

# CURRENT ECONOMIC PROBLEMS IN THE GLOBAL CRISIS PROCESS: EMPIRICAL AND THEORETICAL APPROACH

## EDITORS

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## **PREFACE**

The world economy has focused on some important problems in recent years. Before the effects of the 2008 global economic crisis were completely over the Covid-19 pandemic has taken the whole world under its influence. Some policies implemented to solve the pandemic problem on a global scale have led to the emergence of new problems. In this context, developed and developing countries in the global economy are struggling with many problems, especially unemployment, inflation, environmental pollution, foreign dependency in energy, destruction of natural resources, and reserve management in the financial system.

The Turkish economy, which has intense integration relations with the world economy in recent years, is also seeking solutions to similar problems. In general, these problems became more prominent in the Turkish economy with the Covid-19 pandemic. The book, which was prepared to examine the current economic problems that emerged during the global crisis, includes theoretical and empirical evaluations of a number of problems selected from different aspects. In this context, the book includes studies on the economic and social effects of the pandemic in terms of global public health, the role of taxation in ensuring sustainable environmental conditions, and the problem of unemployment, which is an important output of the crisis processes, and the determination of its causes. The book also includes studies on the increase in dollarization in the financial system as a side effect of inflation, the necessity of developing the defense industry in terms of international relations, and the energy problems of increasing importance in terms of foreign trade relations.

The book named "*Current Economic Problems in the Global Crisis Process: Empirical and Theoretical Approach*" consists of six chapters. We hope that the book will contribute to the world of science and be a source for future studies. We would like to thank all the academicians who contributed to this book, and the staff of IKSAD

Publishing House and ISPEC Agency, who worked hard to publish the book.

Aralık, 2022

Assoc. Prof. Dr. Aliye AKIN

Assoc. Prof. Dr. Barış AYTEKİN

## **CHAPTER 1**

### **HEALTH AS A GLOBAL PUBLIC GOOD: AN ASSESSMENT OF THE ECONOMIC AND SOCIAL IMPACTS OF THE PANDEMIC (COVID-19)**

Lecturer Dr. Nuh Ekrem YILDIRIM <sup>1</sup>

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## INTRODUCTION

The concept of health, by its nature, can affect some regions of countries, as well as all countries or the whole world. In this context, health is accepted as a global public good. Infectious diseases have been seen in every period in the historical process as a part of health goods and have led to the death of millions of people. Infectious diseases that threaten humanity today seem to remain on the agenda in the coming years.

With the increase in globalization in the world, there has been an increase in the circulation of production factors such as labor and capital. Many sectors, especially such as transportation and tourism, have been the scene of international circulation. In this context, infectious diseases spread rapidly to cover all countries of the world. In other words, they show a pandemic feature. An infectious disease, which takes on the characteristics of a pandemic, reveals the need for global cooperation. The World Health Organization (WHO) stands out as the one that will coordinate cooperation with all countries in the prevention/reduction of infectious diseases. WHO continues to work in cooperation with national/international organizations in relation to this task.

The Covid-19 pandemic, which emerged in China in December 2019 and had its first case in Türkiye in March 2020, has taken the whole world under its influence, and over time, its effect has become more severe, bringing life to the point of stopping. In this direction, relations between countries (trade, transportation, etc.) stopped, and a very bad picture was encountered. As in the world, the supply chain in Türkiye has been adversely affected, especially due to transportation and manufacturing. Workplaces and educational institutions were closed in this process, and many macroeconomic variables, such as unemployment and inflation, were adversely affected.

The aim of this study is to examine the impact of the pandemic (Covid-19) on the USA, European Union, China, India, England, Japan, Russia, Türkiye and the world economy. In this context, the concept of global public goods was explained. Important infectious diseases seen in the historical process were included, and the relationship of health as a global public good with globalization was mentioned. In the study, which includes the measures to be taken in the prevention of communicable diseases, the reflection of the economic and social effects of the pandemic (COVID-19) process on the USA, European Union, China, India, England, Japan, Russia, Türkiye and the world economy was given in numbers.

