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THE EFFECTIVENESS OF PUBLIC HEALTH EXPENDITURES IN OECD COUNTRIES

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ABSTRACT

Master's Thesis

The Effectiveness of Public Health Expenditures in OECD Countries

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Health is essential to achieve sustainable development (SD) and the Millennium Development Goals (MDGs). It is not possible to achieve SD without health.

The main purpose of this study is examining the effectiveness of public health expenditure on health outcomes by estimating health production function for 20 selected Organization for Economic Co-operation and Development (OECD) countries in the period 1980 and 2015. In this research, infant mortality rate, under-5 mortality rate and life expectancy at birth were chosen as health outcomes and panel data analysis was used. The data was sourced from World Bank data base and OECD data base. The results are approximately similar with the literature. There is a positive relationship between life expectancy at birth and public health expenditure. On the other hand, there is a negative relationship between public health expenditure and infant mortality rate and under-5 mortality rate. The elasticity rate of public health expenditure for infant mortality rate, under-5 mortality rate and life expectancy at birth are -0.32, -0.36 and 0.04, respectively. According to these results it can be said that, increase in public health expenditure improves health outcomes (infant mortality rate, under-5 mortality rate and life expectancy at birth).

Keywords: Public Health, Health Outcomes, OECD Countries, Effectiveness.

ÖZET

Yüksek Lisans Tezi

OECD Ülkelerinde Kamu Sağlık Harcamalarının Etkinliği

Yagmur Tuçe AKYILDIZ

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Sağlık, sürdürülebilir kalkınmayı (SK) sağlamak ve Binyıl Kalkınma Hedeflerine (BKH'ler) ulaşmak için gereklidir. Sağlık olmadan sürdürülebilir kalkınma olmaz.

Bu çalışmanın temel amacı, 1980 ve 2015 yıllarında seçilen 20 OECD ülkesinin sağlık üretim fonksiyonunun tahmin edilmesi yoluyla sağlık çıktılarına yönelik kamu sağlık harcamalarının etkinliğinin incelenmesidir. Bu araştırmada bebek ölüm hızı, 5 yaş altı ölüm oranı ve doğumda beklenen yaşam süresi sağlık çıktıları olarak seçilmiştir ve panel veri analizi kullanılmıştır. Veriler, Dünya Bankası ve OECD veri tabanlarından sağlanmıştır. Sonuçlar literatürle yaklaşık olarak benzerdir. Doğumda yaşam beklentisi ve kamu sağlık harcamaları arasında pozitif bir ilişki vardır. Öte yandan, kamu sağlığı harcamaları ile bebek ölüm hızı ve 5 yaş altı ölüm oranı arasında negatif bir ilişki vardır. Bebek ölüm hızı, 5 yaş altı ölüm oranı ve doğumda beklenen yaşam süresi için kamu sağlık harcamalarının esneklik oranı sırasıyla -0.32, -0.36 ve 0.04'tür. Bu sonuçlara göre, kamu sağlığı harcamalarındaki artışın sağlık çıktılarını (bebek ölüm hızı, 5 yaş altı ölüm oranı ve doğumda yaşam beklentisi) artırdığı söylenebilir.

Anahtar Kelimeler: Kamu Sağlığı, Sağlık Çıktıları, OECD Ülkeleri, Etkinlik.

THE EFFECTIVENESS OF PUBLIC HEALTH EXPENDITURES IN OECD COUNTRIES

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ABBREVIATIONS

BLUE	Best Linear Unbiased Estimator
ECM	Error Correction Model
FEM	Fixed Effects Model
GDP	Gross Domestic Product
GNP	Gross National Product
GNI	Gross National Income
HIC	High Income Countries
LIC	Low Income Countries
LMC	Lower Middle-Income Countries
LSDV	Least Squares Dummy Variable
MDGs	Millennium Development Goals
MLE	Maximum Likelihood Estimation
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
REM	Random Effects Models
SD	Sustainable Development
UMC	Upper Middle-Income Countries
UNICEF	The United Nations Children's Fund
US	The United States
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
WHO	World Health Organization

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INTRODUCTION

a. Topic of the Study

The topic of this thesis is the effectiveness of public health expenditure on health outcomes. By estimating health production function, 20 OECD countries are selected the period between 1980 and 2015. The most common health outcomes to measure health status are mortality rates and life expectancy at birth rates. In this thesis, infant mortality rate, under-5 mortality rate and life expectancy at birth are used as health outcomes.

There are many different factors that determine the level of health expenditure of a country. But among these, the level of income of a country and the health problems it has to solve are very important. In this context, it is extremely important to compare with other countries in the same income group and geography to assess how well an individual's health expenditure level is.

According to Bidzha (2015: 1) health is a precondition, an outcome and a consequence of economic development. Accordingly, health has an important position in sustainable economic development. In other words, health is a contributor to the achievement of SD and health outcomes can be improved through SD. When health problems are widespread, the goals of SD cannot be achieved. Health is essential for ecological, social and economic development (Von Schirnding and Mulholland, 2002: 3).

As noted in the Millennium Development Goals (MDGs) 4, a reduction of 2/3 of under-five child mortality is the basis for development. In this context, it is important for governments to invest in child health (Amiri and Gerdtham, 2013: 3). The successes of the International Development Goals and MDGs clearly embrace a number of social goals, including the reduction of under-five deaths and infant mortality by two-thirds in 2015 as targets for poverty reduction. But to agree that development measures should include non-economic variables is not the same as the assumption that the realization of development must go beyond a growth-oriented development strategy. Although the goal is to maximize the welfare measured by social indicators, this goal can be best achieved by focusing on growth (Hanmer, Lensink and White, 2003: 102).

Life expectancy at birth is also important health outcome for determining health status. According to OECD (2018a) life expectancy at birth is related with life style improvement, well education, living standards improvement or heath service quality. Thus, life expectancy at birth rate is used as a measurement of effectiveness of public health expenditure in this research.

b. Significance of the Study

The aim of this study is to measure the effectiveness of public health expenditure on health outcomes. Finding out the relationship between public health expenditure and health outcomes is significant for the OECD countries.

According to Or (2000) emerging health spending has become a major issue in the health policy debate in the majority of industrialized countries. An important amount of literature has been devoted to describing variations among countries in health care, particularly those in medical expenditure. Nevertheless, the main issues related to health care input have been examined less in terms of health outcomes than the perspective of global effectiveness.

In addition to that such studies are also significant for determining public health policies. According to Bidzha (2015) it is very important for the country to assess the effectiveness of its programs to design and implement better policy options when it comes to health.

c. Problem Statement of the Study

According to MDGs, life expectancy at birth target is 70 years for the world average. OECD life expectancy at birth average is 83 years in 2015. Therefore, OECD average is higher than MDGs target. In addition, according to World Bank database (2018), world average of infant mortality rate is 31.4 while OECD average of infant mortality rate is 6.1 in 2015. In the same manner, according to World Bank database (2018), world average of under-5 mortality rate is 43.7 while OECD average of under-5 mortality rate is 7.4 in 2015.

> *"Recently there has been a renewed interest in achieving a better appraisal of health outcomes at the aggregate level. The development of relevant and homogeneous measures of the health status of populations is recognized as an important first step in order to assess and compare country*

performances and to establish targets for health policy. However, if these targets are to be achieved, it is also necessary to distinguish the factors behind the country differences in health performance. This, in turn, requires a multidisciplinary approach, which seeks to disentangle the relative impact of medical, social, economic and institutional factors on health outcomes" (Or, 2000: 54).

In recent years, there is an increasing trend in public health expenditure in OECD countries. The aim of this study is measuring the effectiveness of public health expenditures on health outcomes like life expectancy at birth infant mortality rate and under-5 mortality rate in OECD countries between 1980 and 2015.

d. Hypothesis of the Study

The question which tried to be answered in this thesis is whether public health expenditure have any improvement on health outcomes like infant mortality rate under-5 mortality rate and life expectancy at birth in OECD members or not. When measuring the effectiveness of public health expenditures, it is important to determine the relationship between public health expenditures and health outcomes as well as the direction of the relationship between public health expenditures and health outcomes.

In this thesis, by estimating health production function, the relationship between public health expenditure and health outcomes is determined.

e. Method of the Study

The main purpose of this thesis is measuring the effectiveness of public health expenditure on health outcomes by estimating health production function using panel data model for OECD countries in between 1980 and 2015. The first step for achieve this goal is showing the association between public health expenditure and health outcomes (infant mortality rate, under-5 mortality rate and life expectancy at birth) and then examining the direction of these associations.

In Chapter 1, health expenditures and health outcomes are compared according to their income level. And then, health expenditures and health outcomes in OECD are presented. And lastly, the relationship between public health expenditure and health outcomes is showed with figures. Chapter 2 includes literature review with theoretical framework and previous empirical works. In

theoretical framework, health production function is explained. Chapter 3 is about methodology and data. After mentioning where the data is found, definition of all exogenous and endogenous variables empirical model and estimation techniques are explained. Chapter 4 includes findings for diagnostic tests like heteroscedaticity, autocorrelation and endogeneity. Infant mortality rate findings, under-5 mortality rate findings and life expectancy at birth findings are also explained one by one. Lastly, conclusion part summarizes all study.

CHAPTER ONE
HEALTH EXPENDITURES AND HEALTH OUTCOMES

1.1. HEALTH OUTCOMES AND HEALTH EXPENDITURES COMPARISON OF COUNTRIES

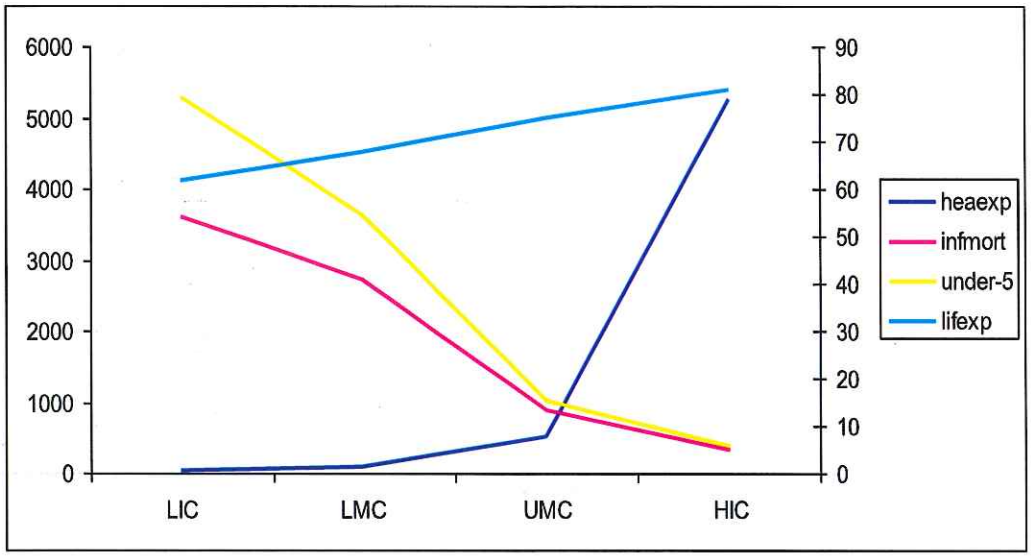
It is important to compare health expenditures with country health status in order to see whether the health expenditures affect health status of countries in the desired direction.

Although there are many ways to classify countries one of them is to measure Gross National Income (GNI) per capita. According to World Bank (2018), low-income economies are defined as with GNI per capita $1,005 or less; lower middle-income economies are defined as with GNI per capita between $1,006 and $3,955; upper middle-income economies are defined as with GNI per capita between $3,956 and $12,235; high-income economies are defined as with GNI per capita $12,236 or more by using World Bank Atlas method for the current 2018 fiscal year.

Life expectancy at birth and mortality rates are the most important measures of health status. According to OECD (2018a) when death rates are same with current death rates, average expected life span is defined as life expectancy at birth. Life expectancy at birth depends on some elements such as education level, lifestyle and health services quality.

Under one year of age children deaths per 1 000 live births are defined as infant mortality rate. There are some variations in countries' infant mortality rate because of different registration techniques of premature infant (OECD, 2018b). The other health status measurement is under-5 mortality rate. According to UNICEF (2018) in recent years for reducing child mortality the world has made significant progress. Although in 1990 under-five mortality rate is 93 deaths per 1 000 live births, in 2016 it decreases 41.

Figure 1: Health expenditure per capita levels and health outcomes of countries by income groups, 2014

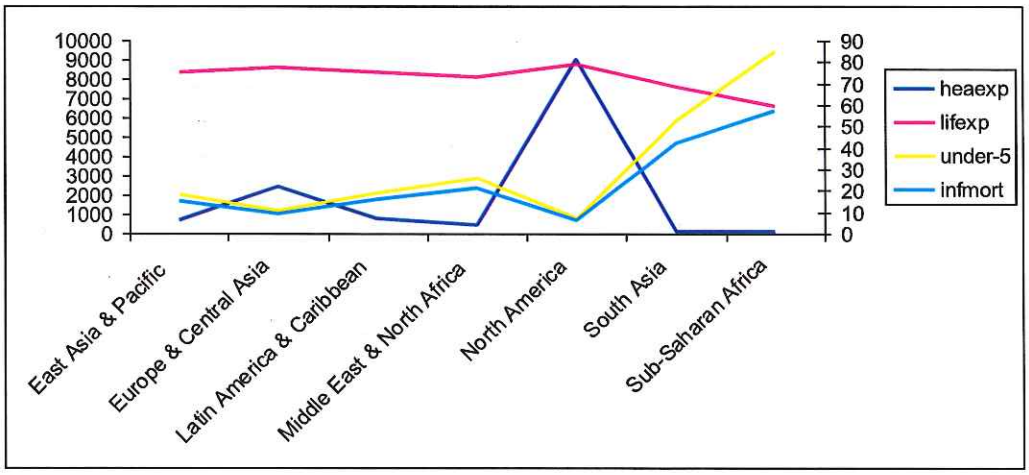


Source: World Bank database, 2018

LIC: Low Income Countries
LMC: Lower Middle-Income Countries
UMC: Upper Middle-Income Countries
HIC: High Income Countries

Health expenditures, life expectancy at birth, under-5 mortality rates and infant mortality rates for countries in both income and region groups are compared in Figure 1 and Figure 2. According to Figure 1, it can be seen that high-income OECD countries have the lowest infant mortality rate and under-5 mortality rate and the country with the highest expected life expectancy and per capita health expenditure. In poorly funded countries and low-income countries, health expenditure per capita is also at its lowest such that health status indicators are extremely poor (low life expectancy at birth, high infant mortality rates, under-5 mortality rate).

Figure 2: Health expenditure per capita levels and health outcomes of countries by region groups, 2014



Source: World Bank database, 2018

High-income countries can have a benchmarking role for countries with good financial resources. The member countries of OECD include democratic countries that range from economic powers, such as Germany, to smaller countries with more modest economic achievement, such as Greece (OECD, 2002).

Table 1: Health Expenditure and Health Outcome in High Income Countries, 2014

Country	Health expenditure as a % of GDP	Health expenditure per capita (current US $)	GDP per capita (current US $)	Life expectancy at birth	Infant mortality rate (per 1000 live births)	Under-5 mortality rate (per 1000 live births)
Australia	9.4	6 031	62 099	82	3	4
Canada	10.4	5 291	50 453	81	4	5
Sweden	11.9	6 807	59 180	82	2	2
UK	9.1	3 934	46 783	81	3	4
US	17.1	9 402	54 598	78	5	6

Source: World Bank database, 2018

Table 1 shows the health expenditure and health outcomes for five selected high-income countries. The US spends about 17.1% of its Gross Domestic Product (GDP) on health care which is the highest percentage among selected countries. In addition, although in the US, health expenditure per capita is higher, life expectancy

at birth is lower and infant mortality rate and under-5 mortality rate is higher than other selected countries.

Table 2: Health Expenditure and Health Outcome in Upper Middle-Income Countries, 2014

Country	Health expenditure as a % of GDP	Health expenditure per capita (current US $)	GDP per capita (current US $)	Life expectancy at birth	Infant mortality rate (per 1000 live births)	Under-5 mortality rate (per 1000 live births)
Botswana	5.4	385	7 497	64	35	44
China	5.5	419	7 683	75	9	11
Malaysia	4.1	455	11 183	75	6	8
Mauritius	4.8	482	10 153	74	13	14
Thailand	4.1	227	5 941	74	11	13

Source: World Bank database, 2018

Table 2 shows health expenditure and health outcomes for five selected upper middle-income countries. These countries were randomly selected from among the countries with information available in 2018. Health expenditure of China as a % share of GDP is 5.5 which is the highest percentage among selected upper middle-income countries. Moreover, life expectancy at birth at highest level on the other hand infant mortality rate is at lowest level at China and Malaysia. Under-5 mortality rate and infant mortality rate is at highest level in Botswana on the contrary life expectancy at birth at the lowest level ranking 64.

Table 3: Health Expenditure and Health Outcome in Lower Middle-Income Countries, 2014

Country	Health expenditure as a % of GDP	Health expenditure per capita (current US $)	GDP per capita (current US $)	Life expectancy at birth	Infant mortality rate (per 1000 live births)	Under-5 mortality rate (per 1000 live births)
Bangladesh	2.8	30	1 084	71	31	38
Cambodia	5.6	61	1 098	68	28	33
Kenya	5.7	77	1 335	66	38	53
India	4.6	74	1 573	68	37	47
Vietnam	7.1	142	2 012	75	17	22

Source: World Bank database, 2018

According to Table 3 which shows health expenditure and health outcomes for five selected lower middle-income countries Vietnam spends highest percentage of its GDP on health care. Health expenditure of Bangladesh as a % share of GDP is 2.8 which is the lowest percentage among these five selected countries. In addition, Vietnam has the lowest level of infant mortality rate and under-5 mortality rate and the highest level of life expectancy at birth.

Table 4: Health Expenditure and Health Outcome in Low-Income Countries, 2014

Country	Health expenditure as a % of GDP	Health expenditure per capita (current US $)	GDP per capita (current US $)	Life expectancy at birth	Infant mortality rate (per 1000 live births)	Under-5 mortality rate (per 1000 live births)
Gambia	7.3	30	434	60	44	69
Uganda	7.2	52	702	59	41	60
Zimbabwe	6.4	57	1 031	59	44	64
Malawi	11.3	29	354	61	43	63
Nepal	5.7	39	706	69	31	38

Source: World Bank database, 2018

Table 4 show health expenditure and health outcomes of five selected low-income countries. Malawi has the highest health expenditure as a % share of GDP in contrast to that Nepal has the lowest percentage among selected countries. On the other hand life expectancy at birth in Nepal is 69 which is the highest level and infant mortality rate is 31 and under-5 mortality rate is 38 which are the lowest level among these five countries.

Health expenditure as a % share of GDP is about 9.9 in the world and about 12.3 in OECD countries according to World Bank data base for the year 2014. As expected, five selected high-income countries are above world average and below the OECD average except for the US which is about 17.1. On the other hand, except Malawi, in selected upper middle-income, lower middle-income and low income countries, health expenditure as a % share of GDP is lower than world average and OECD average.

Health expenditure per capita is $1 058 in the world and $4 739 in OECD countries according to World Bank database for the year 2014. Five selected high income countries are above world average and except United Kingdom they are above OECD average too. As seen from the tables above, in upper middle-income, lower middle-income and low income countries health expenditure per capita is lower than OECD average and also world average.

According to World Bank database (2018), life expectancy at birth is 71 in the world and 80 in OECD countries for the year 2014. Life expectancy at birth in selected high income countries is above from world average and OECD average except the US with 78. In selected upper middle-income countries, life expectancy at birth is higher than world average except Botswana and life expectancy at birth of these selected countries is lower than OECD average. In selected lower middle-income countries, life expectancy at birth is lower than world average except Bangladesh and Vietnam and also their life expectancy is lower than OECD average. As expected, life expectancy at birth in low-income economies is lower than both world average and OECD average.

Infant mortality rate per 1000 live births is 32 in the world and 6 in OECD countries according to World Bank database for the year 2014. In selected high-income countries, infant mortality rate is lower than both world average and OECD

average. Infant mortality rate in selected upper middle-income countries is lower than world average except Botswana and higher than OECD average except Malaysia with 6%. In selected lower middle-income countries, infant mortality rate is lower than world average except Kenya and India and higher than OECD average. Infant mortality rate in selected low-income countries is higher than world average except Nepal and also higher than OECD average.

