014. However, instead of using annual data, five-years average of variables is used

The descriptive statistics of variables for all countries and each income group for model 2 are as follows:[9]

Table 6: Descriptive Statistics for All Countries for Model 2

Variables	For all countries				
	Obs.	Mean	Std.Dev.	Min	Max
GDPPC growth	778	2.61	4.3	-13.63	51.62
GFCF	792	0.21	0.09	0.02	0.65
Trade	776	85.43	50.61	0.19	436.57
LFP	771	63.54	10.29	40.5	88.9
Fertility	788	3.1	1.65	1.15	7.74
HEPC growth	632	0.3	0.28	-0.4	1.85
Initial GDPPC	779	11933.08	17271.36	122.48	103588.6

Source: WDI

Table 7 shows that 5-years average of the growth GDP per capita and health expenditure per capita growth are higher in lower middle income and upper-middle income countries than low-income and high-income countries. So, there might be a convergence between income groups of countries. But fertility rates are low in high income and upper-middle income countries. GFCF is also higher in high-income and upper-middle income countries. The mean values of trade as a ratio of GDP and initial level of GDP per capita are also higher in high income and upper-middle income countries.

Table 7: Descriptive Statistics for High-Income Countries and Upper-Middle Income Countries for Model 2

Variables	High-income Countries					Upper-Middle Income Countries				
	Obs.	Mean	Std.Dev.	Min	Max	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	243	1.87	2.53	-9.45	9.42	224	3.37	5.55	-12.8	51.62
GFCF	251	0.26	0.06	0.06	0.65	228	0.22	0.09	0.06	0.61
Trade	249	101.68	64.15	16.67	400.2	226	89.46	48.68	16.63	436.57
LFP	240	61.19	7.19	47.1	86.6	218	60.59	9.81	40.5	87.2
Fertility	250	1.85	0.61	1.15	5.34	225	2.63	1.12	1.18	7.08
HEPC growth	200	0.25	0.19	-0.19	1.04	182	0.38	0.34	-0.19	1.85
İnitial GDP per capita	248	31147.98	19406.89	5134.61	103588.6	224	5491.06	3009.19	858.93	23120.83

Source: WDI

[9] The descriptive statistics of variables by regions for model 2 are given in appendix part.

Table 8: Descriptive Statistics for Low-Income Countries and Lower-Middle Income Countries for Model 2

Variables	Low-Income Countries					Lower-Middle Income Countries				
	Obs.	Mean	Std.Dev.	Min	Max	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	117	2.02	5.5	-9.46	37.12	194	3.01	3.32	-13.63	12.67
GFCF	118	0.14	0.07	0.02	0.43	195	0.18	0.09	0.02	0.52
Trade	114	60.64	28.2	23.87	257.86	187	74.02	30.88	0.19	163.52
LFP	118	74.85	9.81	50.6	88.9	195	62.88	9.8	43.5	82.5
Fertility	118	5.69	1.06	2.34	7.74	195	3.69	1.35	1.16	7.52
HEPC growth	94	0.25	0.29	-0.4	1.39	156	0.32	0.26	-0.24	1.39
İnitial GDP per capita	117	500.07	208.08	122.48	1268.1	190	1487.69	865.72	237.95	4047.89

Source: WDI

Different from model 1, health expenditures per capita growth is used as a health indicator instead of life expectancy. As discussed before, health status could be employed as an indicator of human capital. So, an increase in health expenditures might increase human capital level as well as population and individual health level. Then, the supply of labor and product are increased thanks to improved health status.

This thesis' empirical methods is to estimate equations similar to Barro-type Growth regression using STATA statistical package. Model 2 use health expenditures as a health indicator between 1995-2014. So, panel least square (PLS) method has employed for model 2. PLS is also used for sub-samples that are classified by income level and by geographic region.

Consider the following model 2:

$$y_{it} = \beta_0 + \beta_1 lnGFCF_{it} + \beta_2 lnTrade_{it} + \beta_3 lnLFP_{it} + \beta_4 lnLHEPC_{it} + \beta_5 lnFertility_{it} + \beta_6 lnGDP_{it} + \varepsilon_{it}$$

$$y_{it} = real\ gdp\ per\ capita\ growth$$

$$lnGFCF_{it} = gross\ fixed\ capital\ formation(\%\ of\ GDP)$$

$$lnTrade_{it} = \text{the ratio of import plus export to GDP}$$

$$lnLFP_{it} = Labor\ force\ partipation\ (\%\ of\ GDP)$$

$$lnHEPC_{it} = Health\ expenditures\ per\ capita\ growth$$

$$lnFertility_{it} = Fertility\ rate$$

$$lnGDP_{it} = Initial\ GDP\ per\ capita$$

$$\varepsilon_{it} = error\ term$$

All variables are used in the logarithmic form. However,5-years average of variables is used in fixed effects and robust panel regression for model 2.

4.2. Empirical Results

4.2.1. Empirical Results for Model 1

Based on two different models in this study, the panel least squares with fixed effect is employed to see the role of life expectancy and health expenditures regarding health status on long-run economic growth all over the world. Therefore, same regression is applied by income and region classifications separately. The results of the regressions are displayed for model 1 in the following tables:

Table 9: Regression Results for Model 1

Model 1- Regression Results		
	Coefficient	Standard Errors
lnLife expectancy	10,2958***	2,8215
lnGFCF	2,7520***	0,5482
lnTrade	0,3364	0,6520
lnLFP	-4,3788	3,1040
lnFertility	-3,3085***	0,9466
lnInitial GDP per capita	-3,9098***	0,4367
Constant	2,8799	15,6190
Number of Observations	542	
R-sq (within)	0,3068	
F statistics (prob.)	28,35 (0,0000)	

Note: *** % 1 significance level, **% 5 significance level, *% 10 significance level

As shown in Table 9, the within r-square value is about 0.31.This means that the independent variables of model 1 such as gross fixed capital formation, trade, labor force participation, life expectancy, fertility rate and initial GDP per capita explain about 32 percent of the variation in the growth of the real GDP per capita. So the remaining variation is explained by other factors.

Life expectancy as a health indicator affected real per capita GDP growth with 1 percent significance level as expected and discussed in literature review part. However, it would be said that a one percent increase in life expectancy would result in 0.10 percentage points increase in GDP per capita growth. So, these results are in parallel with the studies of previous studies such as Barro (1996), Bloom et, al (2004), Gallup and Sachs (2000), Acemoglu and Jonson (2007).