## **1. THE CONCEPT OF GLOBAL PUBLIC GOODS AND ITS IMPORTANCE**

According to human welfare, economic inputs can be classified as private and public goods. Private goods are goods such as bread, clothing, and shoes, whose consumption is withheld from the consumption of other people. These goods are private property rights and are believed to be best determined by market supply and demand. On the other hand, everyone has access to public goods that cannot be excluded, and other individuals cannot be prevented from participating. Lighthouses, peace and security, and law are examples of these goods. Considering the increasing cross-border activities, the production of many public goods depends on international cooperation and cannot be achieved through domestic policy alone (Kaul and Faust, 2001: 870). This feature of public goods, which goes beyond domestic politics and requires international cooperation, gives it a global dimension, and these goods are called global public goods.

Global public goods (GPG), one of the types of public goods, are defined as universal goods benefiting all countries, populations, and generations. There are different classifications for GPGs, and one of these classifications is as follows:

- Natural global common areas (such as the ozone layer and climate balance),
- Human-made global commons (scientific and practical knowledge, norms and principles, cultural heritage),
- Global policy outcomes (such as peace, health, and financial stability) (Deneulin, 2007: 22).

There may also be global public damages, such as global public goods (GPGs). Global public damages are non-excludable goods that are undesirable and desire to be prevented. Examples include global atmospheric pollution, cross-border drug trafficking, international warfare, the global spread of infectious diseases, and the emergence of drug-resistant microbial strains. The current approach of most GPGs policies is to wait for global public damage to occur and then respond to emergencies. However, policies are largely produced on a country-by-country basis. As a result, global public goods are offered less, and global public damages more (Kaul and Faust, 2001: 870). Since the resulting public damages are also negative externalities, it is imperative that scientific studies be increased at the national/international

level in order to transform these negative externalities into positive externalities (for example: finding a vaccine or medicine against an epidemic).

Global public goods, which benefit both developed and developing countries, have played an important role in social, economic, and political progress in the last century. There is little information on how much shares countries allocate for global public goods. Even organizations with global missions, such as the United Nations (UN) and the World Health Organization (WHO), do not report on funding for global public goods. Increasing connections through international trade, migration, and travel has increased the number of critical common challenges facing the global community. Negative situations such as global epidemics, security risks, and financial crises threaten living standards everywhere. Although everyone is affected, especially low-income countries are more affected. The provision of global public goods is a prerequisite for developing and underdeveloped countries' sustainable growth and is vital for reducing poverty within and between countries (Birdsall and Diofasi, 2015: 1-2). Countries with different economic and social structures may not be equally willing to offer global public goods. In the fight against communicable diseases, underdeveloped countries have insufficient health infrastructure, and although they are more affected by this process, developed countries may also be reluctant to provide health assistance to underdeveloped countries.

The market failures and collective problems that exist in the provision of public goods at the local and national levels also apply to GPGs. There is no global government to fix global market failures outside national borders. Public goods are classified according to the relationship between individual contributions and all levels of public goods: total, best hit, the weakest link, and weighted aggregate technique: (Sagasti and Bezanson, 2001: 166).

- *In the addition technique*, the total GPG production level is equal to the sum of the countries making the individual contribution. An example of this is the prevention of global warming by reducing countries' carbon emissions. The global carbon level is the sum of all countries' emissions, and a reduction by one country only reduces the global level by that amount. However, if all countries (or many) decide to reduce emissions cooperatively, a meaningful global reduction will occur.