According to World Bank database average under-5 mortality rate per 1000 live births is 43 in the world and 7 in OECD countries for 2014. In selected high income countries, under-5 mortality rate is lower than both world average and also OECD average as expected. On the other hand, under-five mortality rate in selected upper middle-income countries is lower than world average except Botswana which is 44%. In selected lower-middle income countries, average under-five mortality rate is lower than world average in Cambodia and Vietnam while it is higher than world average in Bangladesh, India and Kenya. Lastly, under-5 mortality rate in selected five low-income countries is higher than OECD average and they are also higher than world average except Nepal.

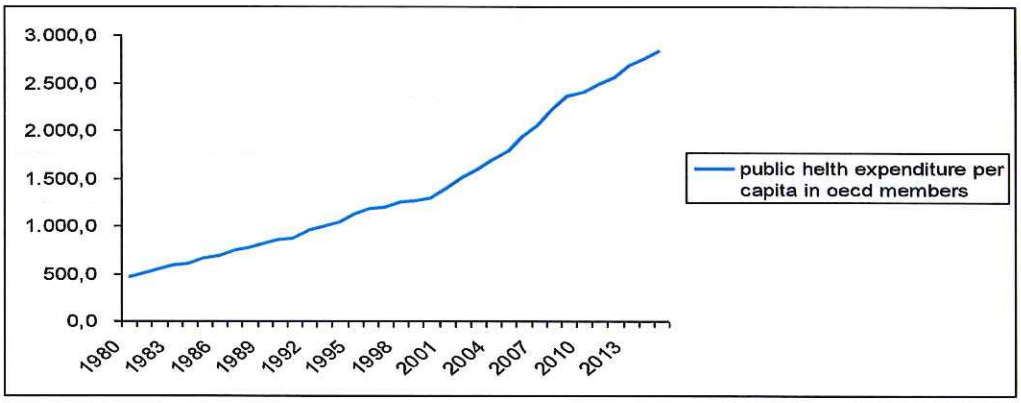
1.2. HEALTH EXPENDITURE IN OECD

According to Çalışkan (2009) in recent years, due to the boom in health expenditures, health policies are not only started to discuss in OECD but also in the world. An accessible, sustainable, equitable, effective and efficient health care system is important for the countries because the final outputs of health policies affect individuals and communities. Therefore, to achieve these goals, the reforms of health system start to increase in many countries. However, these reforms are mostly about reducing costs or controlling expenses within the health systems. Although life span and quality of life improved with rising standard of living, better education, benefiting from health services and efficacy of drugs, rapidly rising health expenditures are the most important debate for OECD countries. In addition, public health expenditure has rise faster than economic growth in OECD countries in recent years. One of the reasons of this rapid increase in health expenditure is publicly financed health insurance and health services. Moreover, health system can be

determined not only by the financial structure but also income level, lifestyle and socio-cultural factors.

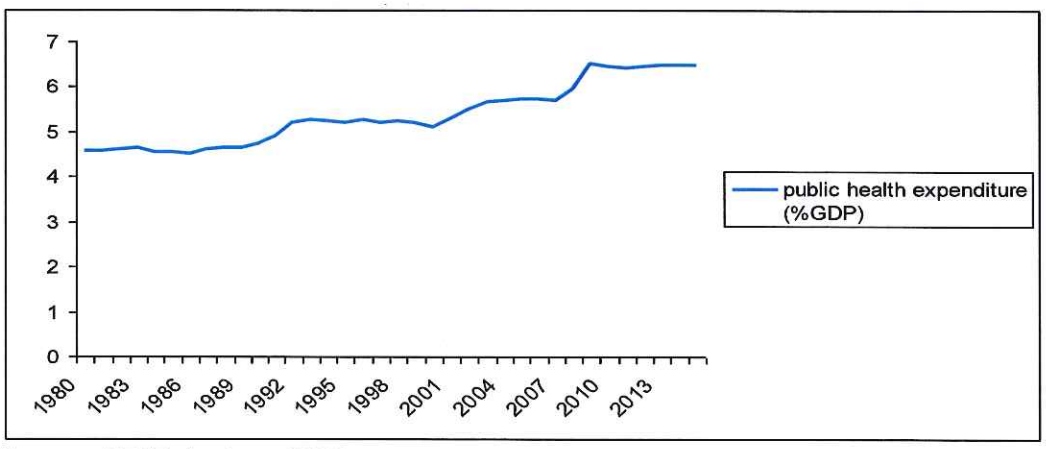
When examining the data in the OECD countries, it can be seen that public health expenditures have increased rapidly in the last thirty years. Particularly after 1990, the debates on change in health policies are accelerating. Public health expenditure and the size of public health expenditure are measured mostly by public health expenditure per capita, public health expenditure as a share of GDP or public/private health expenditure as a share of total health expenditure. As seen Figure 3 and Figure 4, public health expenditure per capita and public health expenditure as a % of GDP increased in OECD members in between 1980 and 2015.

Figure 3: Public health expenditure per capita (Current US$), 1980-2015



Source: OECD database, 2018

Figure 4: Public Health Expenditure as a % of GDP, 1980-2015

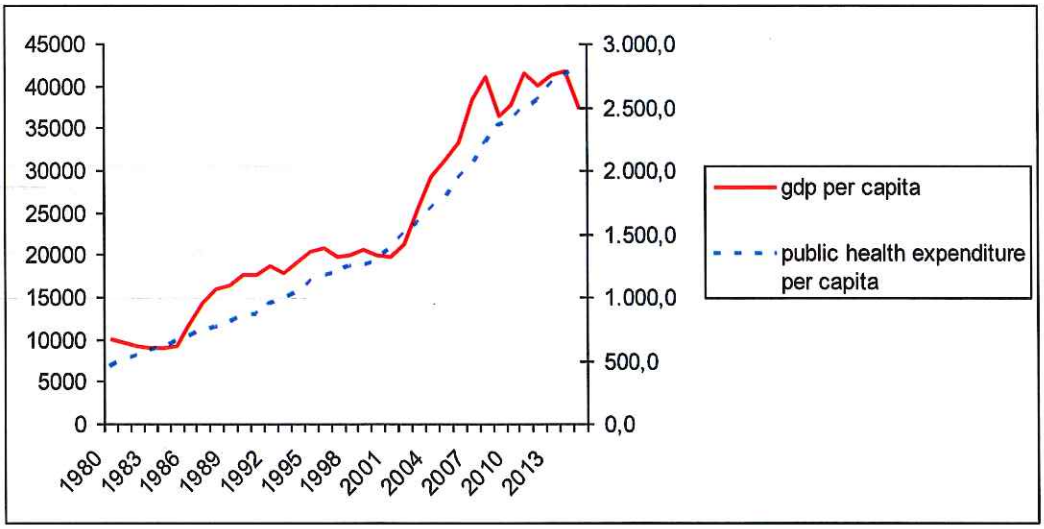


Source: OECD database, 2018

Public health expenditure as a share of GDP varies between OECD members. According to OECD database, OECD average is 4.5 in 1980. Germany, Denmark and France are countries with the highest share of GDP on public health expenditure on the other hand Turkey and Korea are countries with the lowest share of GDP on public health expenditure.

Moreover, the relationship between public health expenditure and GDP is very important. There are many studies in the literature which shed light on the strong correlation between public health expenditure per capita and GDP per capita. There is an increasing trend in OECD countries as seen from Figure 5 in between 1980 and 2015.

Figure 5: Public health expenditure per capita and GDP per capita in OECD members, 1980-2015



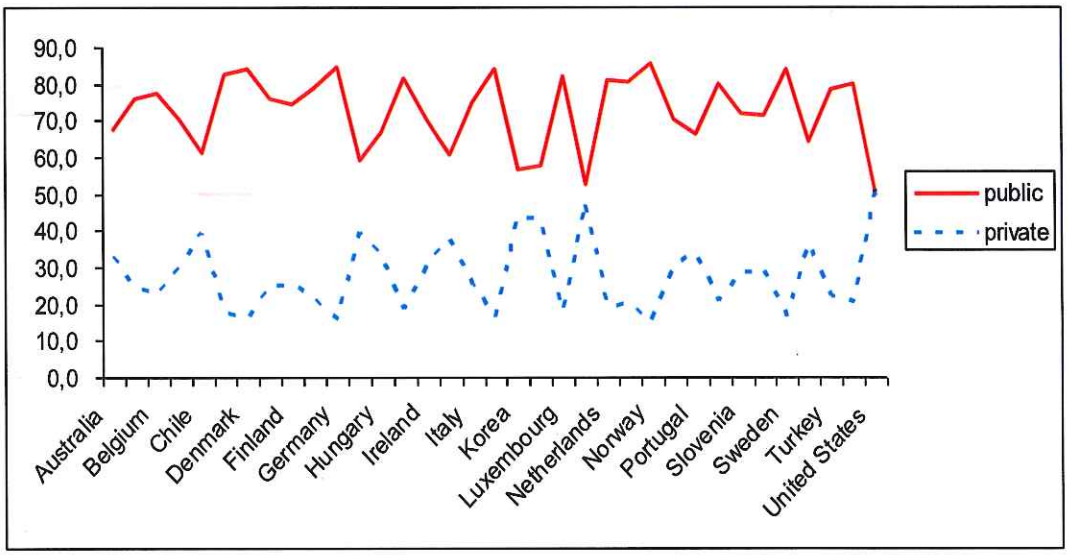
Source: OECD database, 2018

According to Hitiris (1997) there are some important reasons of these rapid increase and international huge differences of health expenditure; economic developments, changes in demographic structure and rapid developments of medical technology. Because of these reasons, controlling the health expenditures is difficult. In the same manner, according to Sampayo and Vale (2012), in addition to income variables, some non-income determinants of health expenditures are described as

important factors in explaining the diversity of health expenditures in countries such as institutional factors, the age structure of the population and technological progress. The share of public financing in health care represent institutional factor. Dependency rates of the populations are characterized by the share of the young population and share of the old population. Technological progress can be represented by infant mortality rate, life expectancy, time trend, the number of specific medical equipment the surgical procedures, number of tomographic scanners and etc.

Health care approach of each country is related with its history, political situation and culture. Bidzha (2015) states that health care system consists of public or private services in a country. Health care expenditure is either financed by government or privately. The government provides nationwide health care with hospitals and health clinics all over the country. The services provided vary between hospitalized and patient care and the development of preventive care and health services.

Figure 6: Share of public and private health expenditures (% of total health expenditure), 2015



Source: OECD database, 2018

Financing methods are also important for explaining changes in health expenditures. Figure 6 shows percentage share of public health expenditure and

private health expenditure to total health expenditure for OECD members in 2015. In Denmark, Germany, Japan and Norway, the percentage share of public health expenditure to total health expenditure is higher than other OECD members. This shows that the public resources are the most important funding tool in health services. On the other hand, in Mexico, Korea and US, the percentage share of public health expenditure to total health expenditure is lower in 2015.

However, the level of public and private spending is not enough alone. The relationship between public and private health finance is also important. There are about four basic models that help shape this relationship. These models have different effects for the dynamics of the systems.

> *"1) Parallel public and private systems: For a given range of services, a separate privately financed system exists as an alternative to the public sector.*
> *2) Co-payment: Across a broad range of services, financing is partially subsidized through public payment, with the remainder financed through out-of-pocket payments and/or private insurance. The degree of co-payment may be scaled according to the income of the patient.*
> *3) Group-based: Certain population groups are eligible for public coverage; others rely on private insurance.*
> *4) Sectoral: Certain health care sectors are entirely publicly financed; others rely much more heavily upon private finance (Tuohy, Flood and Stabile, 2004: 360-361)."*

However, Tuohy, Flood and Stabile (2004) argue that one country does not represent pure example of these four models. They combine components of many models. For example, although the hospital sector in New Zealand offers an example of parallel system in limited number of services, ambulatory sector offers a comprehensive co-payment example.

1.3. HEALTH OUTCOMES IN OECD

The most important health status indicator is health outcomes. There are many factors that affect health outcomes such as health expenditures. Not only health expenditures but also health outcomes varies in between countries. To overcome this and fight disease epidemics, reduce poverty and build a global partnership MDGs and targets are signed in September 2000 by 189 countries. These eight goals are:

> *"1) Eradicate extreme poverty and hunger,*

2) Achieve universal primary education,
3) Promote gender equality and empower women,
4) Reduce child mortality,
5) Improve maternal health,
6) Combat HIV/AIDS, malaria and other diseases,
7) Ensure environmental sustainability, and
8) Develop a global partnership for development" (OECD, 2012).

These goals build a partnership between developed and developing countries to create SD and eliminate poverty. The OECD has established broader and more comprehensive partnerships to carry out the international agenda in various development issues. Economic growth and social protection, conflict and fragility, gender equality and women's empowerment, improving health outcomes, climate change and development, improving domestic resource mobilization are some strategies to support effective international policy. Building smart partnership, financing climate change and investing in women and girl are actions that make difference to achieve the goals.

Kindig and Stoddart (2003: 380) defined public health as "the health outcomes of a group of individuals, including the distribution of such outcomes within the group." According to Donabedian (2003: 46–47) "outcomes include: (1) changes in health status; (2) changes in knowledge acquired by patients and family members that may influence future care; (3) changes in the behavior of patients or family members that may influence future health; (4) satisfaction of patients and their family members with the care received and its outcomes."

According to Kindig (1997) outcome measures at community-level include population demise, morbidity and disability rates, disease prevalence and incidence rates, and perceived health status. A problem with these measures is to make them a positive index of health for the individual or population, as opposed to negative indices such as mortality rates, in order to provide an indication of a life expectancy adapted to health.

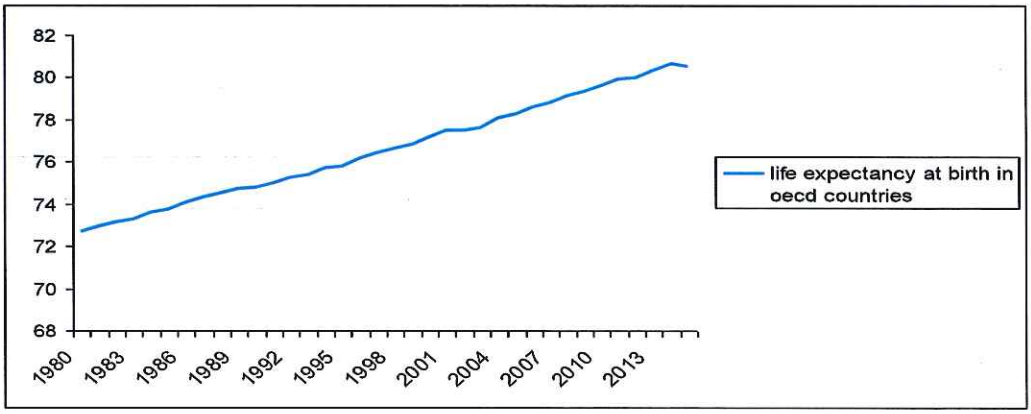
McDowell and Newell (1996) indicates that the outcome measures correspond to the general mortality, morbidity and health status categories, but exclusive indicators of each of these broad outcome measures can be used at different levels. Reliability, validity, feasibility and sensitivity are important criteria to observe usefulness of a measure.

"For examining mortality, morbidity, and health-status outcomes across institution and system levels, outcomes may be aggregated from the patient level within these categories. Patient-level outcome measures focus on individual deaths, on morbidity as reflected both in adverse outcomes and disability limitations, and on the health status outcomes of clinical endpoints, such as blood sugar and blood pressure and subjective health-status measures. At the institution and system levels, these patient-level measures are aggregated to produce case fatality, complication, disability, and diagnosis rates as well as averaged subjective health status for groups of patients" (Aday, Begley, Lairson and Balkrishnan, 2004 :71).

According to World Bank database (2018), life expectancy at birth is 71.9 in the world and 80.3 in OECD countries for the year 2015. These values also change for female and male. Life expectancy at birth for female is 74.1 in the world and 83 in OECD members in 2015. Life expectancy at birth shows improvement and OECD average and world average is above MDGs target which is 70 by the end of 2015.

Figure 7 shows life expectancy at birth in OECD in between 1980 and 2015. There is an increasing trend for the members of OECD in between these years. According to OECD data, Japan has the highest average life expectancy at birth which is 82.6 in 2015. On the other hand, Hungary, Mexico and Latvia have the lowest life expectancy average in 2015 among OECD members (OECD database, 2018).

Figure 7: Life Expectancy at Birth in OECD, 1980-2015

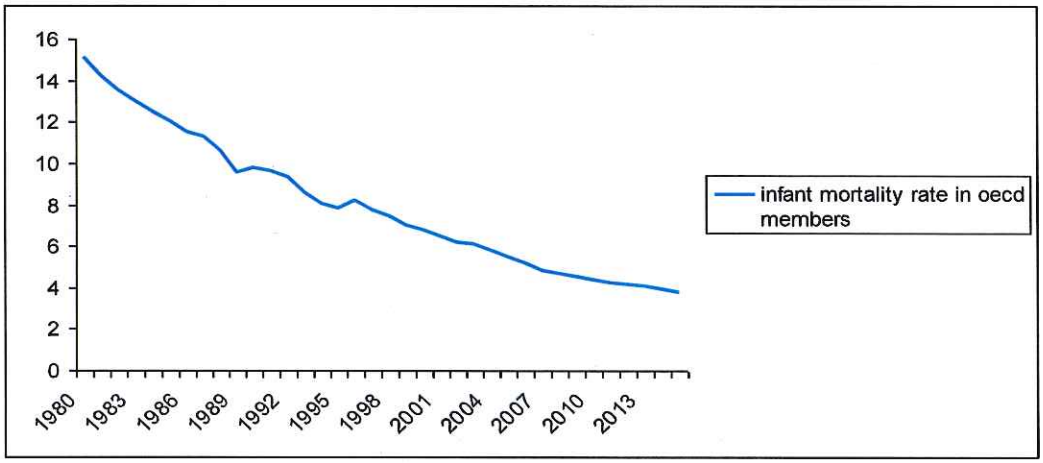


Source: OECD database, 2018

According to World Bank database (2018), infant mortality rate per 1 000 live births is 31.4 in the world and 6.1 in OECD countries in 2015. Female infant

mortality rate per 1 000 live births is 29.2 in the world and 5.5 in OECD countries. Moreover, male infant mortality rate per 1 000 live births is 33.5 in the world and 6.6 in OECD countries in 2015. MDGs number 4 is about infant mortality rate which is reducing by two-thirds in between 1990 and 2015 and indicators are under-five mortality rate, infant mortality rate and proportion of under 1 year-old children immunized against measles.

Figure 8: Infant Mortality Rate in OECD, 1980-2015

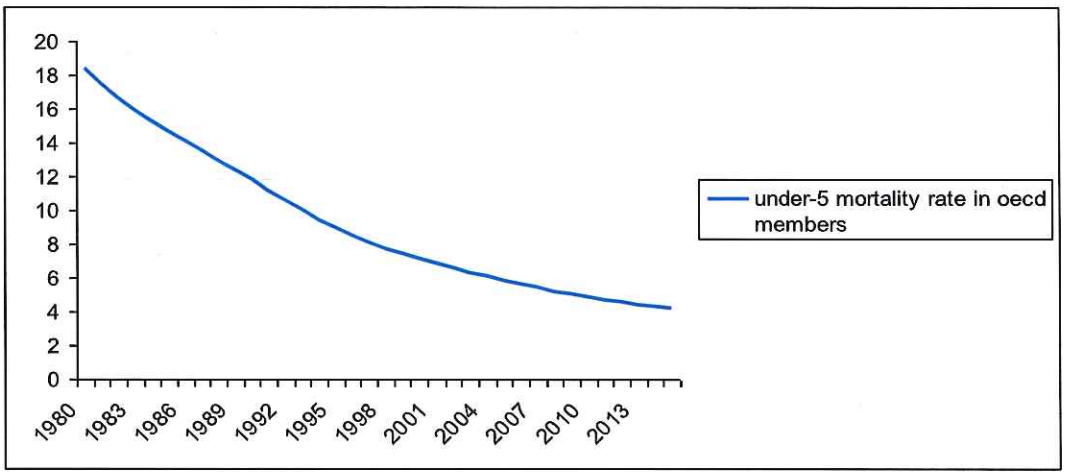


Source: OECD database, 2018

Figure 8 shows infant mortality rate per 1 000 live births for OECD countries between 1980 and 2015. There is a decreasing trend in infant mortality rate for members of OECD as seen from the Figure. According to OECD data, Slovenia and Finland have the lowest infant mortality rate among OECD countries in 2015. On the other hand, Mexico has the highest infant mortality rate with 12.5 per 1 000 live births and it is followed by Turkey with 10.7 per 1 000 live births in 2015 (OECD database, 2018).