Fertility rate affects negatively per capita GDP growth with 1 percent significance level as expected. Due to the results, a one percent increase in fertility rate would result in 0.033 percentage points decrease in per capita GDP capita growth. So, this is also parallel with the empirical literature.

GFCF also has a positive and significant effect on the growth of real GDP per capita. As discussed in the data section, increase in gross fixed capital formation would increase investment, therefore increase in GDP. It would be said that a one percent increase in GFCF is associated with 0,027 percentage points change in GDP per capita growth.

Model 1 takes the initial GDP per capita as an explanatory variable to test convergence between countries. So, initial real GDP per capita is the real GDP per capita of the years of 1960, 1970, 1980, 1990, 2000 and 2010 values of each country. Due to the results, initial GDP per capita has a negative and significant effect on real GDP per capita growth which indicates convergence as expected. A one percent increase in initial GDP is associated with -0,039 percentage points change in GDP per capita growth. Besides, it is found that trade and labor participation rate have not a significant effect for model 1.

However, to make a comparative analysis, model 1 is re-estimated by income classification of World Bank country classification criteria. So, due to this classification, models are run separately for each group. Regression results for each cluster are listed in below table.

Table 10: Regression Results for Model 1 by Income Classifications

Independent Varibles	High-Income		Low-Income		Lower-Middle Income		Upper-Middle Income	
	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.
lnLife expectancy	2,5155*	17,6788	7,4791**	2,9275	16,8006**	6,8612	33,5764**	13,8783
lnGFCF	-3,6626**	1,1874	1,3314**	0,6090	4,7192**	1,6864	4,8779**	1,6055
lnTrade	5,9718***	1,4983	1,1309	2,2016	-1,5422	1,7487	-0,5945	1,5384
lnLFP	45,6114***	9,4140	-1,3778	5,2969	-15,9178*	8,2123	-3,3642	5,4595
lnFertility	-3,9394**	1,8184	-1,0517	2,4486	-4,6441**	1,7442	-1,7548	2,5283
lnInitial GDPPC	-10,7416***	1,3429	-4,6005**	1,3449	-4,9256***	1,2513	-4,3577***	0,6643
Constant	-104,546	99,0918	-0,7080	1,3449	31,7672	43,2471	-100,2005	66,5427
Number of Obs.	168		88		129		157	
R-sq (within)	0,3436		0,3544		0,4737		0,3366	
F statistics (prob.)	64,05 (0,0000)		3,64 (0,0110)		20,21 (0,0000)		21,51 (0,0000)	

Note: *** % 1 significance level, **% 5 significance level, *% 10 significance level

The results indicate that the coefficients of life expectancy are positive and significant for all income groups. So, any increase in life expectancy would stimulate economic growth. As expected, an increase in life expectancy is the less efficient on economic the growth in high-income countries. One probable reason of this is life expectancy in high-income countries are so high such as 83 in Japan, 82 in Spain in 2013 due to World Bank health statistics. Then many of old people retired and they are out of from labor force, then they are a burden on the active labor force. Besides, it is found that the effect of life expectancy on GDP per capita growth is high in upper-middle income countries with the coefficient of 33.57 compare to lower-middle income countries with the coefficient of 16.80, low-income countries with the coefficient of 7.47 and high-income countries with the coefficient of 2.15. However, it would be said that a one percent increase in life expectancy would result in 0.33 percentage points increase in GDP per capita growth in upper-middle income countries, 0.16 percentage points increase in GDP per capita growth in lower-middle income countries, 0.07 percentage points increase in GDP per capita growth in low-income countries and 0.02 percentage points increase in GDP per capita growth in high-income countries. These results also show that higher life expectancy in lower-middle income and upper-middle income countries results in an increase in population at first, then result in more active and productive labor force. Finally, all of these change would stimulate economic growth.

The fertility rate is significant only for high-income and lower-middle income countries. Due to the results, a one percent increase in fertility rate would result in

0,039 percentage points decrease in per capita GDP capita growth in high-income countries and 0,046 decrease in per capita GDP capita growth in lower-middle income countries. So, this is also parallel with the empirical literature.

The results also indicate that the coefficients of GFCF are positive and significant for all income groups except high-income countries. It would be said that a one percent increase in GFCF is associated with 0.013 percentage points change in GDP per capita growth in low-income countries, 0.047 percentage points change in lower-middle income countries, 0,048 percentage points change in upper-middle income countries and -0.036 percentage points change in high-income countries, respectively.

Trade is positive and significant only for high-income countries. Due to the results, a one percent increase in trade would lead to 0.059 percentage points increase in per capita GDP capita growth. One possible explanation of this that trade data are more reliable and eligible in high-income countries, and there are excessive exports in these countries, so economic growth is affected positively by many ways such as new potential markets, increasing technological progress concerning the higher trade balance.

LFP is positive and significant only for high-income countries, and it is negative and significant only for lower-middle income countries. A one percent increase in LFP is associated with 0,45 percentage points change in GDP per capita growth in high-income countries, -0,015 percentage points change in lower-middle income countries. A possible explanation behind this negative effect in lower-middle income countries is that there might be higher unemployment despite their labor force participation. So, higher unemployment could have a negative impact on the economic growth in lower-middle income countries irrespective of its labor force size.

Initial GDP per capita has a negative and significant effect on economic growth for all income groups, as expected. Besides, a one percent increase in initial GDP per capita cause 0.1 percentage points decrease in the growth of GDP per capita in high-income countries, 0.046 percentage points decrease in low-income countries, 0.049 percentage points decrease in lower-middle income countries and 0.43 percentage points decrease in upper-middle income countries. Initial GDP per capita is the most

efficient on the economic growth in high-income countries, so there could be a convergence between income groups.

However, to make more comparative analysis, model 1 is re-estimated by region classification of World Bank country classification criteria. So, due to this classification, models are run separately for each group. Regression results for each cluster are listed in below table[10].