- *In the best hit technique*, the presentation of the global public good is equal to the amount of the country that offers it the most. An example of it is the discovery of an effective vaccine for HIV/AIDS. It is because once the vaccine is discovered, all countries will benefit from it, and there will be no need for another discovery.
- *In the weakest link technology*, the total GPG production level is that of the country making the lowest contribution. An example is the eradication (elimination) of an infectious disease. It is because achieving eradication requires every country to be successful. A country that cannot / does not want to eradicate a disease within its borders jeopardizes all eradication efforts (Michaud, 2010: 7-8).
- *Weighted Addition Technique*, this technique is like the addition technique, except for the weights applied to the individual contributions before the total. It is a more flexible technique that considers factors such as the relative geographical location and size of a country.
- As there are various examples of global public goods, it is remarkable to determine which GPG is suitable for which technique in order to maximize the global benefit to be obtained.
- One of the important issues in the presentation of GPGs is financing these goods. Although there are many projections for financing these goods, there are four main strategies that can be followed (Smith et al., 2004: 275):
- *Voluntary contributions*: These are the simplest option. On the other hand, since each country tends to minimize its contribution, it manifests itself in insufficient contributions to the Global Fund for diseases such as AIDS and Tuberculosis.
- *Coordinated contributions*: Contributions to be made with a formula determined because of negotiations between countries form the basic financing basis of most international organizations. Basing additives on an existing formula can help reduce the "free rider" problem.
- *Global taxes*: The Tobin tax is the most effective tool for financing GPGs compared to the use of national taxes for the provision of national public goods. However, there are criticisms about

financing from this source from the important opposition channels of some developed countries.

- *Market-based systems:* Some market systems can contribute to the financing of GPGs by being largely self-financing.

## **2. GLOBALIZATION AND HEALTH AS A GLOBAL PUBLIC GOOD**

The transition of human relations from the limited framework of the nation-state to a global direction affects not only trade, science, finance, environment, culture, and health. The differences between local and international health problems are getting smaller. Frequent long-distance international contacts are not a new phenomenon. In the past, bacteria have caused pathology and death in humans. Also, human beings living with various wild and domestic animals have shared disease organisms. Through zoonoses (animal-to-human diseases), many new diseases have emerged as pathogenic organisms, changing their ecological niches and infecting humans. Due to international trade, migration, travel, etc., zoonoses have caused morbidity and mortality in animals and humans. In other words, the phenomenon of globalization of infectious diseases has taken place (Barnett and Sorenson, 2011: 166-167). The concept of health is considered a global good in terms of the presence and spread of communicable diseases and the measures to be taken for it, and it will be the main subject of this study.

With new transportation routes and technological advances, while it took one year to travel around the world by ship 150 years ago, today, it takes about one day by plane. With the increasing travel speed, the incubation period of many infectious diseases is longer than the time required for infected individuals to move from one place to another, allowing pathogens to reach uninfected people silently and quickly. Also, urbanization rates have increased significantly due to the concentration of groups of people from poor living conditions. Although the proximity of animals' habitats to humans looks good in many ways, the risk of disease from animals to humans is also increasing (for example, the "mad cow" disease seen in the past). The increase in international animal trade increases the risk of disease spread (Barnett and Sorenson, 2011: 168-169). The requirement to prevent and control communicable diseases against this spread risk has led to its characterization as a global public good. Measures taken to prevent communicable diseases are also regarded as market failures. Thus, the measures to be taken by the

countries in this context are significant in ensuring rational resource allocation.

In the historical process, people have died from infectious diseases rather than wars. In Romania under Justinian, about a third of the people probably died of the plague, and in the 14th century, almost a third of Europe died of the Black Death (Black Plague). In the 16th and 17th centuries, millions of people from the indigenous population of the Americas died from the seven cholera pandemics that spread from South Asia, and during this time, great losses were experienced from yellow fever disease. Between 1918 and 1919, the Spanish Flu killed about 22 million people, and Europe was hit hardest by these deaths. Until the end of the 19th century, soldiers died from disease rather than war (Zacher, 1999: 266).