According to World Bank database (2018), under-5 mortality rate is 43.7 in the world and 7.4 in OECD countries for the year 2015. These values also change for female and male. Female under-5 mortality rate per 1 000 live births is 40.1 in the world and 6.6 in OECD countries. Moreover, male infant mortality rate per 1 000 live births is 44.1 in the world and 7.8 in OECD countries in 2015.

Figure 9: Under-5 Mortality Rate in OECD, 1980-2015



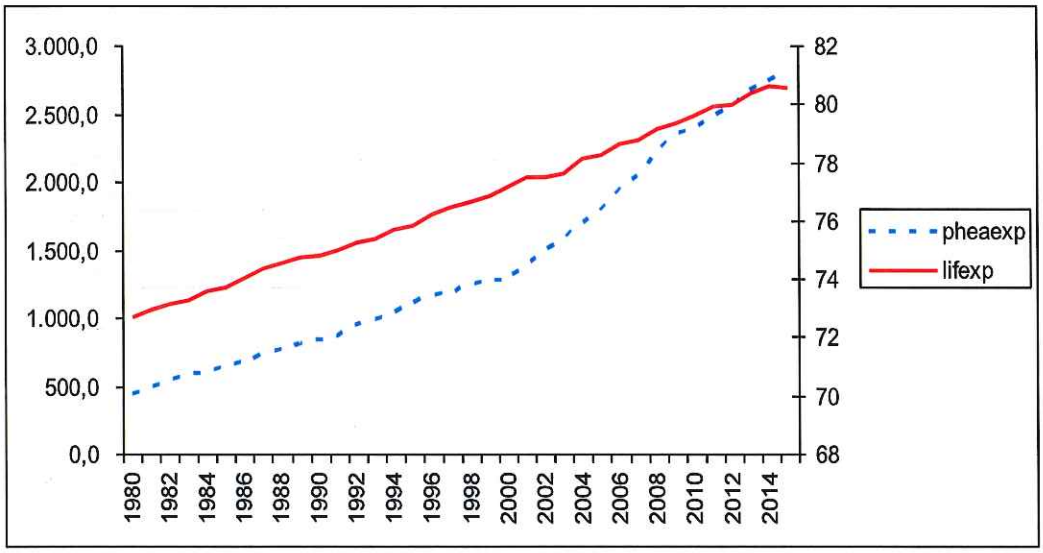
Source: World Bank database, 2018

Figure 9 shows under-5 mortality rate in OECD in between 1980 and 2015. As seen from the Figure here is a decreasing trend for the members of OECD in between these years. According to OECD data, Turkey has the highest average of under-5 mortality rate which is 13.6 in 2015. On the other hand, Iceland, Finland and Luxembourg have the lowest under- five mortality rate average in 2015 among OECD members (OECD database, 2018).

1.4. PUBLIC HEALTH EXPENDITURE AND HEALTH OUTCOMES RELATIONS IN OECD

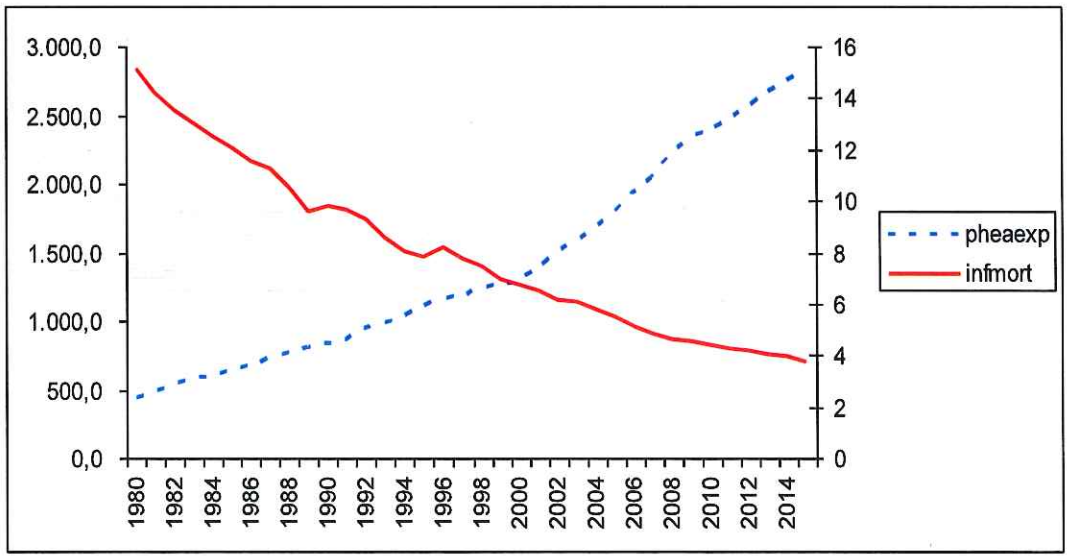
Figure 10 shows the relationship between public health expenditure and life expectancy at birth in OECD countries between 1980 and 2015. It is seen in the Figure 10, there is a positive relationship between public health expenditure and life expectancy at birth. Public health expenditure increased approximately 15.75 % while life expectancy increased approximately 9.4 percent in OECD members between 1980 and 2015 (OECD database, 2018).

Figure 10: Public health expenditure per capita and life expectancy at birth in OECD members, 1980-2015



Source: OECD database, 2018

Figure 11: Public health expenditure per capita and infant mortality rate in OECD members, 1980-2015

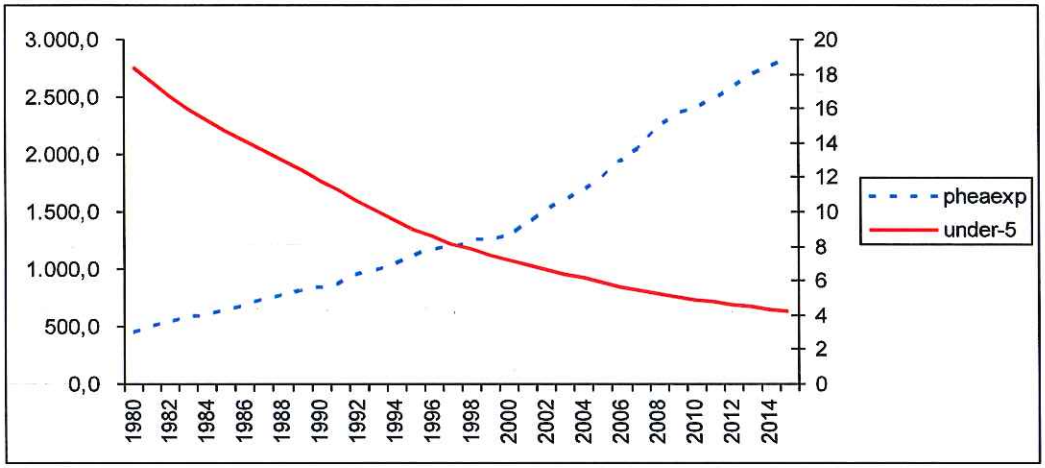


Source: World Bank database, 2018

Figure 11 shows the relationship between infant mortality rate and public

health expenditure in OECD members for the period 1980 to 2015. There is a negative relationship between infant mortality rate and health expenditure. Infant mortality rate decreased approximately 24.5 percent while health expenditure increased approximately 15.75 percent in OECD countries between 1980 and 2015 (World Bank database, 2018).

Figure 12: Public health expenditure per capita and under-5 mortality rate in OECD members, 1980-2015



Source: World Bank database, 2018

Figure 12 shows the relationship between public health expenditure and under-5 mortality rate in OECD members for the period 1980 to 2015. There is a negative relationship between infant mortality rate and health expenditure. Infant mortality rate decreased approximately 22.4 percent while health expenditure increased approximately 15.75 percent in OECD countries between 1980 and 2015 (World Bank database, 2018).

There are many factors that affect the health outcomes (life expectancy at birth, infant mortality rate, and under-5 mortality rate) other than public health expenditure. Therefore, health outcome relations must be observed carefully. This study will evaluate the effect of public health expenditure on health outcomes such as infant mortality rate, under-5 mortality rate and life expectancy at birth taking into account some other control variables such as per capita income, unemployment rate, pollution, immunization ratio, and tobacco and alcohol consumption.

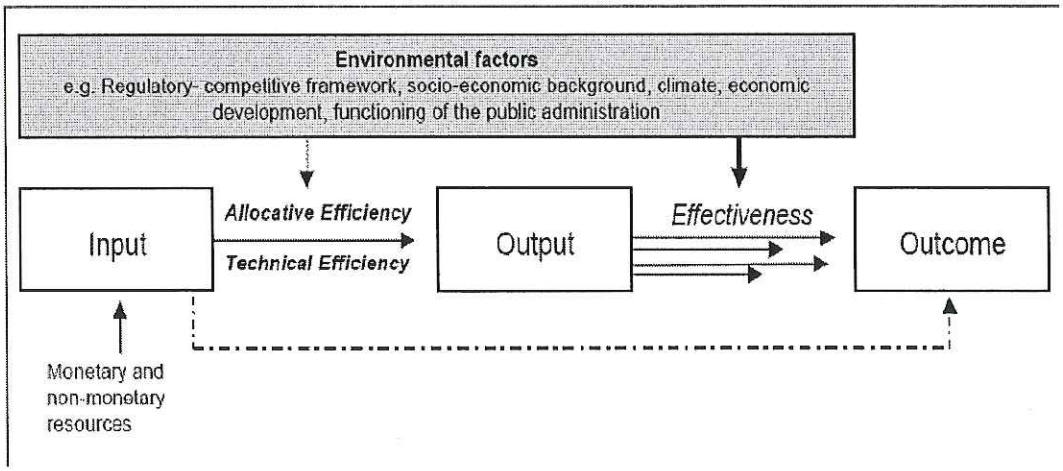
CHAPTER TWO
LITERATURE REVIEW

2.1. Theoretical Framework

When the literature is examined it is possible to encounter different definitions of health. According to the Constitution of WHO (1946) health is defined as "a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity." Grossman (1972) states that "health is a durable capital stock."

Effectiveness of public health expenditure on health outcomes is analyzed in this study. Nevertheless, effectiveness and efficiency are two concepts that are often confused and sometimes they are used in place of each other. To avoid this confusion, the difference between effectiveness and efficiency should be clarified. Mandl, Dierx and Ilzkovitz (2008) state that the efficiency and effectiveness are about the linkage between inputs, outputs and outcomes. On the other hand effectiveness is about final objectives like outcome to achieve input and output. Outcome is affected any other things like political choice so measurement of effectiveness is more difficult than measurement of efficiency.

Figure 13: Conceptual framework of efficiency and effectiveness



Source: Mandl, Dierx and Ilzkovitz, 2008

Figure 13 provides information on effectiveness and efficiency. It shows the relationship between input, output and outcome and environmental factors affecting them.

> *"The monetary and non-monetary resources deployed (i.e. the input) produce an output. For example, education spending (input) affects educational attainment rates (output). The input-output ratio is the most basic measure of efficiency. However, compared to productivity measurement, the efficiency concept incorporates the idea of the production possibility frontier, which indicates feasible output levels given the scale of operations. The greater the output for a given input or the lower the input for a given output, the more efficient the activity is. Productivity, by comparison, is simply the ratio of outputs produced to input used" (Mandl, Dierx and Ilzkovitz, 2008: 3).*

In most studies, the health production function approach is used to determine health care effectiveness. Wibowo and Tisdell (1992: 107) state that medical and non-medical health inputs integration find out health output. Therefore, with change in health inputs, change in health status can be showed. In addition, Bidzha, Greyling and Mahabir (2017: 7) explain "the demand for health with the use of the health production function.

The basic model of health production function:

$$H = f(M, N)$$

H refers to health status of individuals; M refers to medical factors and N refers to non-medical factors like physical environment, life styles and socio-economic variables. For estimating a health production function, defining and measuring health outcomes is a problem. Or (2000: 55) states that unfortunately, there is no comprehensive health index that includes different aspects of the health status on the macro level and comparative results between countries. Consequently, objective measures of mortality rates are usually used in empirical studies.

The most popular measurement of health status, mortality rate can be examined like infant mortality rate, under-five mortality rate, mortality rate for elderly, life expectancy at birth. Mosley and Chen (1984: 142) argue that the mortality rate is used as a dependent variable by social scientists because deaths are measured more easily. However, for the research, large population or small

population cumulating and long periods are necessary. The other health status measurement is morbidity but duration, severity and consequences of a disease is difficult to quantify. There is a need to measure physical, functional, mental or social disabilities.

In their analytical framework, Mosley and Chen (1984) state that socio-economic status impresses the proximate determinants and risk of disease and then these impress health outcomes. More clearly, socio-economic status affects the health outcomes via proximate determinants. Mosley and Chen (1984) group proximate determinants into five categories; "1) maternal factors (age, parity, birth interval), 2) environmental contamination (air, food/water/fingers, skin/soil/inanimate objects, insect vectors), 3) nutrient deficiency (calories, protein, micronutrients –vitamins and minerals-), 4) injury (accidental, intentional) and 5) personal illness control (personal preventive measures, medical treatment)". On the other hand, Mosley and Chen (1984) group socio-economic determinants into three categories; "1) individual-level variables (individual productivity –fathers, mothers-, and traditions/norms/attitudes), 2) household-level variables (income/wealth), 3) community-level variables (ecological setting, political economy, health system)."

According to mentioned model the effect of medical and non-medical resources on health status is examined. It is expected that there is a positive relationship between health care resources and health status. However, Or (2000) stated that the previous studies are so weak and conflicting about this relation. Especially for industrialized countries, health care resources and health outcomes measured by death rates, mortality rates and life expectancy have no significant relationship. In the same manner, in their study, Day and Tousignant (2005) imply that there is no strong statistically significant relationship between real per capita GDP, real per capita spending on health and indicator of health outcomes naming infant mortality rate, the age-standardized mortality rate, a single composite index in Canada for the periods 1960-1997, 1950-1997 and 1926-1999. According to the study, there are two reasons of this weak relationship. The first one is model misspecification. The association between per capita GDP, health outcomes and health spending is not straightforward. The second reason is high level of population health status. In developed countries, increase in GDP has smaller impact than in

non-developed countries because health status is higher. Moreover, with a cross country analysis, finding a relationship is difficult because the results may be sensitive with small number of observations. Filmer and Pritchett (1999) analyze the effect of health spending on health factor in determining child and infant mortality as the outcome variable by using cross-national data. According to this study, the impact of health spending on health factor is not powerful. In addition to that, income inequality, per capita income of a country, female literacy, ethnic fragmentation and predominant religion can explain mortality.

For simplicity the non-medical resources can be classified as life styles, socio-economic factors and physical environment. Physical environment refers to air pollution, noise, and water and soil quality, etc. Matthew, Adegboye and Fasina (2015) imply that there is a significant relationship between public spending on health and health outcomes in Nigeria between 1979 and 2012 by using Johansen Cointegration and the Vector Error Correction Model (VECM) technique. It is stated that environmental factors like air pollution, hospitals are used for determining health outcomes and based on findings, in Nigeria, health outcomes and public health expenditure have negative relationship.

The other non-medical factor, life style refers to tobacco and alcohol consumption, dietary patterns, personal hygiene, physical exercise, etc. Berger and Messer (2002) examine the impact of public financing of health expenditures, insurance coverage and other factors on health outcomes for 20 OECD countries between 1960 and 1992. The model clearly shows that, rising alcohol, tobacco and fat consumption, decreasing female labor force participation is related with increasing mortality rate. However, rising education level and income inequality are related with declining mortality rate. Moreover, there is a robust linkage between increasing publicly financed health expenditure and higher mortality rates. On the other hand, rising coverage insurance is associated with lower mortality rates.

Another non-medical factor is socio-economic factors which refer to income, education and work. Kim and Lane (2013) aim to analyze the relationship between public health expenditure and health outcomes which are infant mortality rate and life expectancy at birth by using linear mixed model among 17 OECD countries between 1973 and 2000. Other than public health expenditure, some socio-economic

covariates are used as control variables for example, the Gini coefficient, real GDP per capita, the rate of aging population and unemployment rates (over 65). According to this study, government health expenditure and infant mortality rate are negatively related and government health expenditure and life expectancy at birth are positively related.

Ashiabi, Nketiah-Amponsah and Senadza (2016) indicate that law of diminishing marginal productivity is one of the most important characteristics of health production function. Diminishing marginal productivity means that when keeping other inputs same and increasing one input, this may increase health outputs but every additional health input results smaller effect on health. This means that there might be non-monotonic and non-linear relationship between health outcomes and health inputs. Marginal product has an importance for policy makers because they are interested in how much health status increase in further health expenditures. For different types of groups, the marginal product is different as poor, young, etc. In developed countries, health inputs and health outcomes are high. When there is a small increase in health input, there is a smaller impact on health outcomes in developed countries than health outcome of developing countries.

2.2. Previous Empirical Works

There are substantial studies explored the link between health expenditure and health outcomes both in developing and developed countries. This section provides a review of relevant studies in which health expenditure has a significant impact, limited impact or no impact on health outcomes for countries which are different income levels.

2.2.1. Health Expenditure and Health Outcomes in Low-Income Economies

Bein, Unlucan, Olowu and Kalifa (2017) examine the relationship between both public and private healthcare expenditures and health outcomes such as adult life expectancy, neonatal, infant and under-five deaths for eight East African

countries which are Eritrea, Burundi, Kenya, Ethiopia, Rwanda, Uganda, Tanzania and Sudan by using panel data regression technique for the years 2000-2014. Based on results, total healthcare expenditures and life expectancy are associated strongly and positively. Moreover, healthcare expenditure has a robust impact on females than on males for improving life expectancy. On the other hand, there is negative relationship between healthcare expenditure and neonatal, infant and under-five deaths. According to study, these results are important to decide encouraging the private healthcare investment or allocating more resources to the healthcare sector.

Wang (2002) aim to choose effective health intervention in low-income economies by identifying determinants of health outcomes like infant mortality rate and under-five mortality rate over 60 low-income countries between 1990 and 1999. According to this study, there is negative relationship between level and inequality in child mortality. Moreover, child mortality rate is significantly different in urban and rural areas. There is slower reduction in rural population child mortality rate than urban population child mortality rate.

Byro and Musonda (2016) analyze the effect of public health expenditure on health outcomes like infant and under-five mortality in Tanzania for the years 1995-2013 by using Bayesian time series approach. According to this study, although government health expenditure models change over 1995 and 2013, health outcomes are not affected from government health expenditures because public health expenditure is still low in Tanzania. In addition to that, income level (GDP) and health outcomes (infant and under five mortality) are related negatively.

Based on these studies, it can be said that in low-income economies health expenditure and life expectancy at birth are related positively on the other hand there is a negative relationship between health expenditure and infant/child mortality rates. In addition, when compared with rural and urban areas, the decline in child mortality rates is slower in rural areas than in urban areas. However, in some low-income economies such as Tanzania, health outcomes are not affected from change in health expenditure because health expenditure is still low.

2.2.2. Health Expenditure and Health Outcomes in Lower-Middle-Income Economies

Barenberg, Basu and Soylu (2015) state that public health expenditure is an important component for reformer policy in poor countries like India. In this study, the effect of public health expenditure on infant mortality rate as a health output is examined after controlling per capita net state domestic product, urbanization, female literacy rate and sex ratio for 31 Indian states and union territories covering the periods between 1983-1984 and 2011-2012. Based on findings, if public health expenditure increases by 1 percent, there is a reduction on infant mortality rate by 8 infant deaths per 1000 live births. In addition, infant mortality rate decreases with female literacy and urbanization in India. On the other hand, according to Document of World Bank (2004) increasing health spending is not enough for reducing infant mortality rate in India. The quality and effectiveness of health spending is also important features for especially poorer states.