Table 11: Regression Results for Model 1 by Regions

Independent Var.	EAS		ECS		LCN		MEA		SSF	
	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.
lnLife expectancy	17.03	17.14	62,99***	17.23	9,52	8.3	17,17	17.88	9,14**	13,8783
lnGFCF	3.71**	1.4	8,96***	1.42	3,02**	1.02	2,33*	1.36	1,54**	1,6055
lnTrade	0.77	1.27	-2,09	1.58	0,43	1.5	-1,47	2.65	1,64	1,5384
lnLFP	18.76*	9.75	-3,28	7.26	10,09*	4.92	-19,24	15.48	-3,99	5,4595
lnFertility	-1.88	2.08	-5,67*	2.87	-3,57*	2.04	-1,06	3.49	-2,82*	2,5283
lnInitial GDPPC	-1.77**	0.68	-7,77***	1.22	-4,32***	0.86	-6,60***	1.4	-3,47***	0,6643
Constant	-147.05	97.15	-198,33***	57.03	-51,41	33.75	61,66	115.42	-0,93	66,5427
Number of Obs.	56		152		97		58		146	
R-sq (within)	0,3938		0,5752		0.6113		0.4181		0.3101	
F statistics (prob.)	10,46 (0,0002)		25,18 (0,0000)		22.16(0,0000)		7.79 (0,0005)		30.31 (0,0000)	

Note: *** % 1 significance level, **% 5 significance level, *% 10 significance level

The results indicate that the coefficients of life expectancy are positive and significant only for ECS and SSF regions countries. It would be said that a one percent increase in life expectancy is associated with 0.62 percentage points change in GDP per capita growth in ECS countries and 0.094 percentage points change in SSF countries. So, higher life expectancy or longer lifespan is very important for Sub-Saharan Africa which is the least developed region of the world.

The fertility rate has a negative and significant effect on the economic growth only for ECS and SSF countries. Due to the results, a one percent increase in fertility rate would lead to 0.056 and 0.028 percentage points decrease in per capita GDP capita growth in ECS and SSF regions, respectively.

GFCF has a positive effect on the economic growth with a different significance level for all regions as expected. Due to the results, a one percent increase in GFCF would cause 0.037, 0.089, 0.03, 0.023 and 0.015 percentage points increase in per capita GDP capita growth in EAS, ECS, LCN, MEA and SSF regions, respectively.

[10] NAC and SAS regions are not estimated for model 1 because of insufficient data.

Trade is insignificant for all regions, and LFP has slightly positive and significant effect on the economic growth only for EAS and LCN regions. Due to the results, a one percent increase in fertility rate would result in 0.18 and 0.1 percentage points increase in per capita GDP capita growth in EAS and LCN regions, respectively.

Initial GDP per capita has a negative and significant effect on economic growth for all regions, as expected. Besides, a one percent increase in initial GDP per capita cause 0.017 percentage points decrease in the growth of GDP per capita in EAS region, 0.07 percentage points decrease ECS region, 0,043 percentage points decrease in LCN region, 0,066 percentage points decrease in MEA regions, and 0.034 percentage points decrease in SSF region. Initial GDP per capita is the most efficient on the economic growth in high-income regions such as ECS and MEA, so there could be a convergence between regions.

4.2.2. Empirical Results for Model 2

This second model examines the impact of health expenditures on economic growth using panel least square method for all over the World. Then, to have a comparative analysis, same regression is employed by income and region classification separately. The results of the regressions are displayed for model 2 in table 12, 13 and 14:

Table 12: Regression Results for Model 2

Model 2- Regression Results		
	Coefficient	Standard Errors
lnHEPC growth	0.18**	0.07
lnGFCF	0.55	0.26
lnTrade	0.09**	0.15
lnLFP	-2.87***	2.27
lnFertility	-1.99	0.54
lnInitial GDP per capita	-1.09***	0.19
Constant	24.42**	9.63
Number of Obs.	488	
R-sq (within)	0.13	
F statistics (prob.)	9.54 (0,0000)	

Note: *** % 1 significance level, **% 5 significance level, *% 10 significance level

The within r-square value is about 0.13 which is lower than model 1. This means that the independent variables of model 2 such as gross fixed capital formation, trade, labor force participation, health expenditures per capita growth, fertility rate and initial GDP per capita explain about 13 percent of the variation in the growth of the real GDP per capita. So the remaining variation is explained by other factors that stayed out of the model.

HEPC growth as a health indicator affected real per capita GDP growth with 5 percent significance level as expected and discussed in literature review part. However, it would be said that a one percent increase in HEPC growth would result in 0.18 percent increase in GDP per capita growth. So, these results are in parallel with the studies of previous studies such as Rivera and Currais (1999), Heshmati (2001) Dreger and Reimers (2005), Wang (2006) and Eryigit et al. (2012).

The trade that is import plus export ratio to GDP also has a positive and significant effect on the growth of real GDP per capita. As discussed in the data section, an increase in trade openness would increase investment, therefore increase in GDP. It would be said that a one percent increase in trade ratio is associated with 0.09 percent increase in GDP per capita growth.

Model 2 takes the initial GDP per capita as an explanatory variable to test convergence between countries as well as Model 1. So, initial real GDP per capita is the real GDP per capita of the years of 1995, 2000, 2005, 2010 and 2014 values of each country. Due to the results, initial GDP per capita has a negative and significant effect on real GDP per capita growth which indicates convergence as expected. A one percent increase in GFCF is associated with 1.09 percent decrease in GDP per capita growth.

Labor force participation effects negatively per capita GDP growth with 1 percent significance level. Due to the results, a one percent increase in fertility rate would result in 2.87 percent decrease in per capita GDP capita growth.

Besides, it is found that fertility rate and gross fixed capital formation have not a significant effect for model 2.

However, to make the comparative analysis, model 2 is re-estimated by income classification of World Bank country classification criteria. So, due to this

classification, models are run separately for each group. Regression results for each group are listed in below table.

Table 13: Regression Results for Model 2 by Income Classifications

Independent Varibles	High-Income		Low-Income		Lower-Middle Income		Upper-Middle Income	
	Coeff.	Std.Err	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.
lnHEPC growth	0.39*	0.22	1.83**	0.44	0.49*	0.29	0.47***	1.35
lnGFCF	0.56	0.74	1.48***	0.19	0.43**	0.26	0.89	0.9
lnTrade	0.40	0.94	0.05	0.185	-0.06	0.06	1.91	1.5
lnLFP	-7.42**	3.68	1.63	2.32	-4.57**	1.91	-10.16*	5.5
lnFertility	-3,97	1.32	-4.35**	1.29	2.31	1.08	-4.22**	2.52
lnInitial GDPPC	-4.99**	1.68	-5.79***	0.82	-0.7	0.45	-5.99**	2.18
Constant	64.31**	26.71	30.45**	11.71	23.3	8.85	-102.42	30.57
Number of Obs.	153		80		166		186	
R-sq (within)	0,29		0.22		0.14		0.22	
F stat. (prob.)	8.23 (0,0000)		6.48(0,00.4)		3.47 (0,0003)		11.54 (0,0000)	