Some epidemics continued over the years and swept countries, and many countries witnessed significant epidemics in the 1990s. Cholera emerged in Peru in 1991, Rift Valley Fever in Egypt in 1994, Plague in India in 1994, and Chile in 1995. Ebola was seen in Zaire and Gabon in 1996, Hantavirus in Chile in 1997, Rift Valley Fever in Kenya in 1998, Avian Flu in 1998 in Hong Kong and China. Lyme and Legionnaires disease, E. coli, and water-food-borne epidemics have emerged in the USA (Zacher, 1999: 273). New diseases such as SARS have been added to these diseases, and most of the victims have been healthcare workers. The SARS epidemic lasted for five months and infected 8098 people, 774 of which were fatal. The impact of SARS was not only limited to the loss of life but also spread economically, psychologically, and politically on a global basis. After East Asia's experience with SARS, many actors outside the medical world have also increased their tendency to secure infectious diseases. The World Health Organization (WHO) warned about the outbreak of the next global epidemic after an infectious disease. Moreover, according to WHO, unprecedented diseases occur in our globe from year to year (Caballero-Anthony, 2006: 108). The health problems and the conjuncture that arise due to the depletion of the ozone layer, the pollution of water resources, the increase in carbon dioxide gas emission, etc., clearly show that serious health problems await the world.

National health services are inadequate against infectious diseases that threaten the health of every human being and the well-being of every nation. The closure of airports and borders and the stockpiling of medicines cannot prevent the spread of these diseases. The actions of other countries are important to any nation that wants to preserve its population. Surveillance of the disease will improve as more countries join efforts to combat

communicable diseases. Most outbreaks occur in countries suffering from policy failure. For example, emphasis was placed on the lack of resources and capacity to manage the spread of avian influenza and SARS diseases. The benefits of reducing the probability of a pandemic occurring and the rate of its spread are great. An old adage says: An ounce of prevention is worth a pound of cure. Fighting infectious diseases is a global public benefit and one of the most serious development challenges. Most developing countries continue to experience devastating costs of infectious diseases on human and social life. It is evident in measuring the horrific death figures in diseases such as malaria and AIDS (Report of the International Task Force on Global Public Goods, 2006: 33-34). However, the negative conjuncture created by infectious diseases was not limited to developing countries. The best example of this has been seen in the COVID-19 pandemic, which has put the world under great threat globally. As seen in the coronavirus epidemic, all countries with different welfare levels are affected by negative externalities created by infectious diseases, and several million people worldwide have died from COVID-19. At the same time, inflation and unemployment rates have increased in countries and have been adversely affected in many ways, such as economic, social, etc.

Many different GPGs can play a role in promoting global health. However, some GPGs have been produced at the national level (Table 1). For example, The US Food and Drug Administration (FDA) or the European Medicines Agency (EMA) approves a new drug, giving an important worldwide signal about the safety and efficacy of the drug. Increased transparency regarding the making of these decisions can make health-oriented GPGs more valuable (Moon et al., 2017: 198-199).

**Table 1:** Examples of Global Public Goods to Strengthen Global Health

<b>Group</b>	<b>Example</b>
Research / Evaluation	Health Technology R&D
	Market Approval (For example, FDA, EMA organizations)
	Health Technology Assessment (Ex: NICE organization)
	Product Quality Assessment (For example: WHO preliminary assessment, GMP certification)
	Guidelines / Formulas (For example: treatment guidelines, reimbursement decisions)

	Distribution / Health Systems Research / Application Research
Normative Functions	Standard Settings (Example: ICD, Codex Alimentarius, GMP)
	Regulations (WHO prequalification, FCTC)
	Policies to Maintain the Effectiveness of Antimicrobials
Managing Externalities	Surveillance of Infectious Diseases
	Strategic Drugs and Vaccine Stocks for Pandemics
	Early Warning System for Natural Disasters

**Source:** Moon et al., 2017: 199.

The combination of private goods (e.g., nutrition, living conditions, and education) and national public or club goods (e.g., water and sanitation systems) found in non-health sectors is critical to health. Poverty reduction, food subsidies, housing improvement, and provision of water and sanitation systems can play an important role in controlling many infectious diseases. In this context, there are some actors that develop and implement strategies for the control of infectious diseases. The main actors are:

- National governments as potential users, sources of funding, and suppliers of most control mechanisms,
- International organizations as consensus-building, collective decision-making, coordinators, channels of supply to government, control mechanisms, and suppliers of the regulatory framework,
- Suppliers and developers of relevant medical technologies, as well as pharmaceutical companies and other commercial companies as political players at the national and international level (Smith et al., 2004: 273-274).