Boachie and Ramu (2016) examine the impact of public health expenditure on health status in Ghana between 1990 and 2012 by using Ordinary Least Squares and Newey-West regression techniques. Based on findings, public health expenditure and literacy reduce infant mortality rate which is health outcome so health status improve. The effect of literacy on health is greater than the effect of public health expenditure. However, the effect of per capita GDP on health is weak in Ghana.

Deluna and Pealta (2014) analyze the relationship among public health expenditure, income and health outcomes like infant mortality rate, under five mortality rate and life expectancy in Philippines between 1981 and 2010 by using Vector Autoregressive (VAR) Analysis and Granger Causality test. According to VAR results, infant mortality rate is affected by past value of public health expenditure but under-five mortality rate is not affected. On the contrary, under-five mortality rate is affected by past and present value of GDP but infant mortality rate is not affected. In addition to that, both GDP and health expenditure has a positive impact on life expectancy in Philippines. Based on those findings, to achieve MDGs, there should be effective health expenditure and sustainable economic growth.

Based on these studies, there is a negative relationship between health

expenditure and infant mortality rate in lower-middle-income economies. Moreover, other variables are as important as health expenditures such as literacy rate and GDP in determining health status. Beside them, not only quantity of health expenditure but also quality of health expenditure is significant for improving health outcomes in lower-middle-income economies.

Besides also the mentioned studies there are also other studies for different countries which resulted in opposite findings. Ogungbenle, Olawumi and Obasuyi (2013) reveal the relationship among public health spending, economic growth and life expectancy in Nigeria by using a VAR model. It is concluded that there is no causal relationship between public health expenditures and life expectancy and also there is no causal relationship between economic growth and life expectancy over the years. On the other hand, according to findings, there is causal relationship between public health spending and economic growth. It means that if public health spending is increased by government, economic growth will take place in Nigeria. Moreover, Burnside and Dollar (1998) analyze the effect of foreign aid on infant mortality rate. According to this study, there is no significant linkage between infant mortality rate and aid in developing countries with weak management. Mazumder (2007) examines effects of education on health on the study named 'How Did Schooling Laws Improve Long-Term Health and Lower Mortality'. Based on findings, changes in compulsory school laws are not significant factor for effecting mortality.

2.2.3. Health Expenditure and Health Outcomes in Upper-Middle-Income Economies

Schulte (2015) states that although Cuba is involved in Third World Nation group[1] and it has lower health care expenditures, the average life expectancy is same as United States because of constitutional mandate, extensive Public Health Law and intricate system of community-based care. However, lack of truly equal care, high abortion rate, lack of transparency and non-governmental monitoring of the health care system cause concerns in Cuba.

Ahmad and Hasan (2016) analyze the effect of governance and public health

[1] Third World Countries are countries outside the capitalist West Bloc and the socialist Eastern Bloc during the Cold War.

expenditure on health outputs such as under-five mortality rate, life expectancy and infant mortality rate in Malaysia between 1984 and 2009 by using Autoregressive Distributed Lag cointegration framework. According to study, there is long-run relationship between health outcomes and public health expenditure, income level, government stability and corruption. If governance level is poor, health outcomes cannot be improved although public health expenditure increases. For this reason, government should reduce corruption to improve health status in Malaysia.

Bidzha, Greyling and Mahabir (2017) examine the effect of public health expenditure on health outcomes in South Africa in between 2005 and 2014. By using control variables like real GDP per capita, immunization coverage ratio, access to formal housing, female literacy rate and HIV/AIDS prevalence, although health expenditure and life expectancy have no statistically significant relationship when health expenditure increases in South Africa, under-five mortality rate decreases.

Based on these previous studies' findings, other than the effect of health expenditure on health outcomes, the other control variables such as governance level is more important in upper-middle-income economies.

2.2.4. Health Expenditure and Health Outcomes in High-Income Economies

Or (2000) analyzes the impacts of environmental factors such as socio-economic factors, life styles and physical environment on health outcome by using country-level data between 1970 and 1992 for 21 OECD countries. According to this study, there is a strong negative relationship between premature mortality rates and income per capita for both men and women. It is not easy to isolate the effects of health expenditure on health outcomes because health expenditure and GDP per capita have strong collinearity. In addition to that, work condition and education have large and significant impact on infant mortality for both men and women. Moreover, according to this study, there is small, positive and significant relation between air pollution and infant mortality rate.

Çalışkan (2009) indicates that per capita GDP is the most important factor to determine the variability of health expenditure in OECD countries between 1984 and

2005. Health expenditure discussed into two parts like public and private expenditures in this study. Demographic structure and environmental conditions has also an impact on health expenditure as significant as income level.

Nixon and Ulmann (2006) state that the contribution of health expenditure to health outcomes is a complicated issue because health expenditure is not unique quantitative and qualitative factor contributes to health outcomes. Health outcomes are quantitative and qualitative too and only quantitative factors can be accountable. According to this study named The Relationship between Health Care Expenditure and Health Outcomes, although there is limitation because of given reasons above, it is concluded that health care expenditure is the most important factor for decreasing infant mortality and health care expenditure is only a marginal contributor for increasing male and female life expectancy in OECD countries.

Cremieux, Ouellette and Pilon (1999) analyze the relationship between health care spending and health outcomes when controlling economic, socio-democratic, nutritional and life-style factors by using ten Canadian provinces data between 1978 and 1992. Although per capita health spending and health outcomes have small differences in these mentioned ten provinces, there is a robust relationship. Based on findings, there is negative linkage between health care spending and infant mortality rate on the other hand there is positive linkage between health care spending and life expectancy in Canada.

Based on these studies, there is a negative relationship between infant/child mortality rates and health expenditure and there is a positive relationship between life expectancy at birth and health expenditure in high-income economies. Moreover, unlike other income groups, environmental factors are also important for determining health status in high-income economies.

2.2.5. Health Expenditure and Health Outcomes According to Cross-Country Analysis

Bokhari, Yunwei and Gottret (2007) imply that there is a connection between per capita income to two health outcomes and country's per capita government health expenditures such as maternal mortality and under-five mortality by using 127

observations for the calendar year 2000. The elasticity of under-five mortality and maternal mortality with respect to government health expenditures and income is estimated. According to findings, government health spending is a significant factor although economic growth is a significant participant to health outcomes for developing countries.

Jaba, Balan and Robu (2014) aim to analyze the relationship between health care expenditures per capita and life expectancy at birth at 175 world countries grouped in accordance with their income level and geographic position in between 1995 and 2010 by using panel data analysis. According to study, there is significant relationship between health expenditures and life expectancy. The variation of health expenditure has a significant importance in between developed, developing and less developed countries. Based on results, for the lower middle income group, health expenditure has the highest effect on health outcomes although for the high income group, it has the smallest effect.

Çevik and Taşar (2013) state that some socio-political determinants like law and order, education level, population are also main determinants like income level. The impact of government health spending on health outcomes like child and infant mortality rate is examined for 131 countries. Based on results, there is a negative relationship between under-five mortality and government health spending as a share of GDP.

Yılmaz and Akdede (2016) examine the impact of governance level on effectiveness of public health expenditure and relationship between public health expenditure and health outcomes measured by under-five child mortality rate between 2002 and 2012 for 149 countries. According to this study, other socio-economic variables are stronger than public health spending to clarify child mortality rate. Moreover, in countries with higher governance level, the impact of public health spending in improving health outcomes is stronger.

Farag, Nandakumar, Wallack, Hodgkin, Gaumer and Erbil (2013) argue that effectiveness of health spending increases with good governance in their study named Health Expenditures, Health Outcomes and the Role of Good Governance. The association between health outcomes and country health spending such as infant mortality and child mortality is analyzed by using 133 low and middle income

countries data for 1995, 2000, 2005 and 2006. According to findings, health spending decreases infant and child mortality for all specified models with right policies and institutions.

According to previous studies, change in health expenditure has higher effect on health outcome in low-income economies than high-income economies. In addition, governance level is also important factor in determining health outcomes for all income economies.

2.2.6. Health Expenditure and Health Outcomes According to Different Regions

In this title, the relationship between health expenditure and health outcomes in previous studies has examined according to different regions such as African countries, sub-Saharan Africa, Pacific Island countries.

Anyanwu and Erhijakpor (2009) examine the impact of income per capita and government health expenditures on two health outcomes which are infant mortality and under-five mortality by using data from 47 African countries between 1999 and 2004. According to this study, health expenditure has a strong impact on health outcomes. Although ethnolinguistic fractionalization and HIV have positive and significant impact on infant mortality and under-five mortality, a great numbers of physicians and female literacy have negative impact on health outcomes.

Novignon, Olakojo and Nonvignon (2012) imply that health care expenditure is related with increasing life expectancy at birth and decreasing crude death rate and infant mortality rate in sub-Saharan Africa. In addition to that, although both public and private sources of health care expenditure are connected with improving health outcomes, public health care expenditure is more significant. An effective public-private partnership on health sector is suggested for improving public health status.

Gani (2009) argues that per capita public health expenditure is an important factor in determining health outcome such as crude death rates, under-five mortality rates and infant mortality rates by using seven Pacific Island countries data between 1990 and 2002. According to elasticity results, if per capita public health spending increases 10%, infant mortality rate decreases approximately 6.6%. Moreover, based

on findings, immunization and per capita income are also significant factors for indicating health outcomes.

CHAPTER THREE
METHODOLOGY AND DATA

3.1. Model

The aim of this study is measuring effectiveness of health expenditure on health outcomes by estimating health production function for OECD countries. The concept of health production function refers to the idea that people use their health inputs, such as health and medical care, to produce their health. The logic here is to obtain better health outcomes through the use of more health inputs. However, increases in the amount of health inputs used lead to smaller improvements in health outcomes (Ashiabi, Nketiah-Amponsah and Senadza, 2016: 1390). The macroeconomic analysis of the health production function provides the following benefits: To provide information on the resource budget required to improve the overall health status of countries in the sample. Knowing the contribution of each factor to improving the health status of countries in the sample can help policymakers to produce more effective policies (Fayissa and Traian, 2011: 3).

As mentioned before, in their analytical framework, Mosley and Chen (1984) examined that health outcomes are affected from socio-economic status via proximate determinants. The proximate determinants are classified like: 1) Maternal factors; 2) Environmental contamination; 3) Nutrient deficiencies; 4) Injury; and 5) Personal illness control.

"Mathematical form of this framework is formulated as;

Health= f (socio-economic variables, proximate determinants, risk of disease)" (cited in Bidzha, 2015: 39).

According to Mosley and Chen (1984) risk of disease refers to health outcomes and health statuses are directly affected from acute and chronic diseases.

The most basic form of health production function can be formulated as:

$$H=f(M, N)$$

H: health status of individuals

M: medical factors

N: non-medical factors

Non-medical factors contain:

1) Physical environment (air pollution, noise, and water and soil quality)

2) Life styles (tobacco and alcohol consumption, dietary patterns, personal hygiene, physical exercise)

3) Socio-economic variables (income, education and work)

3.2. Data

In this study, the data set consists of 20 OECD members for 36 years in between 1980 and 2015. From within 35 OECD countries, 20 OECD countries which are Australia, Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and the US are selected for this research. Due to lack of existing data, other countries are not included in the study. Data sources are OECD data base which includes data for OECD countries and World Bank database which includes indicators of all countries in the world. Data of life expectancy at birth, health expenditure per capita, GDP per capita, tobacco consumption, alcohol consumption, urban population rate, aging population (65 over), and unemployment rate are received from OECD data base. Data of immunization rate, under-five mortality rate and carbon dioxide emission are received from World Bank database and infant mortality rate data is received from both OECD data base and World Bank database.

3.2.1. Dependent Variables

Dependent variables refer to health outcomes in the model. Health status is measured commonly with mortality rates and life expectancy at births as mentioned before. In literature, some studies choose single health outcome to measure effectiveness of health expenditure (Barenberg, Basu and Soylu, 2015; Boachie and Ramu, 2016) while some studies choose more than one health outcomes (Kim and

Lane, 2013; Byro and Musonda, 2016; Ahmad and Hasan, 2016; Matthew, Adegboye and Fasina, 2015; Berger and Messer, 2002). According to Nixon and Ulmann (2006: 15) that health status of population is partially reflected by life expectancy and mortality rates. Especially in developed countries, finding the causality linkage between health expenditures and health outcomes is not easy.

In this study, life expectancy at birth, infant mortality rate and under-five mortality rate are used as health outcomes. The United Nations (2000: 45) defines life expectancy at birth as: "The average number of years that a newborn expects to live in the event of a past life, depending on age-specific mortality rates". Life expectancy is a sign of health conditions and mortality conditions. Environmental, economic and social impacts are presented by this indicator. Accordingly, the global life expectancy for newborns in 2015 is 71.4 years. On the other hand, World Health Statistics shows that the average life expectancy of newborns in 29 high-income countries is 80 or more years, while in Sub-Saharan it is below 60 years (WHO, 2016).

Infant mortality rate and under-5 mortality rate are other health outcomes that are used as a dependent variable. "Infant mortality refers to the probability of dying before age per 1000 newborns. Under-5 mortality means the probability of dying before age per 1000 newborns" (United Nations, 2000: 39). According to WHO (2016), most likely to die without completing the child's first age is 52 per 1000 live births in World Health Organization (WHO) African Region in spite of 8 per 1000 live births in WHO European Region.

> *"Worldwide infant mortality rate dropped from 64.8 deaths per 1000 live births in 1990 to 30.5 deaths per 1000 live births in 2016. Infant mortality, which was 8.8 million in 1990, declined to 4.2 million in 2016. Most likely to die under-5 is 76.5 per 1000 live births in WHO African Region and 9.6 per 1000 live births in WHO European Region. Worldwide under-5 mortality rate dropped from 56 percent from 1990 to 2016. When comparing 1990 and 2016 under-5 mortality rate, 20000 fewer children die in 2016" (WHO, 2016).*

3.2.2. Independent Variables

Determining effectiveness of public health expenditure on health outcomes which are infant mortality rate, under-5 mortality rate and life expectancy in OECD

countries is the purpose of this thesis. The independent variables are chosen as public health expenditure, GDP per capita, immunization ratio, urban population rate, unemployment rate, CO_2 emission, tobacco consumption, alcohol consumption and aging population rate (over 65). The definitions of independent variables and relationship between independent variables and dependent variables are given below.

1. Public Health Expenditure per capita: Total health expenditure covers both public health expenditure and private health expenditure. As said before, the aim of this research determining public health expenditure impact on health outcomes. Therefore, public health expenditure per capita is chosen as explanatory variable. Public health expenditure per capita data is sourced from OECD data base.

According to previous studies, there is positive relationship between life expectancy at birth and public health expenditure (Kim and Lane, 2013; Bein, Unlucan, Olowu and Kalifa, 2017; Deluna and Pealta, 2014; Ogungbenle, Olawumi and Obasuyi, 2013; Ahmad and Hasan, 2016; Bidzha, Greyling and Mahabir, 2017; Nixon and Ulmann, 2006). On the other hand, there is negative relationship between public health expectancy and infant mortality rate and under-5 mortality rate (Çevik and Taşar, 2013; Anyanwu and Erhijakpor, 2009; Gani, 2009; Bein, Unlucan, Olowu and Kalifa, 2017; Wang, 2002; Byro and Musonda, 2016; Deluna and Pealta, 2014).

2. GDP per capita: GDP is a good way to measure a country's economy. Callen (2008: 48) defines GDP as "measures the monetary value of final goods and services produced in a country within a specified period and purchased by the end user." In this study, GDP per capita which is measurement of GDP divided by person in a country is used as a control variable. The data of GDP per capita is received from OECD data base.

According to literature review, GDP per capita is a very important factor for determining health outcomes. Byro and Musonda (2016); Ogungbenle, Olawumi and Obasuyi (2013); Ahmad and Hasan (2016) argue that when other variables keep constant, GDP has positive impact on health status. Filmer and Pritchett (1999) state that GDP may have a direct or indirect impact on health outcomes. Based on literature, it is expected that GDP per capita is positively correlated with life expectancy at birth and negatively correlated with infant mortality rate and under-5 mortality rate.

3. Immunisation Ratio: Vaccinations programs have been established in OECD countries taking into account the benefits and harms of vaccination. Vaccines provide effective protection against certain diseases such as tetanus. The vaccination rates in the world indicate the percentage of children who were vaccinated during childhood. Although the exact age of immunization differs from country to country due to different vaccination programs, it is measured as a percentage of children around 1 year old (OECD, 2018c).

According to Bidzha (2015) immunisation ratio is important determinant as a control variable. It is expected that, immunisation ratio is positively correlated with life expectancy at birth and negatively correlated with under-5 mortality rate and infant mortality rate.

4. Urban Population (% total): As a measure of urbanization, urban population (%total) is used in this research. The data of urban population rate is sourced from OECD data base.

The choice of urban population as a control variable for health outcomes is comes from Anyanwu and Erhijakpor (2009) who show that urbanization as an important determinant for health outcomes. In addition, Wang (2002) and Barenberg Basu and Soylu (2015) argue that health outcomes are significantly different in urban areas and rural areas. It is expected that coefficient is negative for infant mortality rate and under-5 mortality rate and positive for life expectancy at birth.

5. Unemployment (% total labor force): OECD (2018d) defines unemployment rate as the proportion of the unemployed in the percentage of the labor force in a country. Unemployment rate data is received from OECD data base.

Kim and Lane (2013) argue that unemployment is significant determinant as a control variable. It is expected that, unemployment rate is negatively correlated with life expectancy at birth and positively correlated with under-5 mortality rate and infant mortality rate.

6. CO_2 emission (metric tons per capita): In this research, CO_2 emission (metric tons per capita) is used as a pollution indicator.

Or (2000) implies that environment factors like physical environment have significant effects on health. Matthew, Adegboye and Fasina (2015) chose CO_2 emission as a control variable in their study. The expected correlation between CO_2

emission and life expectancy at birth is negative while correlation between CO_2 emission and infant mortality rate and under-5 mortality rate is positive.

7. Tobacco Consumption: One of the main risk factor for lots of diseases is tobacco consumption and harms almost every organ but it is still common worldwide. In this research, tobacco consumption (grammes per capita) is used as a control variable. The data of tobacco consumption is received from OECD data base.

The choice of tobacco consumption as a control variable for health outcomes is comes from Or (2000) who show that tobacco consumption is important determinant for health outcomes. Moreover, in their study, Berger and Messer (2002) choose tobacco usage as a control variable too. Based on literature, it is expected that tobacco consumption is correlated with infant mortality rate and under-5 mortality rate positively while it is correlated with life expectancy at birth negatively.

8. Alcohol Consumption: According to OECD (2018e), "alcohol consumption is annual sales of alcohol in litres per person for 15+ years old" Like tobacco consumption, alcohol consumption carries a risk adverse health too. In this research alcohol consumption (litres per capita) is used as a control variable. The consumption of alcohol data is sourced from OECD data base.

According to Or (2000) and Berger and Messer (2002), alcohol consumption is significant determinant for health outcomes. The expected correlation between alcohol consumption and life expectancy at birth is negative while correlation between alcohol consumption and infant mortality rate and under-5 mortality rate is positive.

9. Rate of Aging Population (Over 65): People aged 65 and more than 65 is called elderly people. It is measured as population percentage. In this research, rate of aging population is used as a control variable. The data is received from OECD data base.

Kim and Lane (2013) chose rate of aging population as a control variable and show that it is significant indicator for determining health outcomes. It is expected that there is a negative correlation between rate of aging population and life expectancy at birth while there is a positive correlation between rate of aging population and infant mortality rate and under-5 mortality rate.

3.2.3. Descriptive Statistics

Descriptive statistics represents the all variables in an econometric model. In model which is used in this study includes 20 OECD countries over the time period 1980 and 2015.

Table 5: Descriptive Statistics

Variables	obs	mean	std.dev.	min	max
Log(Infant mortality rate)	519	1.75	0.61	-0.10	4.40
Log(Under-5 mortality rate)	519	1.96	0.60	0.83	4.75
Log(Life expectancy)	519	4.35	0.04	4.07	4.42
Log(Public health expenditure per capita)	519	7.16	0.77	2.95	8.56
Log(GDP per capita)	519	10.08	0.71	7.12	11.54
Immunization ratio	519	90.14	10.68	33	99
Urban population rate	519	77.95	8.85	46.99	96.70
Unemployment rate	519	6.57	3.62	0.40	26.10
CO_2 emission	519	9.39	3.89	1.89	20.78
Log(Tobacco consumption)	519	7.49	0.35	6.29	8.24
Alcohol consumption	519	9.23	3.15	1.20	20.10
Rate of aging population (over 65)	519	13.74	3.34	4.20	26

Source: Own computing using Eviews6, includes 20 OECD countries between 1980 and 2015

Table 5 shows descriptive statistics which are mean, standard deviation, maximum and minimum values for all dependent variables (life expectancy, infant mortality rate, and under-5 mortality rate) and independent variables (public health expenditure, GDP, immunization ratio, alcohol consumption, tobacco consumption, aging population rate, unemployment rate, urbanization rate, CO_2 emission) in this study.