Note: *** % 1 significance level, **% 5 significance level, *% 10 significance level

The results indicate that the coefficients of health expenditures per capita growth are positive and significant for all income groups. So, any increase in health expenditures per capita growth would stimulate economic growth. As expected, an increase in HEPC growth is the less efficient on the economic growth in high-income countries. One probable reason of this is HEPC in high-income countries are so high such as 8900$ in the USA, 9700$ in Norway in 2013 due to World Bank health statistics. Besides, it is found that the effect of HEPC growth on GDP per capita growth is high low-income countries with the coefficient of 1.83 compared to lower-middle income countries with the coefficient of 0.49, upper-middle income countries with the coefficient of 0.47 and high-income countries with the coefficient of 0.39. However, it would be said that a one percent increase in HEPC growth would result in 0.47 percent increase in GDP per capita growth in upper-middle income countries, 0.49 percent increase in GDP per capita growth in lower-middle income countries, 1.83

percent increase in GDP per capita growth in low- income countries and 0.39 percent increase in GDP per capita growth in high income countries. These results also show that higher health expenditures in all income groups lead to an increase in human capital and health status of a population at first, then result in more active and productive labor force. Finally, all of these change would stimulate economic growth.

The fertility rate is significant only for low-income and upper-middle income countries. Due to the results, a one percent increase in fertility rate would result in 4.34 percent decrease in per capita GDP capita growth in low-income countries and 4.22 percent decrease in per capita GDP capita growth in upper-middle income countries. So, this is also parallel with the empirical literature.

The results also indicate that the coefficients of GFCF are positive and significant only for low-income and lower-middle income countries. It would be said that a one percent increase in GFCF is associated with 1.48 percent increase in GDP per capita growth in low-income countries, 0.43 percent increase in lower-middle income countries.

The results also indicate that the coefficients of LFP are negative and significant for all income groups except low-income countries. A one percent increase in LFP is associated with 7.42 percent decrease in GDP per capita growth in high-income countries, 4.57 percent decrease in lower-middle income countries, 10.16 percent reduction in these income groups of countries. A possible explanation behind this negative effect in these income groups is that there might be higher unemployment despite their labor force participation. So, higher unemployment could have a negative impact on the economic growth in these income groups irrespective of its labor force size.

Initial GDP per capita has a negative and significant effect on economic growth except for lower-middle income countries, as expected. Besides, a one percent increase in initial GDP per capita cause 4.99 percent decrease in the growth of GDP per capita in high-income countries, 0.82 percent decrease in low-income countries, and 5.99 percent decrease in upper-middle income countries a. Initial GDP per capita is the most efficient on the economic growth in high-income countries, so there could be a convergence between income groups.

Besides, it is found that Trade variable has no significant effect on any income group for model 2.

However, to make more comparative analysis, model 2 is re-estimated by region classification of World Bank country classification criteria. So, due to this classification, models are run separately for each group. Regression results for each group are listed in below table[11].

Table 14: Regression Results for Model 2 by Regions

Independent Varibles	EAS		ECS		LCN		MEA		SSF	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
lnHEPC growth	-0.21**	17.14	0.43***	0.11	0.29*	0.43	-0.22**	0.09	1.21*	0.56
lnGFCF	1.31**	1.4	0.01	0.28	1.17	1.52	0.44	0.85	0.17	0.46
lnTrade	-0.2*	1.27	-0.02	0.31	2.84**	0.99	0.48	1.63	-1.2	1.17
lnLFP	-6.93	9.75	-9.61**	3.68	4.36	1.74	9.44**	3.18	4.68	2.99
lnFertility	-2.45	2.08	-0.98	0.99	-0.01	2.03	-0.42	2.3	-1.84**	7.89
lnInitial GDPPC	-0.88*	0.68	-1.48**	0.31	-0.75	1.56	-0.66	1.08	-0.46**	6.1
Constant	42.24**	97.15	55.31***	15.21	-20.8	20.6	-31.71*	15.34	-142.09**	53.34
Number of Obs.	56		165		78		42		109	
R-sq (within)	0.2		0.28		0.21		0.3		0.25	
F stat. (prob.)	4.88 (0,0069)		9.63(0,0000)		2.83(0,0315)		4.30 (0,0009)		5.73 (0,0000)	

Note: *** % 1 significance level, **% 5 significance level, *% 10 significance level

The results indicate that the coefficients of HEPC growth are significant for all regions. It would be said that a one percent increase in HEPC growth is associated with -0.21 percent decrease in GDP per capita growth in EAS countries, 0,43 percent increase in ECS countries, 0.29 percent increase in GDP per capita growth in LCN countries, 0,22 percent decrease in MEA countries and 1.21 percent increase in GDP per capita growth in SSF countries. So, higher health expenditures are very important for Sub-Saharan Africa which is the least developed region of the world.

The fertility rate has a negative and significant effect on the economic growth only for SSF countries. Due to the results, a one percent increase in fertility rate would result in 1.84 percent decrease in per capita GDP capita growth in SSF region.

[11] NAC and SAS regions are not estimated for model 2 because of insufficient data.

GFCF has a positive effect on the economic growth only for EAS region as Due to the results, a one percent increase in GFCF would result in 1.31 percent increase in per capita GDP growth in EAS region.

Trade has a significant effect on the economic growth only for EAS and LCN regions. Due to the results, a one percent increase in trade would result in 0.2 percent decrease in per capita GDP capita growth in EAS region, and 2.84 percent increase in per capita GDP capita growth in EAS region

LFP has a significant effect on the economic growth only for ECS and MEA regions. Due to the results, a one percent increase in LFP would result in 9.61 percent decrease and 9.44 percent increase in per capita GDP capita growth in ECS and MEA regions, respectively.

Initial GDP per capita has negative a and significant effect on economic growth for EAS, ECS and SSF regions. Besides, a one percent increase in initial GDP per capita cause 0.88 percent decrease in the growth of GDP per capita in EAS region, 1.48 percent decrease ECS region, 0.46 percent decrease in SSF region. Initial GDP per capita is the most efficient on the economic growth in high-income regions such as ECS, so there could be a convergence between regions.