In the past, nation-states have been content with the national policies they have implemented in the prevention of communicable diseases. On the other hand, the fact that diseases have become pandemics has led to the inadequacy of nation-states and increased international actors' significance. The inadequacy of the nation-state has already been one of the biggest factors in the formation of GPGs. Therefore, the focal point of GPGs is now international organizations with which nation-states cooperate more closely.

### **3. PREVENTION OF INFECTIOUS DISEASES AS A GLOBAL PUBLIC GOOD**

It is difficult to imagine a healthy society without basic foundations such as security and peace, basic rules of behaviour, regulations to protect health, measures taken against disease, and ways of treatment. Since it is socially beneficial to produce such goods, it is insufficient to be produced by the private sector, so the public sector is responsible for the supply of public goods with the public policies it has implemented. Public goods are needed not only at the national level but also at the global level. The increase in interaction at the global level and the development of cross-border connections have increased the demand for global public goods (Moon et al., 2017: 196-197). Thus, the solution to the problems that arise with this increase in demand should also be addressed on a global scale.

Improving health services requires collective action, both individually and across countries. Initiatives such as the establishment of the Global Fund to combat diseases such as AIDS, Tuberculosis, and Malaria raise awareness of this reality. However, initiating, organizing, and financing collective action for health at the global level poses a challenge for international organizations. In public goods, no one can be deprived (not excluded) of consumption, and one person's consumption does not hinder anyone else's consumption (no competition in consumption). For example, the eradication of global infectious diseases such as polio and smallpox create a situation in which all countries will benefit without harming others, and no country can be excluded. However, these features of public goods create a paradox. It is because, although there is a benefit to be gained, no commercial system will encourage people to do them. National governments intervene financially in the production of these public goods through taxation, etc. However, there is no global government to provide and finance global public goods. The globalization of travel, technological changes, and trade liberalization affect health. Infectious diseases often spread more rapidly in a drug-resistant manner. Are voluntary contributions, global taxation, or market-based mechanisms the best for international funding for GPGs? (Smith et al., 2004: 475). A clear answer to this question will contribute to the good functioning of the financing leg of the fight against communicable diseases. Co-financing and global cooperation of health as a global public good seem essential because of their potential benefit. By its very nature, health creates a global negative externality, which shows that the financing problem in health cannot

be limited to some countries. Even if there is co-financing for health, there are many problems in the global health system in practice and await solutions.

New health initiatives are yet to be fully financed, with committed funding usually coming from completed official development assistance, donations from private foundations, and private sector contributions. Since disease control is to everyone's benefit, it can be argued that the costs should be partially covered by countries' national health budgets rather than just aid budgets. Most countries also contribute to WHO from their national health budgets. In addition, the US Treasury Department provides tax incentives to companies that conduct research on global diseases or export drugs to developing countries. It is important to allocate the cost of health initiatives between aid and national budgets of industrialized countries. At the root of current health problems is often a lack of funding for research on diseases that disproportionately affect the developing world. Existing private health initiatives are designed around drugs and R&D activities that will benefit the poor. Some charities, such as Rockefeller, offer incentives to promote and develop health innovations. The cooperation of charities providing such aid with new foundations to be established should also be strengthened (Kaul and Faust, 2001: 871-872).