As seen from the Table 5 standard deviation of public health expenditure per capita is so low which is 0.7 so descriptive statistics show that there are no wide variations in public health expenditure per capita among 20 selected OECD countries. According to World Bank database (2018) world average of urban population rate is 54.8%. On the other hand, the selected countries' mean is 77.9%. Moreover, Table 5 shows that immunization ratio is %90.1 which is higher than world average which is 80%.

3.3. Empirical Model

The relationship between health outcomes and public health expenditure per capita in OECD members is estimated with health production function by using panel data estimation techniques in this thesis. Health production function is modeled mathematically as:

$H = f(pheaexp, gdp, immun, alcohol, tobacco, over65, unemp, urban, co2)$

H: health outcomes (infant mortality rate, under-5 mortality rate, life expectancy at birth)

pheaexp: public health expenditure per capita

gdp: Gross Domestic Product per capita

immun: % of children immunised

alcohol: alcohol consumption litres per capita (+15)

tobacco: tobacco consumption grammes per capita (+15)

over65: Rate of aging population (over65)

unemp: unemployment (% total labor force)

urban: urban population (%total)

co2: CO_2 emission (metric tons per capita)

This equation is modeled econometrically as:

$$lnH_{it} = \beta_0 + \beta_1\, lnpheaexp_{it} + \beta_2\, lngdp_{it} + \beta_3\, immun_{it} + \beta_4\, alcohol_{it} + \beta_5\, lntobacco_{it} + \beta_6\, over65_{it} + \beta_7\, unemp_{it} + \beta_8\, urban_{it} + \beta_9\, co2_{it} + u_{it}$$

Logarithms of health outcomes (infant mortality rate, under-5 mortality rate, life expectancy at birth), public health expenditure per capita, GDP per capita and tobacco consumption are used for interpretation of relationship between public health expenditure and health outcomes. Based on literature, all these independent variables are already used as control variables in the other studies (Bidzha, Greyling and Mahabir, 2017; Ashiabi, Nketiah-Amponsah and Senadza, 2016; Matthew, Adegboye and Fasina, 2015; Bein, Unlucan, Olowu and Kalifa, 2017).

3.4. Estimation Techniques

Firstly, pooled Ordinary Least Squares (OLS) model is estimated before the Fixed Effects Model (FEM) and Random Effects Models (REM) are estimated. For random effects model Breusch-Pagan test and for FEM F-test are used. "If pooled OLS model is used although the tests show that either FEM or REM are preferred, the differences can lead to correlation between the independent variable and the error term leading to endogeneity problem. As a result, estimates would be biased and inconsistent" (Bidzha, 2015: 47).

However, theoretically or practically it is not easy to chose one of the models because both of them have advantages and disadvantages. "Fixed effect formulation of the model assumes that differences across units can be captured in differences in the constant term" (Greene, 2003: 287). "In FEM, the intercept in the regression model is allowed to differ among individuals in recognition of the fact that each individual, or cross-sectional, unit may have some special characteristics of its own" (Gujarati and Porter, 2009: 613). It provides correlation of unobserved individual effects with included variables.

As said before, the study used panel data can be analyzed with REM as well as FEM. "In FEM each cross-sectional unit has its own (fixed) intercept value, in all N such values for N cross-sectional units. In REM, on the other hand, the (common) intercept represents the *mean value* of all the (cross-sectional) intercepts and the error component εi represents the (random) deviation of individual intercept from this mean value" (Gujarati and Porter, 2009: 603).

"To decide which approach is appropriate, the Hausman test can be used or Breusch-Pagan test can be also used to see if REM is appropriate. In this case, it is necessary to examine whether the difference between the parameter estimators of the REM and the FEM parameter estimators is statistically significant. Hausman test statistic is used to choose between two models. The Hausman test statistic "Random effects estimator is correct" shows the degree of freedom k-squared distribution under the null hypothesis. If it does occur, it can be determined that the components of the error terms of the REM are not related to the independent variables. In this case, the FEM will be preferred" (Pazarlıoğlu and Kiren Gürler, 2007: 39).

The hypothesis is:

H_0 = there is no differences between fixed and random effect

When H_0 is rejected, FEM is used. According to Bell and Jones (2013) it is not so easy to provide required REM condition which is no correlation between individual specific effects and explanatory variables. Therefore, FEM is used generally in the studies.

In this thesis, model specification, heteroscedasticity, endogeneitiy and autocorrelation are applied by using Eviews6. Instrumental variable estimation techniques are applied to the affected regression model where the explanatory variable on the selected FEM or REM is endogenous to public health. As there are many explanatory variables in the study and there is a potential for correlation between the regressors, a multicollinearity test is also carried out. Estimated standard errors are set for random serial correlation and heteroscedasticity.

CHAPTER FOUR
FINDINGS

4.1. Diagnostic Tests

In order to show econometric estimates findings, diagnostic tests are important for proving estimation robustness. "Diagnostic tests determine the estimation technique and validity of the findings. Furthermore, diagnostic checks are conducted to ensure that the reported results are consistent, unbiased, efficient, and reliable" (Bidzha, 2015: 51). Test for heteroscedaticity, autocorrelation, and misspecification of the functional form are diagnostic tests.

4.1.1. Heteroscedasticity Tests

According to Ramanathan (1998) in OLS and Maximum Likelihood Estimation (MLE), it is assumed that the residuals u_t is distributed with equal variance and zero mean. "The equal variance assumption is called homoscedasticity. However, this assumption can be false in especially cross-section data. Regression disturbances whose variances are not constant across observations are heteroscedastic" (Greene, 2003: 215).

> *"If heteroscedasticity among the stochastic disturbance terms in a regression model is ignored and the OLS procedure is used to estimate the parameters, then the following properties hold:*
>
> *a. The estimators and forecasts based on them will still be unbiased and consistent.*
>
> *b. The OLS estimators are no longer BLUE [Best Linear Unbiased Estimator] and will be inefficient. Forecasts will also be inefficient.*
>
> *c. The estimated variances and covariances of the regression coefficients will be biased and inconsistent, and hence tests of hypotheses are invalid" (Ramanathan, 1998: 382-383).*

According to Greene (2003) White's General Test, Goldfeld-Quandt Test and Breusch-Pagan/Godfrey LM Test are some of heteroscedasticity tests. Unlike other tests, White's General Test is more general and does not need any assumptions. "The White test can be a test of (pure) heteroscedasticity or specification error or both. It

has been argued that if no cross-product terms are present in the White test procedure, then it is a test of pure heteroscedasticity. If cross-product terms are present, then it is a test of both heteroscedasticity and specification bias" (Gujarati and Porter, 2009: 388).

White's General Test is applied on infant mortality rate, under-5 mortality rate and life expectancy at birth output for testing heteroscedasticity as seen from Table 6.

Null hypothesis H_0: Homoscedasticity, the variance of residual is constant

Alternative hypothesis H_1: Heteroscedasticity, the variance of residual is not constant

Table 6: White's General Test

Infant mortality rate			
F-statistic	6.476814	Prob. F(54,463)	0.0000
Obs*R-squared	222.9097	Prob. Chi-Square(54)	0.0000
Scaled explained SS	316.0540	Prob. Chi-Square(54)	0.0000
Under-5 mortality rate			
F-statistic	11.69723	Prob. F(54,464)	0.0000
Obs*R-squared	299.2073	Prob. Chi-Square(54)	0.0000
Scaled explained SS	288.7902	Prob. Chi-Square(54)	0.0000
Life expectancy at birth			
F-statistic	12.31859	Prob. F(54,464)	0.0000
Obs*R-squared	305.7382	Prob. Chi-Square(54)	0.0000
Scaled explained SS	323.0040	Prob. Chi-Square(54)	0.0000

Source: Own computing using Eviews6

Whenever probability value of observed R-square is more than 5% in this case null hypothesis which is homoscedasticity is accepted. According to Table 6, for infant mortality rate, under-5 mortality rate and life expectancy at birth probability values of observed R-squared which are zero are lower than 5%. Therefore, null hypothesis is rejected and alternative hypothesis is accepted for all of them. This means that there is heteroscedasticity problem and estimated parameters of models

are not efficient.

4.1.2. Autocorrelation Tests

According to Ramanathan (1998) error terms can be associated for time periods that is not too far away. This situation is called serial correlation or autocorrelation. In panel data model, serial correlation in the error term is identified since serial correlation in linear panel data models leads to standard errors and leads to less efficient results. (Drukker, 2003: 168).

Since, researchers need to define the serial correlation of sequential error terms in a panel-data model.

There are some test of autocorrelation like Durbin-Watson test for first-order serial correlation and Lagrange multiplier test for first-order and higher orders. However, to apply Durbin-Watson test regressors must be non-stationary which means that the values in the repeated sample are constant. If this assumption does not hold, d-test cannot be applied.

Breusch and Godfrey found an autocorrelation test to avoid handicaps of Durbin–Watson test. Gujarati and Porter (2009: 440) states that this test allows: "(1) nonstochastic regressors, such as the lagged values of the regressand; (2) higher-order autoregressive schemes, such as AR(1), AR(2), etc.; and (3) simple or higher-order moving averages of white noise error terms, such as εt in Eq"Breusch and Godfrey test is also called Lagrange multiplier test. According to Ramanathan (1998) Lagrange multiplier test is useful not only in first order, but also in higher orders. To be meaningful there must be at least 30 degrees of freedom because it is large sample test.

Null hypothesis H_0*:* there is no serial correlation

Alternative hypothesis H_1*:* there is serial correlation

Table 7: Lagrange Multiplier Test

Infant mortality rate

F-statistic	838.1457	Prob. F(2,506)	0.0000
Obs*R-squared	397.8932	Prob. Chi-Square(2)	0.0000

Under-5 mortality rate

F-statistic	2040.980	Prob. F(2,507)	0.0000
Obs*R-squared	461.6596	Prob. Chi-Square(2)	0.0000

Life expectancy at birth

F-statistic	1496.183	Prob. F(2,507)	0.0000
Obs*R-squared	443.8055	Prob. Chi-Square(2)	0.0000

Source: Own computing using Eviews6

According to Table 7, at 1% level of significance, the null hypothesis which is no autocorrelation is rejected and alternative hypothesis is accepted. This means that there is autocorrelation for infant mortality rate, under-5 mortality rate and life expectancy at birth outputs with zero p-value.

4.1.3. Endogeneity Test

In this thesis, health production function is estimated to show effects of public health expenditure on health outcomes by using FEM or REM in OECD countries. In FEM, because of special characteristics of each individual or cross-sectional, it is allowed to vary the intercept of regression model. Dummy variables can be used for differing intercepts. If in FEM the dummy variables are used, it is called the least-squares dummy variable (LSDV) model. (Gujarati and Porter, 2009: 613). There is an alternative to FEM which is called REM or error correction model. Gujarati and Porter (2009: 613) states that individual unit intercept is selected randomly from population which have constant mean value in ECM. Constant mean value deviations are explained with individual intercept. As mentioned previous chapter, to decide which model is appropriate, Hausman test is applied.

Null hypothesis H_0: REM is appropriate

Alternative hypothesis H_1: FEM is appropriate

Table 8: Hausman Test

Infant mortality rate

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	9.721590	9	0.3735

Under-5 mortality rate

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	9.131192	9	0.4253

Life expectancy at birth

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	8.690246	9	0.4663

Source: Own computing using Eviews6

The Hausman test's null hypothesis is estimators of FEM and Error Correction Model do not differ. When null hypothesis is not accepted, FEM is appropriate because of the correlation between random effects and regressors. (Gujarati and Porter, 2009: 605). As seen from the Table 8, the Hausman test accept null hypothesis because probability levels are greater than 5%. Therefore, FEM is rejected in favor of REM.

Although it is accepted that explanatory variables are exogenous, this condition is not always achieved because of unsuitable FEM or REM. Gujarati and Porter (2009: 706) states that even tough endogeneity or exogeneity of a variable is a judgment in practice, to decide endogeity or exogeneity of a variable, Hausman specification test is used. For testing orthogonality of the random effects and

regressors, Hausman (1978) device the specification test. (Greene, 2003: 301).

Null hypothesis H_0: public health expenditure per capita is exogenous

Alternative hypothesis H_1: public health expenditure per capita is endogenous

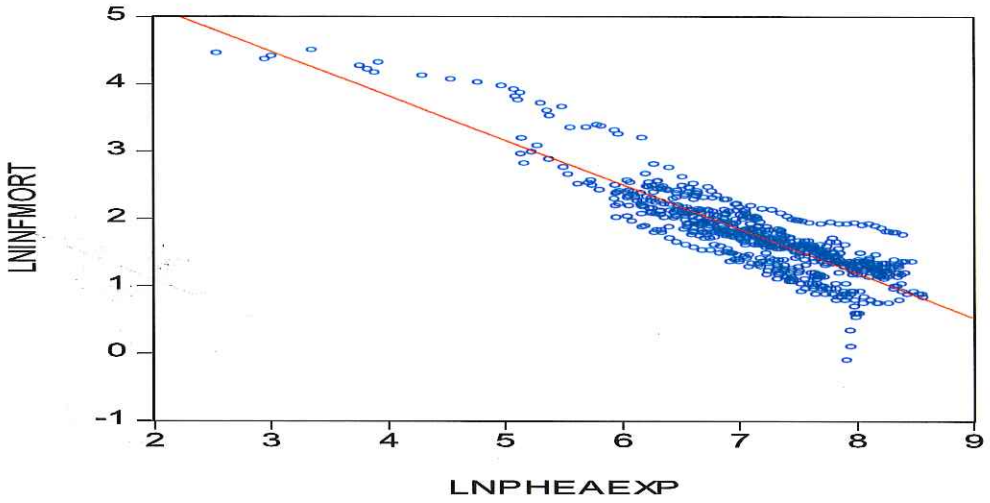
According to Hausman specification test, for infant mortality rate, under-5 mortality rate and life expectancy at birth, the endogeneity problem of public health expenditure per capita does not occur. The test shows statistically insignificant residual variable with probability level of 0.44 (infant mortality rate), 0.75 (under-5 mortality rate) and 0.22 (life expectancy at birth). Therefore, alternative hypothesis is rejected and null hypothesis is accepted which means public health expenditure per capita is exogenous. In this case, there are no need instrumental variable regressions.

4.2. Infant Mortality Rate Findings

Scatter plots show the correlation between health outcomes and regressors. According to Figure 13, there is negative relationship between log of infant mortality rate and log of public health expenditure per capita. Other control variables and infant mortality rate relations are showed at Appendix 1.

According to scatter plot analysis, there is negative relationship between log of infant mortality rate and log of GDP, immunization level, alcohol consumption, rate of aging population (over 65), urban population ratio, and CO_2 emission. On the other hand, there is positive relationship between log of infant mortality rate and log of tobacco usage, unemployment rate.

Figure 14: Log (infant mortality rate) and Log (public health expenditure per capita)



Source: Own computing using Eviews6

Table 9: Infant mortality rate regression results

Regressors	Fixed effect model	Random effect model	Pooled OLS model
lnpheaexp	-0.337532 (0.039536) (-8.53)	-0.329025 (0.037899) (-8.68)	-0.154339 (0.048243) (-3.19)
lngdp	-0.169185 (0.036811) (-4.59)	-0.181937 (0.036456) (-4.99)	-0.513167 (0.050526) (-10.15)
immun	-0.001058 (0.000905) (-1.16)	-0.001052 (0.000895) (-1.17)	-0.000279 (0.001321) (-0.21)
alcohol	-0.034770 (0.007636) (-4.55)	-0.031957 (0.007210) (-4.43)	-0.001365 (0.004406) (-0.30)
lntobacco	0.175432 (0.037928) (4.62)	0.163084 (0.037053) (4.40)	-0.124579 (0.037686) (-3.30)
over65	-0.006996 (0.005064) (-1.38)	-0.007711 (0.004884) (-1.57)	-0.020043 (0.004751) (-4.21)
unemp	-0.021884 (0.002748) (-7.96)	-0.021254 (0.002699) (-7.87)	-0.019314 (0.003609) (-5.35)
urban	-0.005779 (0.003756) (-1.53)	-0.006188 (0.003363) (-1.83)	-0.016369 (0.001543) (-10.61)
co2	-0.003212 (0.007022) (-0.45)	-0.000811 (0.006590) (-0.12)	0.019132 (0.003160) (6.05)
R-squared	0.95	0.86	0.83

Source: Own computing using Eviews6 (coefficients, standard errors -in parentheses under coefficients- and t-statistics –in parentheses under standard errors-)

Table 9 shows the regression results for FEM, REM and pooled regression model. According to literature review to decide which model (FEM or REM) is suitable, Hausman test is applied as mentioned before. When Hausman test is applied to the model, it is seen that REM is appropriate than FEM because of null hypothesis is not rejected with 0.37 probability level. On the other hand, the aims of this study showing the relationship between public health expenditure per capita and health output. To control endogeniety problem of public health expenditure per capita, Hausman specification test is applied. According to this test, public health expenditure per capita is exogenous with 0.44 probability level and instrumental variable regressions are not added to the model.

At Table 9, R-squared values of FEM, REM and pooled OLS model is presented. According to table, R-squared of FEM is 0.95, R-squared of REM is 0.86 and R-squared of pooled OLS model is 0.83. This means that 86 percent of variation in infant mortality rate is explained in REM which is chosen in this thesis.

According to Table 9, public health expenditure per capita which is an explanatory variable has expected sign (-) from the literature for FEM, REM and pooled regression model. For REM, elasticity level of public health expenditure per capita is -0.32. This means that, when holding other variables constant a 1 percent increase in public health expenditure per capita results approximately 0.3 declines in infant mortality rate in OECD members.

In this study, the elasticity level on public health expenditure per capita is higher than some studies in literature. For example, according to Or (2000), elasticity on public health expenditure per capita is -0.16 for women premature mortality rate and -0.17 for men premature mortality rate in selected OECD countries. On the other hand, in some studies elasticity is higher than -0.32. According to Nixon and Ulmann (2006)'s study the elasticity of public health expenditure per capita elasticity is -0.49 for infant mortality rate.

In addition, among the control variables, GDP per capita, alcohol usage, tobacco usage and unemployment are statistically significant. GDP per capita, alcohol usage, tobacco usage and unemployment rate have elasticity level -0.18, -0.03, 0.16 and -0.02, respectively. This means that holding other variables constant, when GDP per capita increases 1 percent, infant mortality rate decrease

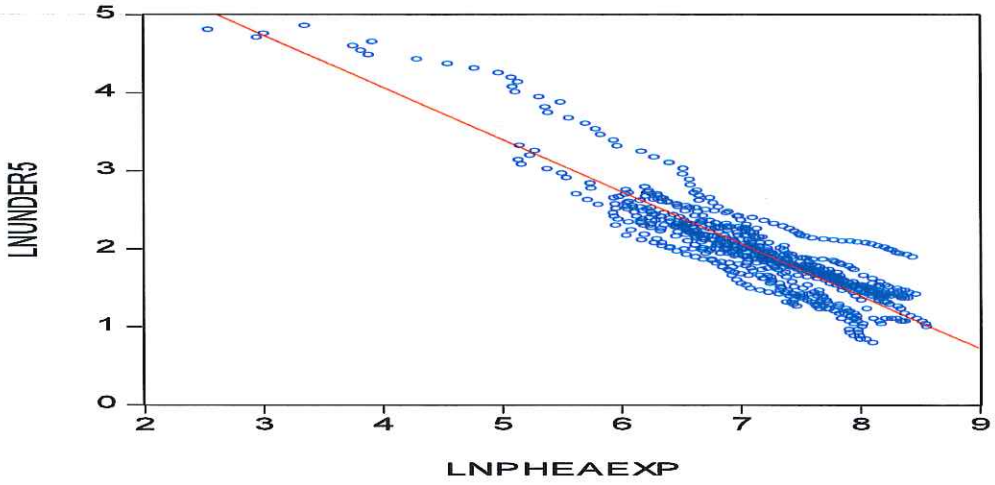
approximately 0.1 percent; when alcohol usage increases 1 percent, infant mortality rate decreases approximately 0.03 percent; when tobacco usage increases 1 percent, infant mortality rate increases approximately 0.16 percent; when unemployment rate increases 1 percent, infant mortality rate decreases approximately 0.02 percent in OECD countries.