5. CONCLUSION

There has been a widespread view that the health status of individuals and population could positively affect living standards of that nation and its long-run economic growth. So, health is admitted to be required and primary component of the welfare of individual and society as a whole. and sustainable development and economic growth. Moreover, almost all of the previous research suggests that improvement of health status, especially regarding higher life expectancy and increasing health expenditures, lead to increases in the long-run economic growth.

In the literature, the most common health indicators that affect the long-run economic growth are life expectancy at birth, fertility rate, crude death rate, infant mortality, health expenditures, and health expenditures per capita. In this study, life expectancy and health expenditure per capita growth are used to see health role on the economic growth. Life expectancy is mostly found significant and positive for the long run economic growth. And, health expenditures per capita is another health indicator which is used in the comparison of countries because the sustainable development and growth could be provided by having a healthy population. So, qualified health services and adequate health expenditures are required for having a healthy population. However, international comparison of the health expenditures is also important for policy-makers to monitor health status and the growth level of other countries.

In this study, the role of health on the economic growth has investigated by two different models with panel least square method. In the first model, life expectancy is used as a health indicator to see health effect on the long run economic growth over the period of 1960 to 2014. In the second model, the growth of health expenditures per capita is used as a health indicator to see health effect on the long run economic growth over the period of 1995 to 2014. However, countries are classified by their income levels and their geographic regions due to World Bank classifications criteria to compare health effect on the economic growth between these groups.

According to the regression results, life expectancy has a positive and significant impact on the GDP per capita growth for all over the world in model 1. The

results indicate that the coefficients of life expectancy are positive and significant for all income group of countries. However, higher life expectancy in low-income and lower-middle income countries have a stronger effect on the GDP per capita growth than other income groups. The results also state that the coefficient of life expectancy is positive and significant only for ECS and SSF regions. So, higher life expectancy is crucial for Sub-Saharan African countries.

Regression results of Model 2 show that the growth of health expenditures per capita has a positive and significant effect on the growth of GDP per capita all over the world. The results also indicate that HEPC growth also has a positive and significant impact on the long-run economic growth for all income group of countries. Besides, HEPC growth has the least effect on the economic growth in high-income countries. The results also indicate that the coefficients of HEPC growth are positive and significant for all regions, and higher health expenditures affect heavily on the economic growth in the Sub-Saharan African region which is the least developed region of the world.

In conclusion, this study states that there has been a positive and significant relationship between health status in the context of life expectancy and health expenditures per capita and long-run economic growth. Therefore, health-oriented growth policy is suggested for countries irrespective of its income group or its geographic region which aim to have sustainable economic growth and development.

6. REFERENCES

Acemoglu, D. & Johnson, S. 2007. Disease and development: the effect of life expectancy on economic growth. **Journal of Political Economy**. 115(6), 925-985.

Aghion, P. Howitt, P. & Murtin, F. 2010. The relationship between health and growth: when Lucas meets Nelson-Phelps (No. w15813). **National Bureau of Economic Research**.

Aísa, R. & Pueyo, F. 2004. Endogenous longevity, health and economic growth: a slow growth for a longer life. **Economics Bulletin**. 9(3), 1-10.

Asghar, N. Awan, A. & Hafeez ur Rahman 2012. Human Capital and Economic Growth in Pakistan: A Cointegration and Causality Analysis, **Intemational Joumal of Economics and Finance**. 4(4), 135-147.

Ashraf, Q. H. Lester, A. & Weil, D. N. 2008. When does improving health raise GDP?. **NBER macroeconomics annual**. 23(1), 157-204.

Baltagi, B.H. 2005. **Econometric Analysis of Panel Data**, 3rd edition, John Wiley&Sons Ltd. West Sussex, England.

_____. 2008. **Econometric Analysis of Panel Data**. John Wiley & Sons.

_____. 2011. **Econometrics**, Fifth Edition, Springer, New York.

Barro, R. 1996. Health and economic growth. **World Health Organization.**

_____. 1991. Economic growth in a cross section of countries. **The quarterly journal of economics**. 106(2), 407-443.

_____. 1999. Determinants of Economic Growth: A Cross Country Empirical Study. **MIT Press**. Cambridge, MA.

Barro, R. J., & Lee, J. W. 1994.. Sources of economic growth. **In Carnegie-Rochester conference series on public policy** (Vol. 40, pp. 1-46). North-Holland.

Becker, G. S. 1964. **Human Capital Theory**. Columbia, New York.

Becker, G. S., Murphy, K. M., & Tamura, R. 1990. Human capital, fertility, and economic growth. **Journal of political economy**. 98(5, Part 2), S12-S37.

Bhargava, Alok, Jamison, Dean T., Lau, Lawrence and Murray, Christopher JL. 2001. Modeling The Effects Of Health On Economic Growth, **Journal of Health Economics**, 20 (3), 423-440.

Bloom, D. E. & Canning, D. 2005. Schooling, health and economic growth: reconciling the micro and macro evidence. unpublished, **Harvard School of Public Health**.

_____. 2009. Population health and economic growth. **Health and Growth**. 53.

Bloom, D. E. Canning, D. & Graham, B. 2003. Longevity and life-cycle savings. **The Scandinavian Journal of Economics** 105(3), 319-338.

Bloom, D. E., Canning, D., & Sevilla, J. 2001. The effect of health on economic growth: theory and evidence (No. w8587). **National Bureau of Economic Research**.

Bloom, D. E. Sachs, J. D. Collier, P., & Udry, C. 1998. Geography, demography, and economic growth in Africa. **Brookings papers on economic activity**. 1998(2), 207-295.

Bloom, D. Malaney, P. 1998 Macroeconomic Consequences of the Russian mortality crisis, **World Development**. Vol.26, pp. 2073-2085.

Bloom, David E. Canning, David and Sevilla, Jaypee 2004. The Effect Of Health On Economic Growth: A Production Function Approach, **World Development** 32 (1), 1-13.

Caselli, F. Esquivel, G., & Lefort, F. 1996. Reopening the convergence debate: a new look at cross-country growth empirics. **Journal of Economic Growth**, 1(3), 363-389.

Chakraborty, S. 2004. Endogenous Lifetime and Economic Growth',**Journal of Economic Theory**, Vol.116, pp. 119-137.

Chang, K. & Ying, Y. H. 2006. Economic growth, human capital investment, and health expenditure: a study of OECD countries. **Hitotsubashi Journal of Economics**. 1-16.

Cole, M.A. Neumayer, E. 2005. The Impact of Poor Health on Total Factor Productivity. **Journal of Development Studies**,.Vol.42, pp. 918–938.