Developing countries need more resources and more efficient use of resources to strengthen their health infrastructure. Efforts to implement good governance systems and reduce corruption are needed for more official development assistance. Otherwise, these countries will be almost impossible to control pandemics, and diseases will spread further. Some OECD countries that provide official development assistance argue that this aid should not be increased. It is claimed that there is no correlation between the level of official development assistance and economic growth. It is argued that some corrupt governments do not allocate this aid to the most needed sectors such as health, that aid remains in their pockets, wrong incentives are applied, and that these developing countries do not implement healthy development policies. On the other hand, there are some studies showing the relationship between health expenditures and economic development. Gupta, Verhoven, and Tiongson's (2001) study on 70 countries show that health expenditures are more effective in terms of economic growth in low-income countries than in the middle- and high-income countries (Steinberg, 2004: 12). Ideas such as global finance tax and global carbon tax for global health finance are discussed in public opinion. Moreover, proposals such as obtaining income from countries that allocate resources for space exploration, and deductions from a certain

percentage of the income of countries with a GDP above a certain figure (usually developed countries) can be discussed.

Even if the financing proposals mentioned above are put into practice, international organizations are needed to ensure the collective financing of global public goods and to establish the legal process. Health initiatives created in recent years have focused on global health with the "solidarity mobilization" function of health aids. Supporting developing countries to deliver health services such as childhood immunizations through the Global Alliance on Vaccination and Immunization (GAVI) and combating three main diseases such as HIV/AIDS, tuberculosis, and malaria, through the Global Fund and UNITAID, the UN's aid agency are examples for these initiatives. It is essential to mobilize solidarity while providing health benefits (Moon et al., 2017: 198).

The World Health Organization has played a central role in providing the various GPGs listed in the table below, whether or not they are accessible.

**Table 2:** Various Global Public Goods Offered by the World Health Organization

<b>Subject</b>	<b>Example</b>
Publications, Standards	International Classification of Diseases
Guides	HIV Treatment Guide
Assessments	Prequalification of Medicines and Vaccines
Building Consensus on Controversial Issues	Framework for Preparation of Pandemic Medicines Against a Virus
Coordination Framework	Global Action Plan on Antimicrobial Resistance
Voluntary Normative Guidance	Code of Conduct in International Employment of Healthcare Personnel
Binding International Law	Framework Convention on Tobacco Control and International Health Regulations

**Source:** Moon et al., 2017: 198.

Also, WHO facilitates the sharing of information between countries on health policies and practices, although these GPGs have made significant contributions to improving global public health, institutional arrangements for their production and financing are not sufficient. Development partnerships have been funded largely through short-term grants by the Bill and Melinda Gates Foundation and a handful of charities. WHO receives about 80 percent of its billion-dollar budget from donor contributions rather than core funds, which undermines technical independence and political neutrality. WHO's

unstable financial structure undermines its capacity to provide GPGs (Moon et al., 2017: 198). Former US President Trump has also been included in this situation regarding the WHO's neutrality discussions. Trump accused WHO of being pro-China and stated that it did not act impartially. He stated that WHO was responsible for the spread of the coronavirus around the world and announced that he had cut off the financial aid it provided to this organization. Apart from this, there are those who defend the policies/approaches of WHO during the pandemic process, and there are also institutions/countries that criticize them.

The increasing threat of bioterrorism is also an important element in the field of health. This threat has significantly impacted virus management, particularly in the United States. In order to combat the bio-terrorist threat, the United States has allocated more resources at the federal and state level and created new statutes and programs. It has led to the efforts of the USA to intensify international cooperation against bioterrorism, such as the establishment of the Global Health Security Initiative (GHSI) between the G8 countries and Mexico and its cooperation with WHO in preparing and combating bioterrorism (Fidler, 2004: 802).

The "patent right" for the prevention of infectious diseases is one of the important elements. The R&D cost of vaccine studies lasting for many years reaches hundreds of millions of dollars. This high financing cost causes the cost of the vaccines to be found to be covered by the patent right and the price of the vaccine to rise. In this context, difficulties have been experienced in all countries in the world to benefit from the vaccine/drug in a pandemic that has spread rapidly in the world, such as the coronavirus, and has a large impact area. It is clear that the countries of the world should cooperate in providing a global solution to such problems.