Although alcohol usage and unemployment rate are statistically significant, their sign are opposite direction from expected sign. "This finding is counter intuitive and makes interpretation difficult which is perhaps suggestive of errors in measurement on this control variable" (Bidzha, 2015: 60).

4.3. Under-5 Mortality Rate Findings

According to Figure 15 which is scatter plots and shows the correlation between health outcome (under-5 mortality rate) and regressors, there is negative relationship between log of public health expenditure per capita and log of under-5 mortality rate. At Appendix 1, relationship between under-5 mortality rate and other control variables are presented.

Figure 15: Log (under-5 mortality rate) and Log (public health expenditure per capita)



Source: Own computing using Eviews6

Scatter plot analysis show that, there is negative relationship between log of under-5 mortality rate and log of GDP, immunization level, alcohol consumption, rate of aging population (over 65), urban population ratio, and CO_2 emission. On the other hand, there is positive relationship between log of under-5 mortality rate and log of tobacco usage, unemployment rate.

Table 10: Under-5 mortality rate regression results

Regressors	Fixed effect model	Random effect model	Pooled OLS model
lnpheaexp	-0.364050 (0.028585) (-12.73)	-0.361903 (0.027771) (-13.03)	-0.178000 (0.041904) (-4.24)
lngdp	-0.153252 (0.026604) (-5.76)	-0.159177 (0.026435) (-6.02)	-0.469851 (0.043886) (-10.70)
immun	-0.001098 (0.000654) (-1.67)	-0.001078 (0.000649) (-1.66)	-0.000734 (0.001147) (-0.63)
alcohol	-0.016311 (0.005521) (-2.95)	-0.016489 (0.005316) (-3.10)	-0.007898 (0.003824) (-2.06)
lntobacco	0.118770 (0.027339) (4.34)	0.110445 (0.026911) (4.10)	-0.105586 (0.032501) (-3.24)
over65	-0.004435 (0.003657) (-1.21)	-0.005463 (0.003570) (-1.53)	-0.024208 (0.004126) (-5.86)
unemp	-0.018666 (0.001987) (-9.39)	-0.018515 (0.001963) (-9.43)	-0.019319 (0.003132) (-6.16)
urban	-0.006329 (0.002711) (-2.33)	-0.006269 (0.002518) (-2.48)	-0.015046 (0.001340) (-11.23)
co2	-0.002715 (0.005075) (-0.53)	-0.001457 (0.004869) (-0.29)	0.015790 (0.002744) (5.75)
R-squared	0.97	0.92	0.87

Source: Own computing using Eviews6 (coefficients, standard errors -in parentheses under coefficients- and t-statistics –in parentheses under standard errors-)

Table 10 shows the regression results for FEM, REM and pooled regression model. Hausman test is applied to decide which model (FEM or REM) is suitable as mentioned before based on literature review. According to Hausman test, REM is

more appropriate than FEM with 0.42 probability level. Presenting relationship between public health expenditure per capita and health outputs is the aim of this study as mentioned. Therefore, for testing endoneity problem of public health expenditure per capita, Hausman specification test is applied and the result shows that public health expenditure per capita is exogenous with 0.75 probability level. Because of there is no endoneity problem, there is no need to add instrumental variable regressions to the model.

At Table 10, R-squared values of FEM, REM and pooled OLS model is also presented. According to table, R-squared of FEM is 0.97, R-squared of REM is 0.92 and R-squared of pooled OLS model is 0.87. This means that 92 percent of variation in under-5 mortality rate is explained in REM which is chosen in this thesis.

As seen from the Table 10, explanatory variable which is public health expenditure has expected sign for pooled regression model, FEM and REM. Elasticity level of public health expenditure per capita is -0.36 for REM which is chosen model for this study. This means that, holding other variables constant a 1 percent increase in public health expenditure per capita results approximately 0.3 declines in under-5 mortality rate in OECD countries.

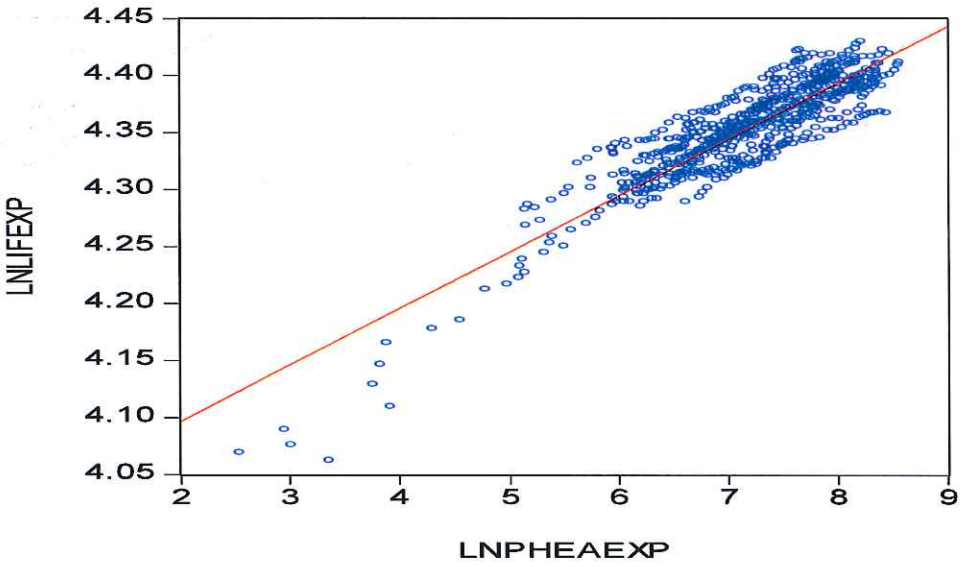
Moreover, among the control variables, GDP per capita, alcohol usage, tobacco usage, unemployment rate and urbanization are statistically significant. GDP per capita, alcohol usage, tobacco usage, unemployment rate and urbanization have elasticity level -0.36, -0.15, -0.01, 0.11, -0.01, -0.006, respectively. This means that, holding other variables constant, when GDP per capita increases 1 percent, under-5 mortality rate decreases approximately 0.15 percent; when alcohol usage increases 1 percent, under-5 mortality rate decreases approximately 0.01 percent; when tobacco usage increases 1 percent, under-5 mortality rate increases approximately 0.11 percent; when unemployment rate increases 1 percent, under-5 mortality rate decreases approximately 0.01 percent; urbanization increases 1 percent, under-5 mortality rate decreases approximately 0.006 percent in OECD members.

Although alcohol usage and unemployment rate are statistically significant, their sign are opposite direction from expected sign. According to Berger and Messer (2002) there is positive relationship between alcohol consumption and mortality rate.

4.4. Life Expectancy at Birth Findings

According to Figure 16 which is scatter plots and shows the correlation between health outcome (life expectancy at birth) and regressors, there is positive relationship between log of public health expenditure per capita and log of life expectancy at birth. At Appendix 1, relationship between life expectancy at birth and other control variables are presented.

Figure 16: Log (life expectancy at birth) and Log (public health expenditure per capita)



Source: Own computing using Eviews6

Scatter plot analysis show that, there is positive relationship between log of life expectancy at birth and log of GDP, immunization level, alcohol consumption, rate of aging population (over 65), urban population ratio, and CO_2 emission. On the other hand, there is negative relationship between log of life expectancy at birth and log of tobacco usage, unemployment rate.

Table 11: Life expectancy at birth regression results

Regressors	Fixed effect model	Random effect model	Pooled OLS model
lnpheaexp	0.048269 (0.002609) (18.50)	0.047288 (0.002480) (19.07)	0.033768 (0.003099) (10.89)
lngdp	0.001876 (0.002428) (0.77)	0.002604 (0.002399) (1.08)	0.019786 (0.003246) (6.09)
immun	0.000309 (5.97E-05) (5.18)	0.000315 (5.89E-05) (5.34)	3.54E-05 (8.48E-05) (0.41)
alcohol	-0.000685 (0.000504) (-1.35)	-0.000694 (0.000470) (-1.47)	-0.000522 (0.000283) (-1.84)
lntobacco	0.008800 (0.002495) (3.52)	0.009211 (0.002424) (3.79)	0.019366 (0.002404) (8.05)
over65	0.000166 (0.000334) (0.49)	0.000182 (0.000320) (0.56)	0.000275 (0.000305) (0.90)
unemp	0.000991 (0.000181) (5.46)	0.000979 (0.000177) (5.52)	0.001040 (0.000232) (4.49)
urban	-4.37E-05 (0.000247) (-0.17)	6.34E-05 (0.000216) (0.29)	0.000946 (9.91E-05) (9.54)
co2	0.000828 (0.000463) (1.78)	0.000479 (0.000428) (1.16)	-0.001542 (0.000203) (-7.59)
R-squared	0.96	0.91	0.86

Source: Own computing using Eviews6 (coefficients, standard errors -in parentheses under coefficients- and t-statistics –in parentheses under standard errors-)

Table 11 shows the regression results for FEM, REM and pooled regression model. According to literature review to decide which model (FEM or REM) is suitable, Hausman test is applied as mentioned before. When Hausman test is applied to the model, it is seen that REM is appropriate than FEM because of null hypothesis is not rejected with 0.46 probability level. On the other hand, the aims of this study showing the relationship between public health expenditure per capita and health output. To control endogeniety problem of public health expenditure per capita, Hausman specification test is applied. According to this test, public health expenditure per capita is exogenous with 0.22 probability level and instrumental variable regressions are not added to the model.

At Table 11, R-squared values of FEM, REM and pooled OLS model is presented. According to table, R-squared of FEM is 0.96, R-squared of REM is 0.91 and R-squared of pooled OLS model is 0.86. This means that 96 percent of variation in infant mortality rate is explained in REM which is chosen in this thesis according to Hausman test.

As seen from the Table 11, explanatory variable which is public health expenditure has expected sign for pooled regression model, FEM and REM Elasticity level of public health expenditure per capita is 0.04 for REM which is chosen model for this study. This means that, holding other variables constant a 1 percent increase in public health expenditure per capita results approximately 0.04 rise in life expectancy at birth in OECD countries.

In this study, the elasticity level on public health expenditure per capita is higher than some studies in literature. For example, according to Kim and Lane (2013), elasticity on public health expenditure per capita is 0.026 for life expectancy at birth in selected OECD countries. On the other hand, in some studies elasticity is higher than 0.04. According to Bein, Unlucan, Olowu and Kalifa (2017)'s study the elasticity of public health expenditure per capita elasticity is 1.17 for life expectancy at birth.

Moreover, among the control variables, immunization, tobacco usage and unemployment rate are statistically significant. Immunization, tobacco usage and unemployment rate have elasticity level 0.0003, 0.009 and 0.0009, respectively. This means that, holding other variables constant, when immunization ratio increases 1 percent, life expectancy at birth increases approximately 0.0003 percent; when tobacco usage increases 1 percent, life expectancy at birth increases approximately 0.009 percent; when unemployment rate increases 1 percent, life expectancy at birth increases approximately 0.0009 percent in OECD members.

As seen from the results, life expectancy at birth is affected by public health expenditure per capita, immunization, tobacco consumption and unemployment rate. Unlike other studies public health expenditure per capita is not influenced by GDP per capita. Although tobacco usage and unemployment rate are statistically significant, their sign are opposite direction from expected sign based on literature review. For example, according to Cremieux, Ouellette and Pilon (1999) there is

negative relationship between unemployment rate and life expectancy at birth and also there is negative relationship between tobacco usage and life expectancy at birth.

CONCLUSION

The main purpose of this thesis is measuring the effectiveness of public health expenditure on health outcomes (infant mortality rate, under-5 mortality rate and life expectancy at birth) by estimating health production function with panel data estimation techniques for selected 20 OECD countries between 1980 and 2015. According to findings, increase in public health expenditure has an improvement on infant mortality rate, under-5 mortality rate and life expectancy at birth.

The elasticity rate of public health expenditure with regards to infant mortality rate, under-5 mortality rate and life expectancy at birth are -0.32, -0.36 and 0.04, respectively. When holding other variables constant a 1 percent increase in public health expenditure per capita results approximately 0.32 declines in infant mortality rate. In the same manner, when holding other variables constant a 1 percent increase in public health expenditure per capita results approximately 0.36 declines in under-5 mortality rate. On the other hand, when holding other variables constant a 1 percent increase in public health expenditure on public health expenditure per capita results approximately 0.04 rises in life expectancy at birth. Based on these results, the most sensitive health outcome is under-5 mortality rate while life expectancy at birth is the least sensitive for changing public health expenditure in selected OECD countries.

According to literature review (Byro and Musonda, 2016; Or, 2000; Çalışkan, 2009) GDP is one of the most important control variable. Based on findings of this thesis, like literature review, GDP is statistically significant determinant for infant mortality rate model and under-5 mortality rate model. On the other hand, according to life expectancy at birth model findings, GDP is statistically insignificant while immunization ratio, tobacco usage and unemployment rate is statistically significant. This means that, improvement in immunization ratio, tobacco usage and unemployment rate have more effect than GDP on public health expenditure. Therefore, the government should make public health expenditure more effective by interfering with tobacco usage rate, immunization ratio and unemployment rate. Some government regulations to prevent tobacco usage include: smoke-free airspace, increased tobacco taxes, warning pictures on cigarette packets, and the prohibition of

tobacco advertisements. The most important anti-smoking method is increasing taxes. Thus, it is thought that both the state will increase the tax income and if the individual exceeds the purchasing power, the smoking will be abolished. In addition, the government can prevent cigarette use with widespread and effective anti-smoking campaigns and by supporting those who can not quit smoking. In addition, the increase in the rate of vaccination improves the life expectancy. It should be the responsibility of the government to ensure that all infants are vaccinated and widespread, and sanctions should be imposed on those who are not vaccinated to create a healthier generation. Lastly, unemployment rate is significant for effective public health expenditure. To decrease unemployment rate, the government should increase investment and therefore increase growth and employment or the government should encourage individuals by providing jobs for those who want to be employers.

Moreover, GDP per capita, alcohol usage, tobacco usage and unemployment rate are statistically significant for infant mortality rate and under-5 mortality rate. Therefore, the government should intervene GDP per capita, alcohol and tobacco usage and unemployment rate for effective public health expenditure. To increase GDP per capita, the government should increase the quality of education because highly educated population contributes to the national economy. Secondly, exports should be increased because the increase in exports contributes to GDP and also GDP per capita. Then, consumer spending should be encouraged to increase GDP per capita. Lastly, rising in government spending (subsidies, infrastructure etc.) increases GDP per capita due to GDP.

For improvement in health outcomes in OECD, the government of all OECD members should increase the share of public health expenditure. Based on findings, in addition to medical factors, non-medical factors (physical environment, life-style, socio economic factors) also have an importance to improve health outcomes and government should make necessary intervention.

Some limitations need to be taken into consideration when commenting on the results. First of all, the model includes medical and non-medical determinants. According to Or (2000), these determinants are limited. To overcome this problem women and men separation may be interesting in health-care consumption and life

style, etc. The second limitation is the estimated equations are not interested in dynamic effects. The third one is more detailed health indicators should be preferred. It is more beneficial in order to examine every country's health problems and needs. And lastly, reliability of findings is depending on some measurement problem that arises when using total national data. Despite the tremendous efforts of the OECD to standardize the definitions, the series are not always consistent between countries or over time.

According to Nixon and Ulmann (2006: 9) for most industrialized countries health expenditure and health outcome relations are the most important concern for policy makers. On the other hand, finding a casual relationship is not easy because health status measurements are difficult. Moreover, there are lots of quantitative and qualitative determinants that affect health outcomes and health expenditure is only one of them.

Although these limitations exist, this study has an importance because it shows the relationship between public health expenditure and health outcomes and also health outcome determinants in OECD countries. Therefore, the effectiveness of public health expenditure on health outcomes can be measured to govern health investment. Moreover, interpretation of health expenditure effectiveness is significant for deciding which programme should be used.

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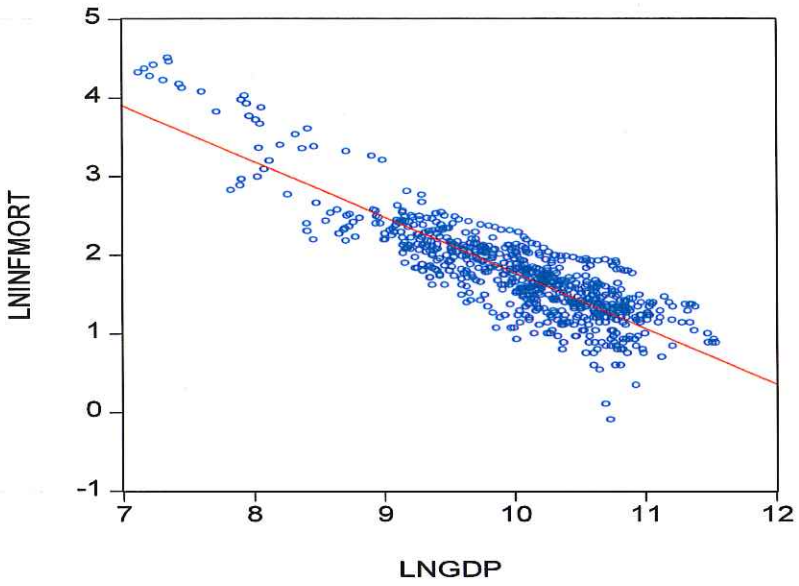
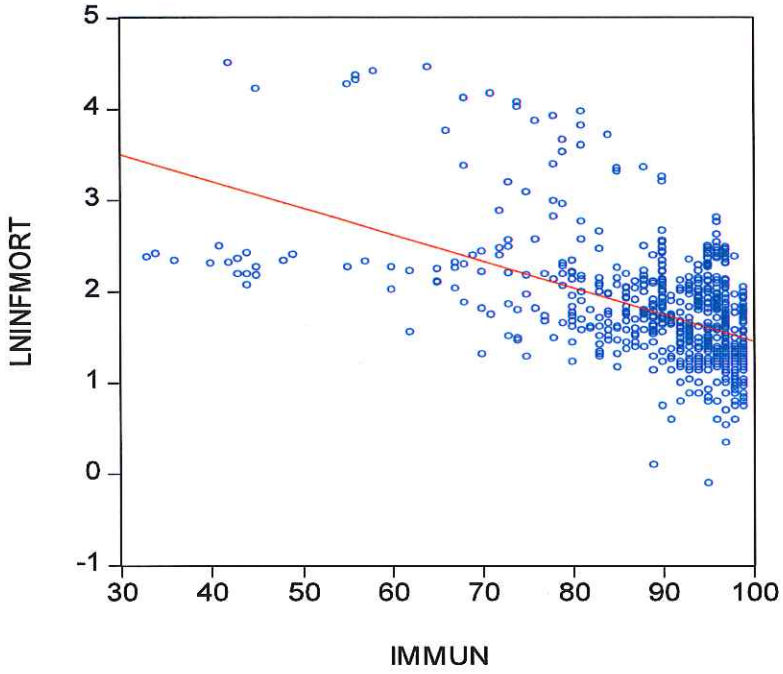
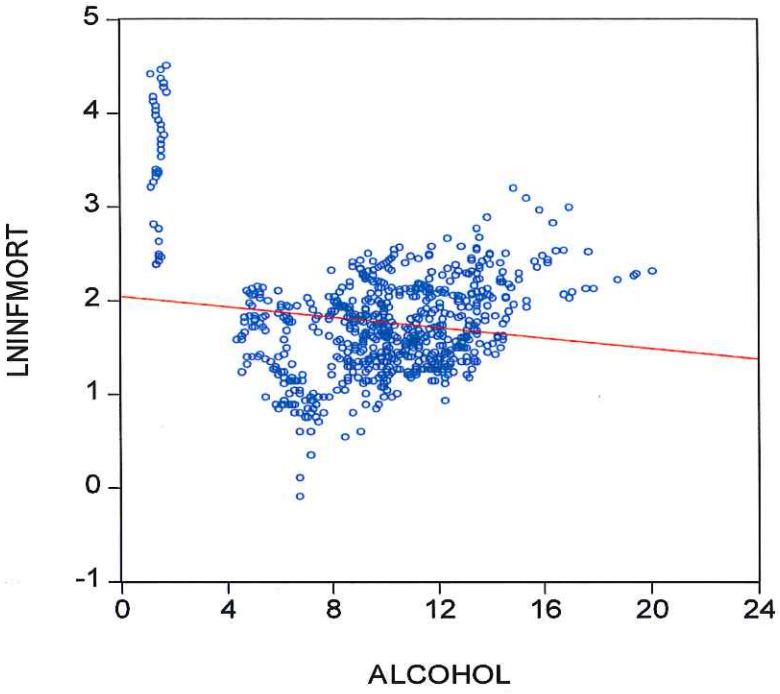
APPENDICES