Cooray, A. 2013. Does health capital have differential effects on economic growth?. **Applied Economics** Letters.20(3), 244-249.

Çetin, M. & Ecevit, E.2010. Sağlık Harcamalarının Ekonomik Buyume Uzerindeki Etkisi: OECD Ulkeleri Uzerine Bir Panel Regresyon Analizi, **Doğuş Universitesi Dergisi**. 11 (2) 2010, 166-182.

Deaton, A. 2003. Health, inequality, and economic development. **Journal of Economic Literature**. 41(1), 113-158.

Devlin, N. Hansen, P., 2001. Health care spending and economic output: Granger-causality. **Applied Economics Letters** 8: 561–564.

Dreger, Christian ve Reimers Hans-Eggert. 2005. Health Care Expenditures in OECD Countries: A Panel Unit Root And Cointegration Analysis. **Iza Discussion Paper**. 1469, s. 1-20..

Erdil, E. Yetkiner, I.H. 2004. Theory and Evidence on Income-Health Causality. (3rd ed), **International Conference on Health Economics, Management & Policy**. Athens.

Erdoğan, S. & Bozkurt, H. 2008. Turkiye'de Yaşam Beklentisi-Ekonomik Buyume ilişkisi: ARDL Modeli İle Bir Analiz. **Bilgi Ekonomisi ve Yonetimi Dergisi**. 3(1), 25-38.

Eryigit, S.B. Eryigit, K.Y. & Selen, U. 2012. The Long-run Linkages between Education, Health and Defence Expenditures and Economic Growth: Evidence from Turkey. **Defence and Peace Economics**. 23(6), December, 559 – 574.

Gallup, J. L. & Sachs, J. D. 2001. The economic burden of malaria. **The American journal of tropical medicine and hygiene**. 64(1_suppl), 85-96.

Gong, L. Li, H. & Wang, D. 2012. Health İnvestment, Physical Capital Accumulation, and Economic Growth. **China Economic Review**. 23, 1104-1119.

Greene, W.H. 2003. Econometric Analysis. Fifth Edition, Pearson Education, Inc. Upper Saddle River, New Jersey.

Grossman, M. 1972. On the concept of health capital and the demand for health. **Journal of Political Economy**. 80(2), 223-255.

Gyimah-Brempong, K. & Wilson, M. 2004. Health Human Capital and Economic Growth in Sub-Saharan African and OECD Countries. **The Quarterly Review of Economics and Finance**. 44(2) 296-320.

Hamoudi, A. A. & Sachs, J. D. 1999. Economic consequences of health status: a review of the evidence (No. 30). **Center for International Development at Harvard University.**

Hartwig, J. 2010. Is health capital formation good for long-term economic growth?–Panel Granger-causality evidence for OECD countries. **Journal of Macroeconomics.** 32(1), 314-325.

Heshmati, A. 2001. On the causality between GDP and Health Care Expenditure in Augmented Solow Growth Model. **Department of Economic Statistics Stockholm school of Economics**.

Knowles, S. & Owen, P. D. 1995. Health capital and cross-country variation in income per capita in the Mankiw-Romer-Weil model**. Economics Letters**.48(1), 99-106.

Lee, R. 2003. The demographic transition: three centuries of fundamental change. **The journal of economic perspectives**, 17(4), 167-190.

Lorentzen, P. McMillan, J., & Wacziarg, R.2008. Death and development. **Journal of economic growth**. 13(2), 81-124.

Lucas, R. E. 1988. On the mechanics of economic development. **Journal of monetary economics**. 22(1), 3-42.

Malik, G. 2006. An examination of the relationship between health and economic growth. **ICRIER**. Working Paper # 185.

Mankiw, N. G. Romer, D. & Weil, D. N. 1992. A contribution to the empirics of economic growth. **The quarterly journal of economics**. 107(2), 407-437.

McDonald, S. ve Roberts, J. 2002. Growth and multiple forms of human capital in an augmented Solow model: a panel data investigation. Economic Letters, 74, ss. 271- 276.

Mehrara, M. & Musai, M. 2011. Granger causality between Health and Economic Growth in oil exporting countries. **Interdisciplinary Journal of Research in Business**. 1(8), 103-108.

Mushkin, S. J. 1962. Health as an Investment. **Journal of political economy**. 70(5, Part 2), 129-157.

Muysken, J. Yetkiner, I. H., Ziesemer, T. 2003. **Health, Labor Productivity and Growth in Growth Theory and Growth Policy** (Eds. Harald Hagemann and Stephan Seiter), Routledge, London

Narayan, S., Narayan, P. K., & Mishra, S. 2010. Investigating the relationship between health and economic growth: Empirical evidence from a panel of 5 Asian countries. **Journal of Asian Economics**. 21(4), 404-411.

Peykarjou, K. Gollu, R. B. Gashti, H. P., & Shahrivar, R. B. 2011. **Interdisciplinary journal of contemporary research in business**.

Preston, S. H. 1975. The Changing Relation between Mortality and Level of **Economic Development Population Studies**. Vol. 29**,** pp. 231-248.

Pritchett, L. & Summers, L. H. 1996. Wealthier is Healthier. **The Journal of Human Resources**. vol.31**,** pp. 841-868.

Rengin, A. K. 2012. The relationship between health expenditures and economic growth: Turkish case. **International Journal of Busi-ness Management & Economic Research**. 3(1), 404-409.

Rivera, B. & Currais, L. 1999. Income variation and health expenditure: evidence for OECD countries. Review of Development Economics. 3(3), 258-267.

_____. 2003. The Effect of Health Investment on Growth: A Causality Analysis. **International Advances in Economic Research**. Vol. 9, no. 4, pp. 312−323.

Romer, P. M. 1986. Increasing returns and long-run growth. **Journal of political economy**. 94(5), 1002-1037.

Sachs, J. D. & Warner, A. M. 1997. Fundamental sources of long-run economic growth. **The American Economic Review**. 183-188.

Sachs, J. D. & Warner, A. M. 1997. Sources of slow growth in African economies. **Journal of African Economies**. 6(3), 335-376.

Selim, S. Uysal, D. & Eryiğit, P. 2014. Türkiye'de Sağlık Harcamalarının Ekonomik Büyüme Üzerindeki Etkisinin Ekonometrik Analizi. **Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi**. 7(3), 13-24.