APPENDIX 1: SCATTER PLOTS

A1. Scatter Plots for Infant Mortality Rate



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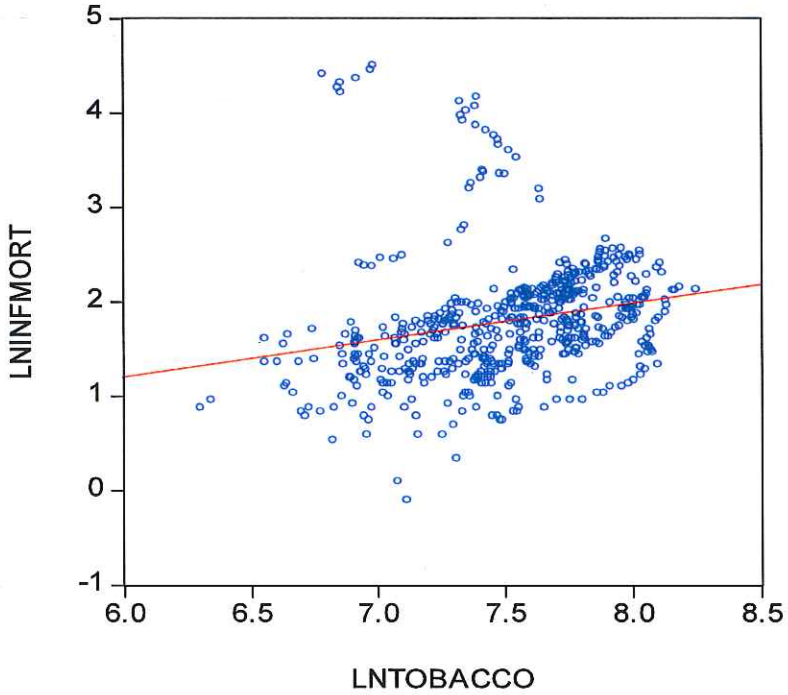
ALCOHOL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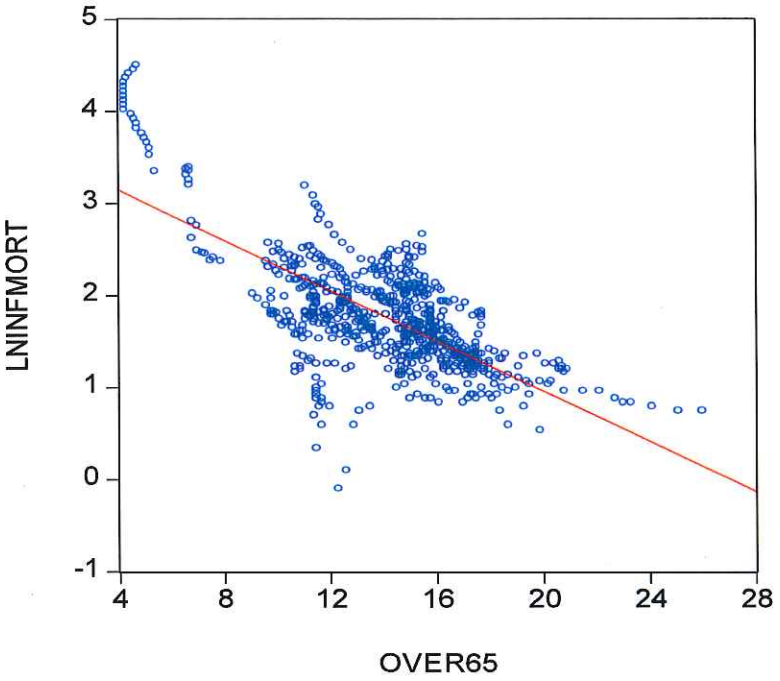
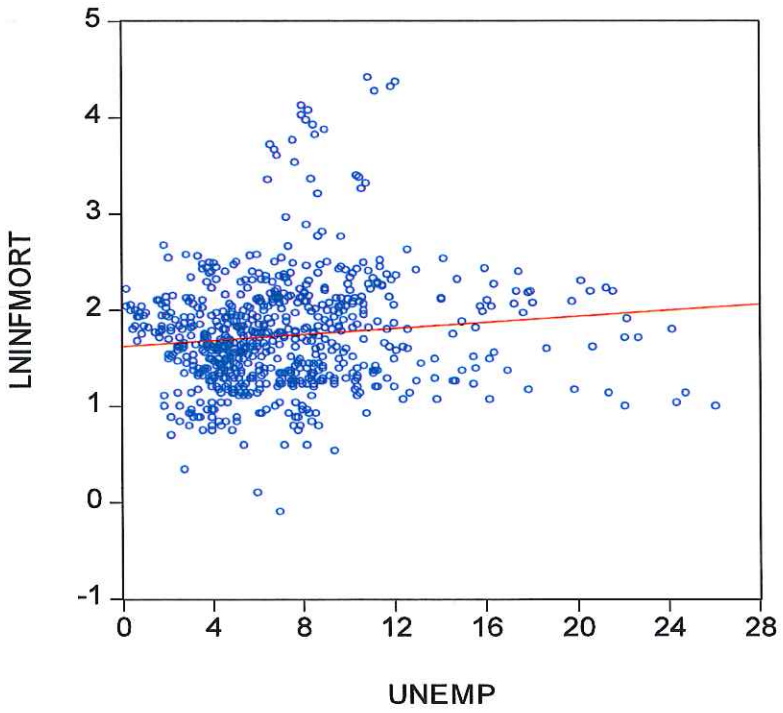
6.5
7.0
7.5
8.0
8.5
LNTOBACCO


LNINFMORT
5
4
3
2
1
0
-1
4
8
12
16
20
24
28
OVER65


LNINFMORT
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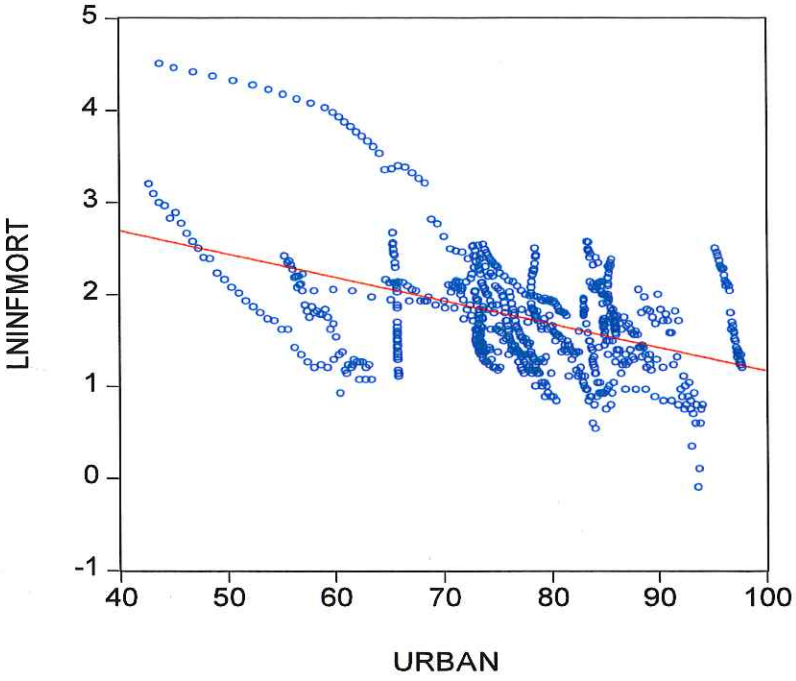
3
2
1
0
-1
0
4
8
12
16
20
24
28
UNEMP


LNINFMORT
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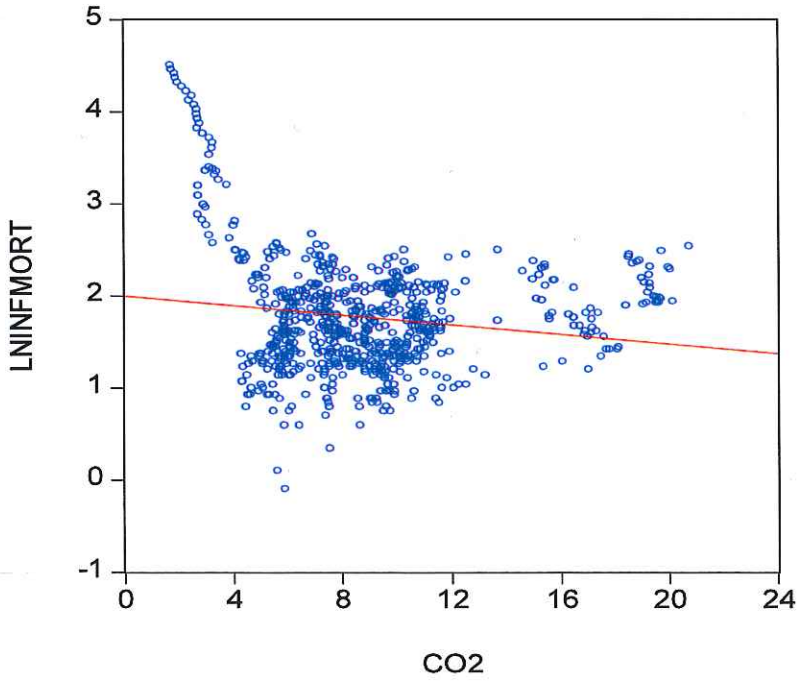
-1
40
50
60
70
80
90
100
URBAN


LNINFMORT
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3
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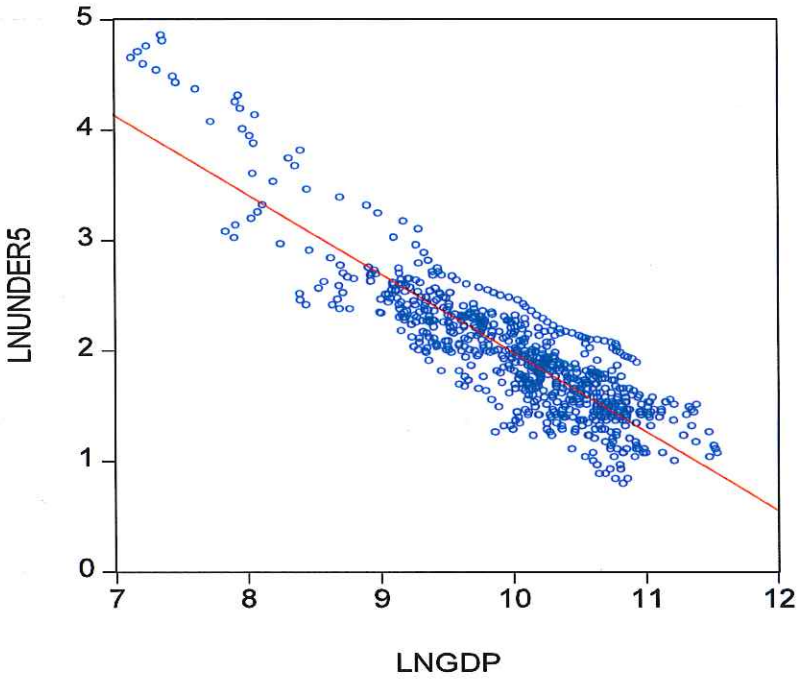
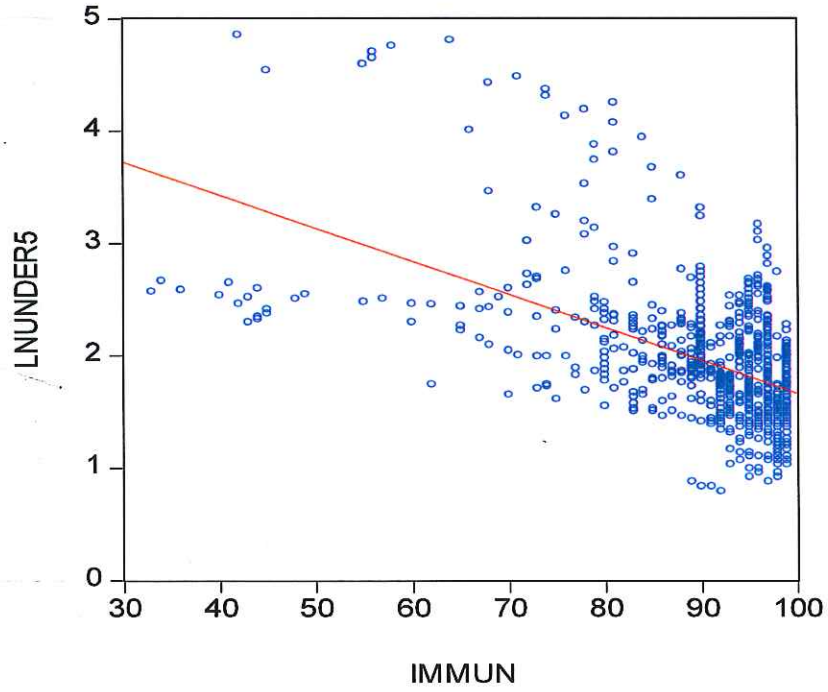
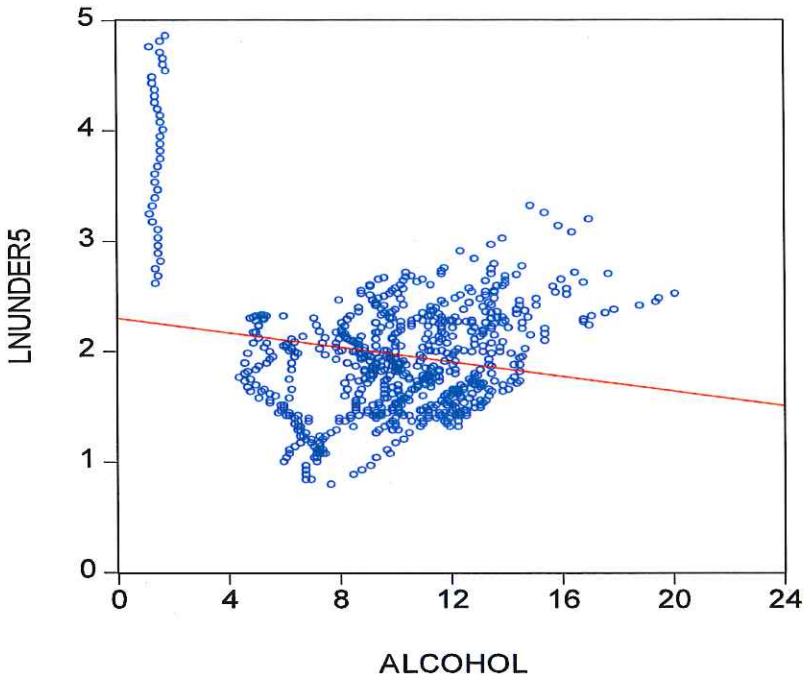
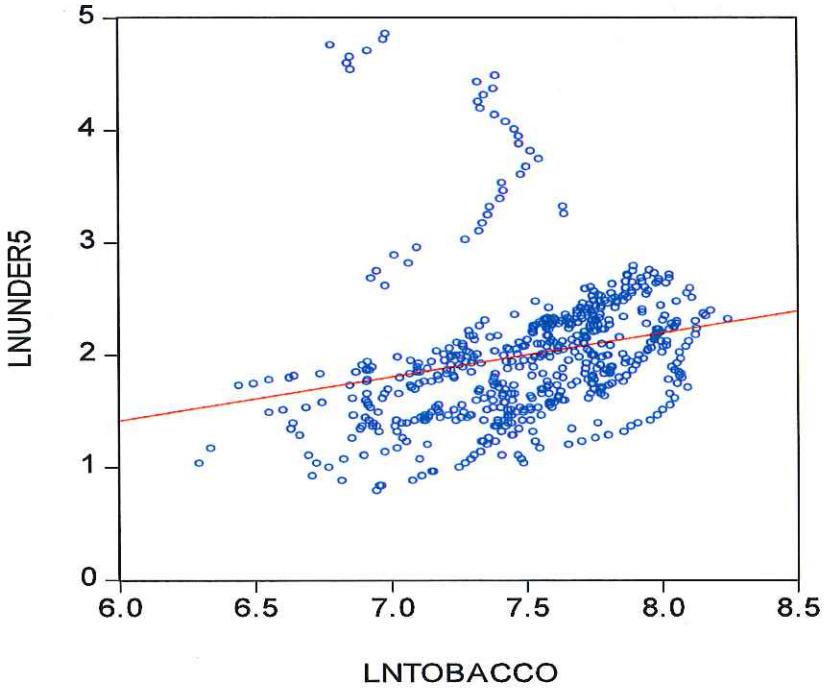
1
0
-1
0
4
8
12
16
20
24
CO2

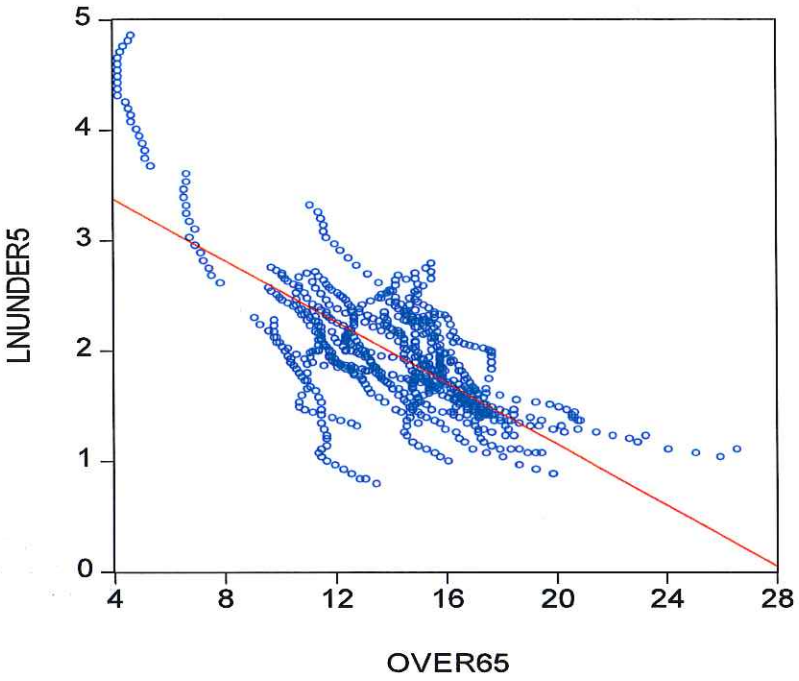
A2. Scatter Plots for Under-5 Mortality Rate

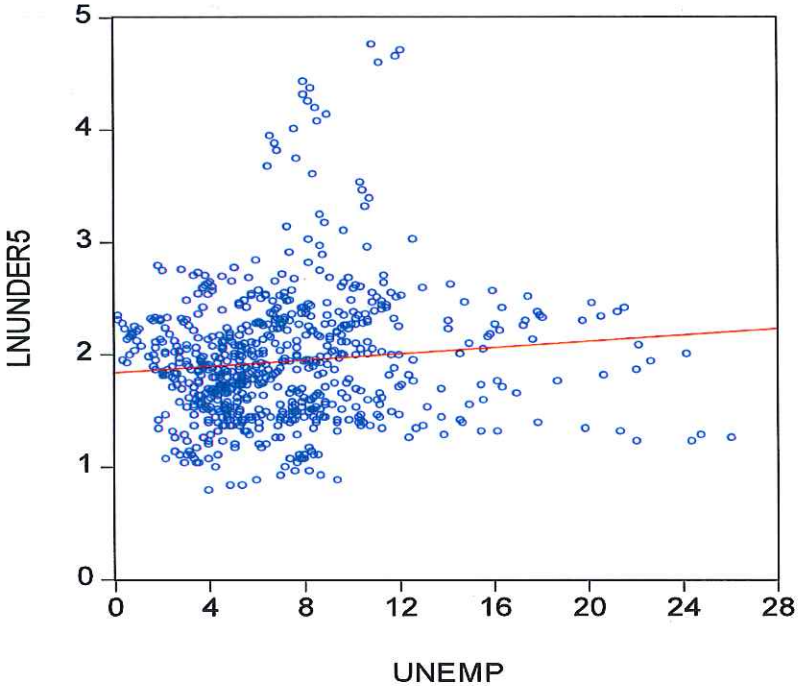


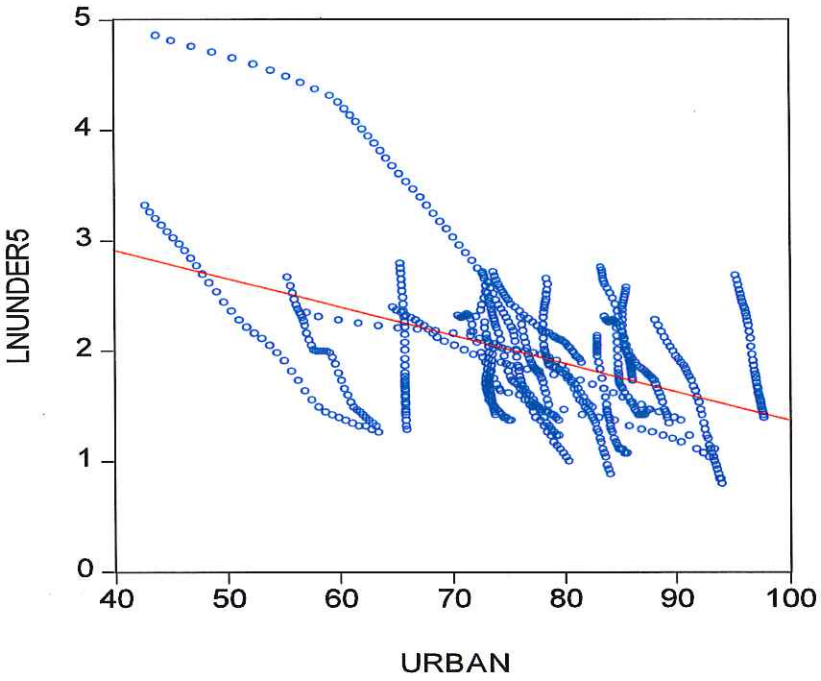


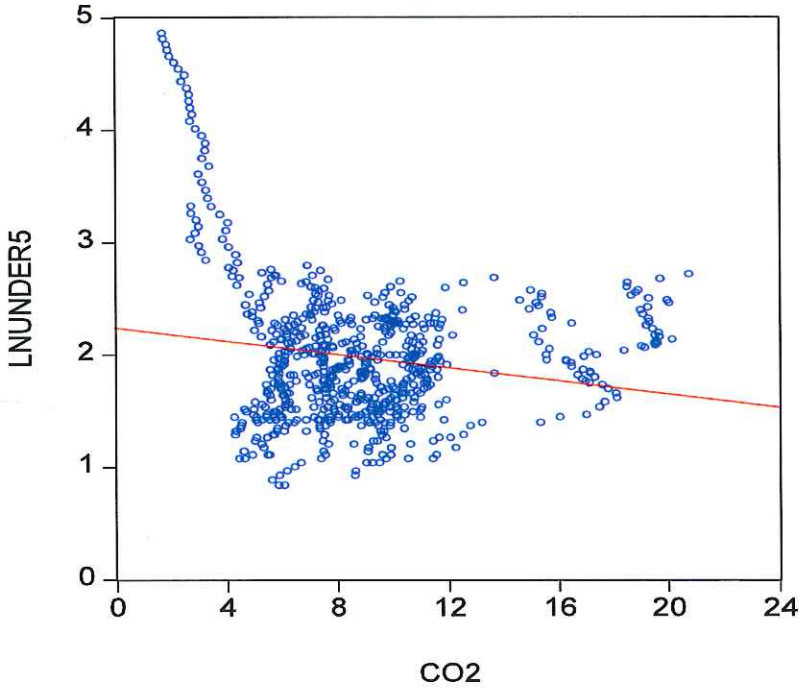

LNUNDER5
5
4
3
2
1
0
0
4
8
12
16
20
24
ALCOHOL


LNUNDER5
5
4
3
2
1
0
6.0
6.5
7.0
7.5
8.0
8.5
LNTOBACCO

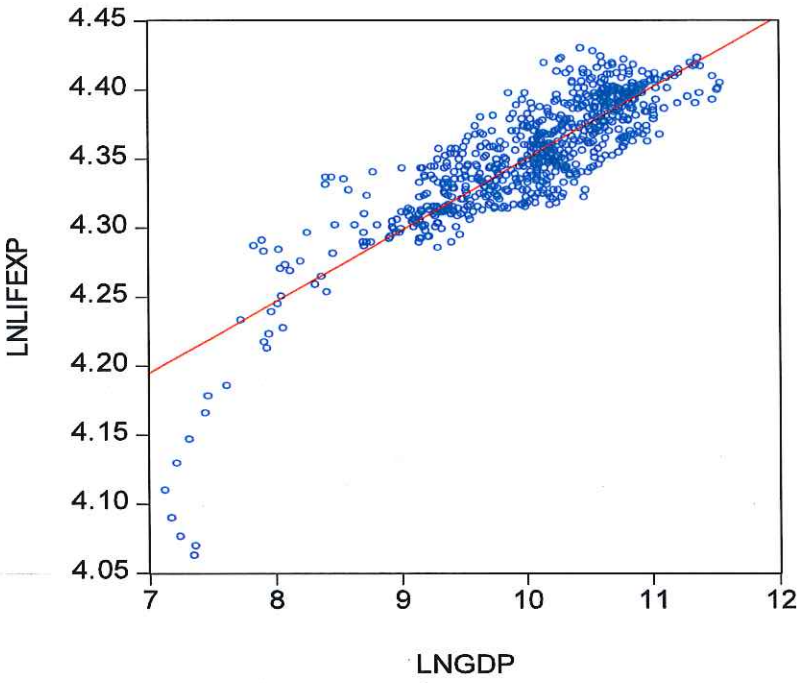

LNUNDER5
5
4
3
2
1
0
4
8
12
16
20
24
28
OVER65

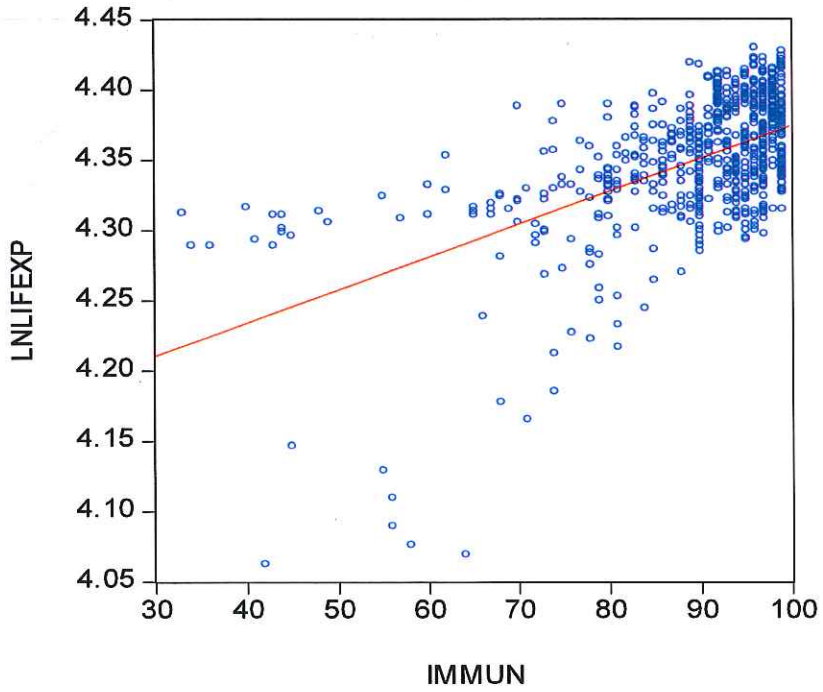

LNUNDER5
5
4
3
2
1
0
0
4
8
12
16
20
24
28
UNEMP

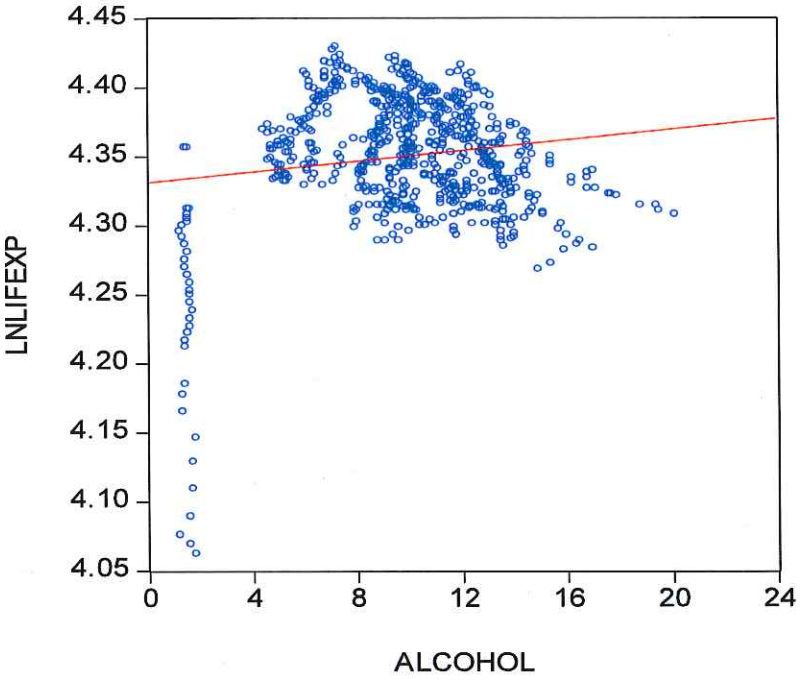

LNUNDER5
URBAN
0
1
2
3
4
5
40
50
60
70
80
90
100

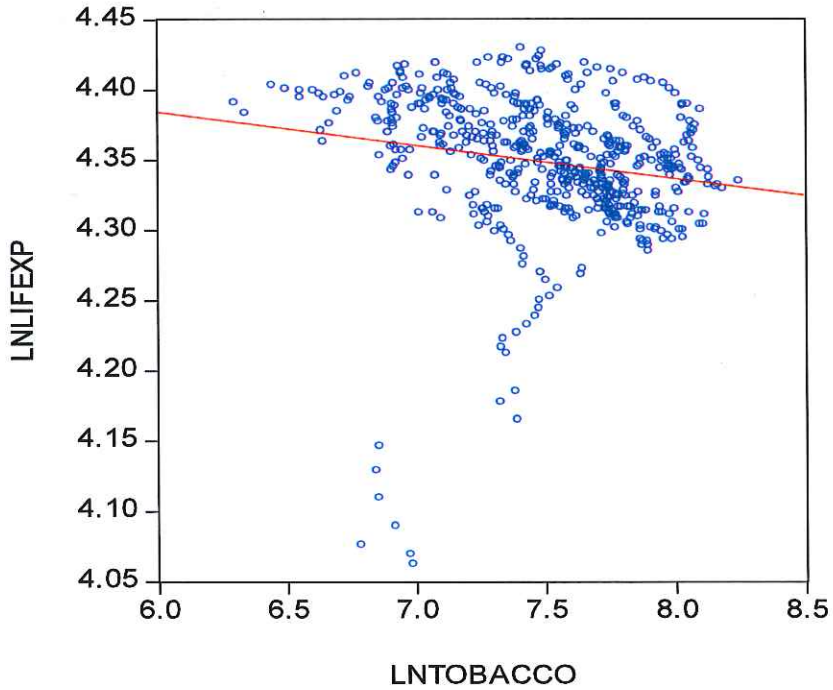

LNUNDER5
CO2
0
1
2
3
4
5
0
4
8
12
16
20
24

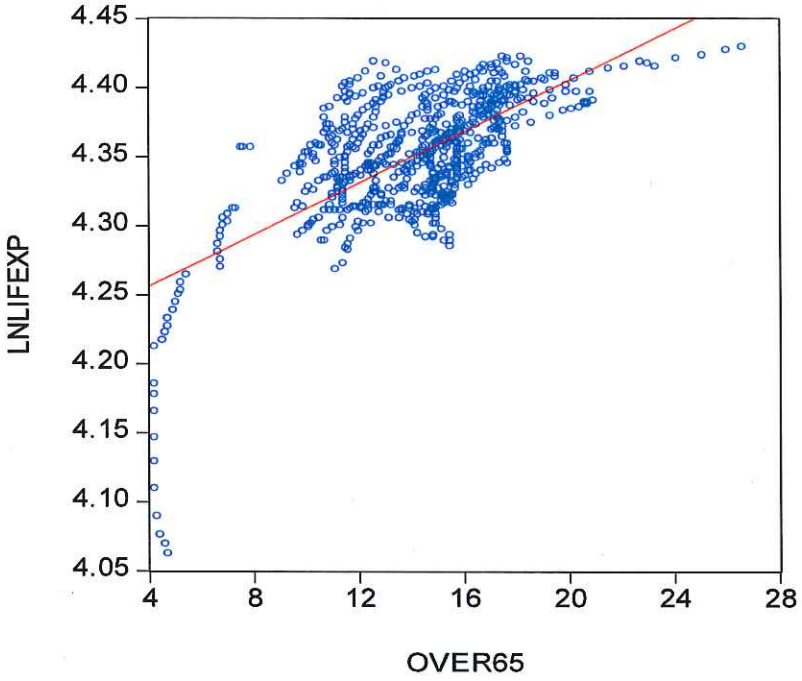
A3. Scatter Plots for Life Expectancy at Birth

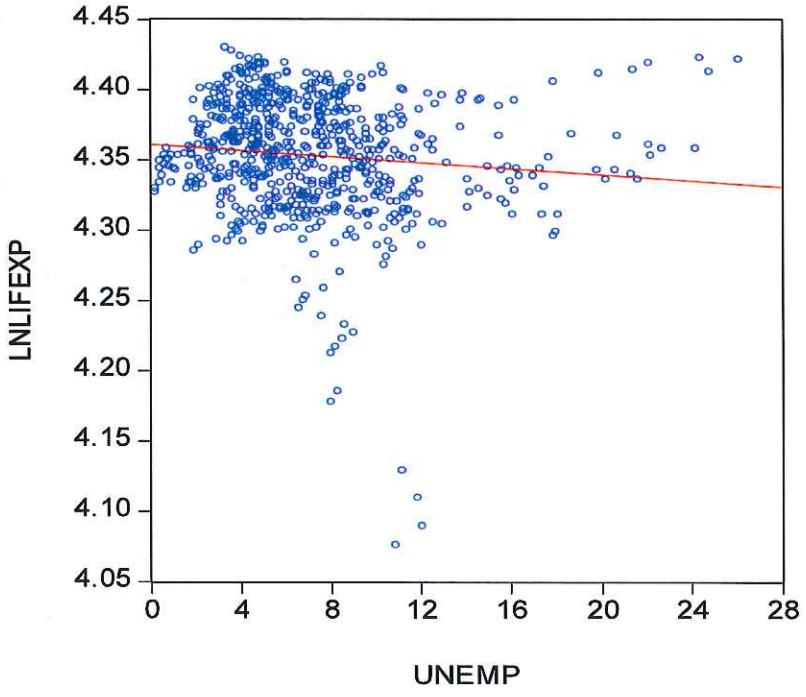


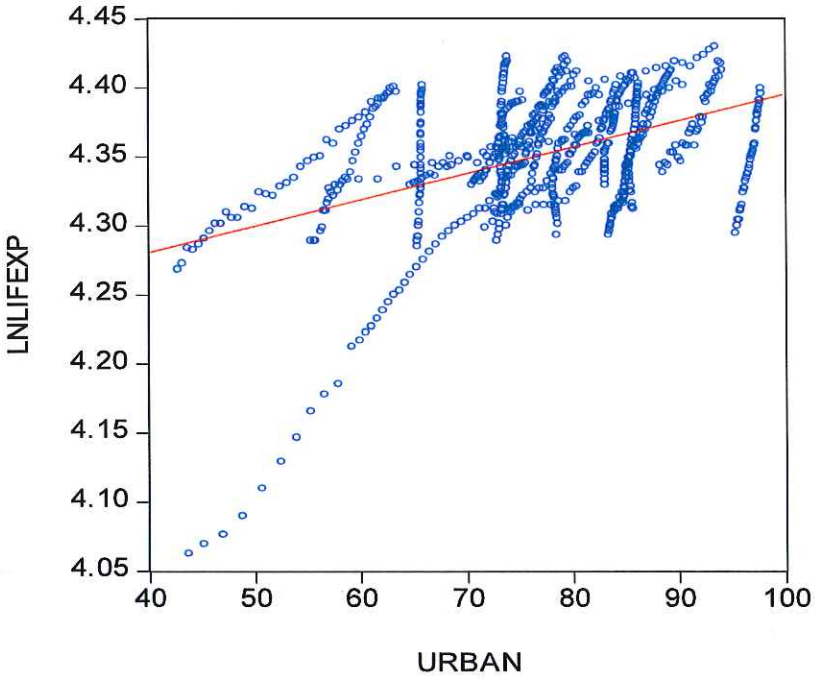


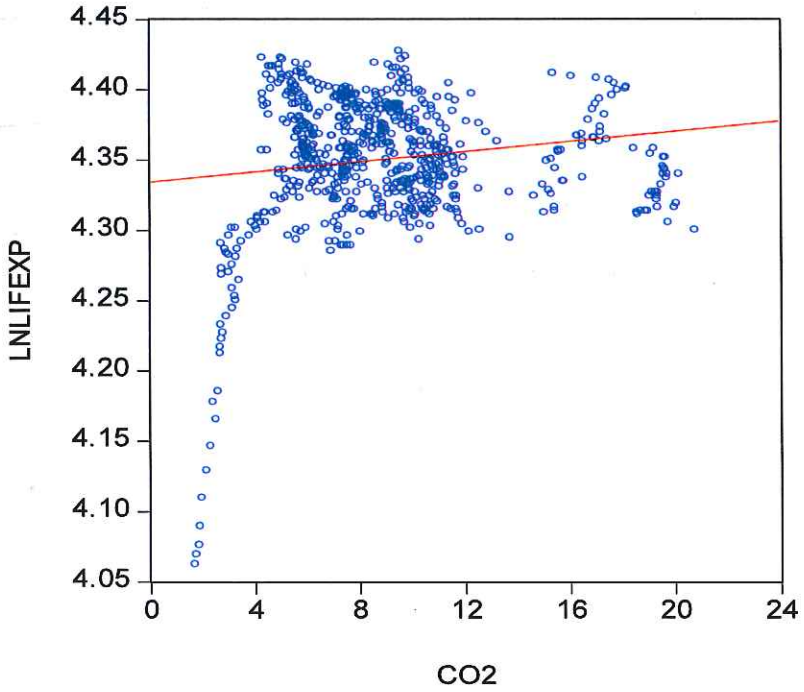

LNLIFEXP
4.45
4.40
4.35
4.30
4.25
4.20
4.15
4.10
4.05
0
4
8
12
16
20
24
ALCOHOL


LNLIFEXP
4.45
4.40
4.35
4.30
4.25
4.20
4.15
4.10
4.05
6.0
6.5
7.0
7.5
8.0
8.5
LNTOBACCO


LNLIFEXP
4.45
4.40
4.35
4.30
4.25
4.20
4.15
4.10
4.05
4
8
12
16
20
24
28
OVER65


LNLIFEXP
4.45
4.40
4.35
4.30
4.25
4.20
4.15
4.10
4.05
0
4
8
12
16
20
24
28
UNEMP


LNLIFEXP
4.45
4.40
4.35
4.30
4.25
4.20
4.15
4.10
4.05
40
50
60
70
80
90
100
URBAN


LNLIFEXP
4.45
4.40
4.35
4.30
4.25
4.20
4.15
4.10
4.05
0
4
8
12
16
20
24
CO2