Solow, R. M. 1956. A contribution to the theory of economic growth. **The quarterly journal of economics**. 70(1), 65-94.

Suhrcke, M. McKee, M., Mortensen, J., Arce, R. S., & Tsolova, S. 2005. The contribution of health to the economy in the European Union. **Luxembourg: Office for Official Publications of the European Communities**.

Swift, R. 2011. The Relationship between Health and GDP in OECD Countries in the very Long Run. **Health Economics**. Vol. 20, pp.306-322.

Taban, S. & Kar, M. 2006. Beşeri Sermaye ve Ekonomik Buyume: Nedensellik Analizi, 1969-2001. **Anadolu Universitesi, Sosyal Bilimler Dergisi.** 6(1), 159-181.

Taban, S. 2006. Turkiye'de Sağlık ve Ekonomik Buyume Arasındaki Nedensellik İlişkisi. **Sosyoekonomi**. 2, 31-46.

Van Zon, A. & Muysken, J. 2001. Health and endogenous growth. **Journal of Health Economics**. 20(2), 169–185.

Wang, K. M. 2011. Health care expenditure and economic growth: Quantile panel-type analysis. **Economic Modelling**. 28(4), 1536-1549.

Weil, D. N. 2007. Accounting for the effect of health on economic growth. The quarterly journal of economics, 122(3), 1265-1306.

Yardimcioglu, F. 2012. OECD Ülkelerinde Sağlık ve Ekonomik Büyüme İlişkisinin Ekonometrik Bir İncelemesi. **Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi** 13(2).

Yetkiner, İ. Hakan 2006. Sağlık ile Büyüme (Growth with Health), **Ege Academic Review**. 6 (2), 83-91.

Yumuşak, İ.G. & Yıldırım, D.Ç. 2009. Sağlık Harcamaları İktisadi Buyume İlişkisi Uzerine Ekonometrik Bir İnceleme. **Bilgi Ekonomisi ve Yonetimi**. 4(1), 57-70.

7. APPENDIX

7.1. Country List for Model 1 and Model 2

Albania	Cyprus	Kenya	Qatar
Algeria	Czech Republic	Kuwait	Romania
Angola	Denmark	Kyrgyzstan	Russian Federation
Antigua and Barbuda	Djibouti	Lao People's DR	Rwanda
Argentina	Dominica	Latvia	Saudi Arabia
Armenia	Dominican Republic	Lebanon	Senegal
Australia	Ecuador	Lesotho	Serbia
Austria	Egypt	Liberia	Seychelles
Azerbaijan	El Salvador	Lithuania	Sierra Leone
Bahamas	Equatorial Guinea	Luxembourg	Singapore
Bahrain	Estonia	Madagascar	Slovakia
Bangladesh	Ethiopia	Malawi	Slovenia
Barbados	Fiji	Malaysia	South Africa
Belarus	Finland	Maldives	Spain
Belgium	France	Mali	Sri Lanka
Belize	Gabon	Malta	Sudan (Former)
Benin	Gambia	Mauritania	Suriname
Bermuda	Georgia	Mauritius	Swaziland
Bhutan	Germany	Mexico	Sweden
Bolivia	Ghana	Mongolia	Switzerland
Bosnia and Herzegovina	Greece	Montenegro	Tajikistan
Botswana	Grenada	Morocco	Thailand
Brazil	Guatemala	Mozambique	Togo
Brunei Darussalam	Guinea	Myanmar	Trinidad and Tobago
Bulgaria	Guinea-Bissau	Namibia	Tunisia
Burkina Faso	Haiti	Nepal	Turkey
Burundi	Honduras	Netherlands	Turkmenistan
Cabo Verde	Hungary	New Zealand	Uganda
Cambodia	Iceland	Nicaragua	Ukraine
Cameroon	India	Niger	United Arab Emirates
Canada	Indonesia	Nigeria	United Kingdom
Central African Republic	Iran	Norway	United States

Chad	Iraq	Oman	Uruguay
Chile	Ireland	Pakistan	Uzbekistan
China	Israel	Panama	Venezuela
Colombia	Italy	Paraguay	Viet Nam
Comoros	Jamaica	Peru	Yemen
Congo	Japan	Philippines	Zambia
Costa Rica	Jordan	Poland	Zimbabwe
Croatia	Kazakhstan	Portugal	

7.2. Descriptive Statistics by Geographic Region for Model 1

Variables	East Asia & Pacific				
	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	85	3.45	2.73	-4.35	11.07
Gross fixed capital formation	77	25.62	7.37	8.76	52
Trade	82	90.33	81.33	0.33	391.94
Labor force participation	63	68.49	7.71	55	82.5
Fertility	85	3.11	1.43	1.23	6.71
Life expectancy	85	68.47	8.16	47.34	83.15
İnitial GDP per capita	80	11098.46	15275.44	140.91	52346.9

Variables	Europe & Central Asia				
	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	204	2.55	3.57	-9.78	30.41
Gross fixed capital formation	201	23.32	4.79	12.34	49.56
Trade	201	86.16	44.55	10.32	355.04
Labor force participation	167	59.42	6.17	44.36	75.59
Fertility	205	1.99	0.83	1.22	6.48
Life expectancy	205	73.69	5.23	49.28	82.76
İnitial GDP per capita	187	21669.96	19508.77	450.39	103588.6

Variables	Latin America & Caribbean				
	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	162	1.81	2.04	-3.62	7.51
Gross fixed capital formation	156	20.84	6.07	10.64	61.95
Trade	156	70.51	35.77	12.25	169.88
Labor force participation	99	63.92	5.23	51.61	76.17
Fertility	160	3.61	1.5	1.73	7.4
Life expectancy	159	67.96	6.96	43.99	81.04
İnitial GDP per capita	152	5920.9	4700.16	688.85	24957.57

Variables	Middle East & North Africa				
	Obs.	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP per capita growth	96	1.9	4.77	-8.66	34.57
Gross fixed capital formation	86	22.53	6.54	2.91	38.97
Trade	92	86.98	45.7	28.68	307.89
Labor force participation	71	53.01	10.82	39.2	86.64
Fertility	96	4.32	1.93	1.41	7.99
Life expectancy	96	67.56	8.71	46.54	81.89
İnitial GDP per capita	78	13471.07	19321.91	807.88	111958.2

Variables	North America				
	Obs.	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP per capita growth	18	1.76	1.71	-3.49	4.3
Gross fixed capital formation	14	19.7	5.5	5.94	23.96
Trade	14	43.5	23.9	9.53	77.13
Labor force participation	8	65.44	1.31	62.7	66.8
Fertility	15	1.93	0.43	1.58	2.98
Life expectancy	17	75.87	3.72	69.59	81.65
İnitial GDP per capita	18	42760.81	20271.49	17142.19	86001.17

Variables	South Asia				
	Obs.	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP per capita growth	36	3.06	1.84	-1.2	7.25
Gross fixed capital formation	33	23.68	10.7	13.09	58.99
Trade	36	49.15	37.51	9.21	194.15
Labor force participation	26	65.25	11.1	50.25	85.6
Fertility	36	4.17	1.61	2.12	6.87
Life expectancy	36	60.76	9.73	37.88	76.54
İnitial GDP per capita	36	1030.38	1274.2	268.11	6699.61

Variables	Sub-Saharan Africa				
	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	225	1.51	3.56	-10.3	31.74
Gross fixed capital formation	193	20.58	13.12	0	138.71
Trade	214	70.47	41.12	19.26	334.7
Labor force participation	160	70.54	10.94	47.5	90.6
Fertility	224	5.78	1.37	1.49	8.37
Life expectancy	223	52.1	8.38	30	73.83
İnitial GDP per capita	219	1709.21	2732.11	175.14	23120.83

7.3. Descriptive Statistics by Geographic Region for Model 2

Variables	East Asia & Pacific				
	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	80	3.88	2.9	-1.43	11.8
GFCF	80	0.25	0.1	0.06	0.65
Trade	79	102.45	82.6	0.19	400.2
LFP	80	68.74	7.36	55	82.5
Fertility	80	2.42	0.87	1.23	5.38
HEPC growth	64	0.36	0.24	-0.17	1.09
İnitial GDP per capita	80	13628.73	17258.22	237.95	52346.9

Variables	Europe & Central Asia				
	Obs.	Mean	Std.Dev.	Min	Max
GDP per capita growth	223	2.95	4.51	-13.63	31.63
GFCF	230	0.21	0.07	0.04	0.41
Trade	229	93.89	43.77	23.21	355.04
LFP	230	59.13	6.18	43.3	76.8
Fertility	230	1.73	0.54	1.15	4.58
HEPC growth	184	0.36	0.27	-0.16	1.63
İnitial GDP per capita	228	21953.77	22254.74	364.64	103588.6

Variables	Latin America & Caribbean				
	Obs.	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP per capita growth	140	1.86	2.36	-7.51	9.02
GFCF	141	0.2	0.06	0.06	0.42
Trade	141	75.88	32.99	16.63	180.89
LFP	125	64.22	5.3	50.1	76.1
Fertility	138	2.7	0.73	1.73	4.93
HEPC growth	112	0.26	0.2	-0.19	0.83
İnitial GDP per capita	139	6901.49	4953.47	688.85	24957.57

Variables	Middle East & North Africa				
	Obs.	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP per capita growth	89	1.25	2.73	-9.45	5.87
GFCF	93	0.24	0.08	0.05	0.47
Trade	89	94.07	49.57	34.64	307.89
LFP	93	53.67	11.34	40.5	86.6
Fertility	93	3.14	1.15	1.38	7.52
HEPC growth	74	0.23	0.29	-0.14	1.51
İnitial GDP per capita	86	15693.08	18381.24	1036.20	74448.87

Variables	North America				
	Obs.	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP per capita growth	10	1.51	1.04	-0.13	3.1
GFCF	10	0.24	0.01	0.2	0.27
Trade	10	47.29	23.49	22.38	77.17
LFP	10	65.27	1.11	63	66.6
Fertility	10	1.78	0.21	1.52	2.04
HEPC growth	8	0.23	0.11	0.11	0.37
İnitial GDP per capita	10	43754.13	4918.47	37568.11	49575.4

Variables	South Asia				
	Obs.	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP per capita growth	33	3.94	1.72	0.81	7.59
GFCF	35	0.22	0.09	0.1	0.47
Trade	35	68.22	45.53	22.47	194.15
LFP	35	64.12	11.18	49.2	85.6
Fertility	35	3.2	0.92	2.12	5.34
HEPC growth	28	0.37	0.29	-0.15	1.08
İnitial GDP per capita	33	1462.15	1462.03	403.15	6699.61

Variables	Sub-Saharan Africa				
	Obs.	**Mean**	**Std.Dev.**	**Min**	**Max**
GDP per capita growth	203	2.69	5.97	-9.46	51.62
GFCF	203	0.18	0.11	0.02	0.61
Trade	193	76.49	49.62	14.77	436.57
LFP	198	70.57	10.9	48.4	88.9
Fertility	202	5.25	1.34	1.49	7.74
HEPC growth	162	0.28	0.33	-0.4	1.85
İnitial GDP per capita	203	1997.07	3212.57	122.48	23120.83

8. RESUME

1. Adı Soyadı : Özdemir Teke

2. Doğum Tarihi : 1985

3. Unvanı : Araştırma Görevlisi

4. Çalıştığı Kurum : Yıldız Teknik Üniversitesi

5. Öğrenim Durumu :

Derece	**Alan**	**Üniversite**	**Yıl**
Lisans	Ekonomi	Fatih Üniversitesi	2009
Y. Lisans	İktisat	Yıldız Teknik Üniversitesi	2017

7. Yayınlar

7.1. Uluslararası hakemli dergilerde yayınlanan makaleler

Çifter A., Akay G., Teke Ö., "Turkish tourism, exchange rates and income", TOURISM ECONOMICS, vol.23, pp.66-77, 2017

7.3. Uluslararası bilimsel toplantılarda sunulan ve bildiri kitabında basılan bildiriler

Teke Ö., Karaduman H.A., "Health and Economic Growth", 2. ANNUAL INTERNATIONAL CONFERENCE ON SOCIAL SCIENCES, İSTANBUL, TÜRKIYE, 2-4 Haziran 2016, pp.12-12

Teke Ö., Çifter A., Akay G., "Exchange Rate, Income and Tourism Trade Balance: Evidence from Turkish Tourism ", 1 st IBESRA CONFERENCE, İSTANBUL, TÜRKIYE, 29-30 Aralık 2014, pp.1-12

8. Projeler

"Esenler Belediyesi Tekstil Atölyelerini İyileştirilmesi Fizibilite Raporu", Diğer Kamu Kuruluşlarınca Desteklenen, Araştırmacı, 2016