Surveillance of emerging infectious diseases has significant global externalities. Having knowledge about a disease is extremely valuable, not just for that country but for all countries potentially affected by the disease. Consider a country that lacks domestic surveillance capacity (all other countries have effective surveillance systems). When a new disease appears in a country that lacks surveillance, these countries are faced with importing the disease, despite effective surveillance in all other countries. It is the externality of poor surveillance, and the disease begins to spread from the country of origin. On the other hand, effective surveillance under the assumption of transparency provides a positive externality to all other at-risk countries. If a new infectious disease emerges in a country with good early

detection capacity, there may be an intervention to prevent the international spread of the epidemic. Given these features, an emerging infectious disease meets the criteria for GPG, and the lack of effective surveillance can be considered a global "market failure" (Michaud, 2010: 9).

Considering the world's lack of health, the following three elements should be implemented as an urgent strategy to control infectious diseases:

**Table 3:** Strategies for Controlling Infectious Diseases

<p><b>1- Development of the global preparedness-response chain</b> Preventing the emergence and spread of a disease requires preparation, prevention and treatment, surveillance, reporting, and response. Preparedness: The first step to be taken is the early and strategic use of antiviral drugs to establish an effective mechanism for the production and distribution of vaccines and limit the pandemic's negative impact at its source. Prevention and treatment: The trend of disease programs to focus on prevention or treatment being unsustainable, addressing both. Surveillance: Building oversight capability through an effective approach and creating a regional network of health centers overseen by WHO. Reporting: WHO's effectiveness in coordinating the international response to rapidly spreading diseases and reporting the epidemic within the framework of the full transparency mechanism of the countries. Intervention: Requiring additional human resources and funding to develop, manufacture, and distribute new treatments and vaccines.</p>
<p><b>2- Strengthening the capacity of the public health system in the prevention and treatment of infectious diseases</b> The second element of a successful strategy emphasizes the national and local capacity of the state to prevent and respond to emerging diseases. Many developing countries' national health systems need funding, medical doctors, administrators, and social aid. If the national health systems of poor or fragile countries cannot be strengthened, the fight against infectious diseases will be in vain. According to WHO, the global country population is increasing, but the number of healthcare workers is declining/stagnating.</p>
<p><b>3- Increasing the level of knowledge about vaccines and treatment</b> Research on the prevention of infectious diseases in tropical countries is lacking. About 10 percent of global health research resources are spent on diseases that affect 90 percent of the world. - Establishment of a specialized research network in tropical diseases by a global organization -Global funds offering incentives for the development of new medicinal products and vaccines</p>

**Source:** Report of the International Task Force on Global Public Goods, 2006: 33-37.

Therefore, although every step to be taken in the fight against infectious diseases is important, focusing especially on the surveillance/observation phase is required. Establishing a good observation

network in the first country where an infectious disease emerged and developing an international mechanism (such as WHO) that can simultaneously announce this information flow to all countries of the world is a serious step towards a solution. It is because the measures to be taken before the spread of an infectious disease are more effective.

#### **4. ECONOMIC AND SOCIAL IMPACTS OF THE PANDEMIC (COVID-19)**

The Covid-19 pandemic, which emerged in China and affected the whole world, has caused economic and social damage in many countries. Due to the application of restriction measures by countries whose economies were negatively affected at the global level, the pandemic brought along supply and demand shocks, the world economies were exposed to contractions, and many macro variables, especially unemployment and inflation, were adversely affected. Although vaccine studies against the epidemic yield positive results, it seems inevitable that the negative effects of the pandemic will be felt for a long time. In this context, the table below shows the data of some selected world economies during the pandemic process.

As can be seen in Table 4, economic shrinkage occurred in many countries in 2020 during the pandemic process, and recovery occurred mainly in the economies with the measures taken in 2021. While inflation rates remained low in many countries in 2020 due to the contraction in supply and demand, they generally remained high in 2021. With the outbreak of the epidemic, an increase in the unemployment rate was observed with the beginning of the restrictions in the countries. Especially the year 2020, when the epidemic became a pandemic, was a year in which the unemployment rate was high in general, together with the contraction in supply and demand. Although there was a partial improvement in 2021, the unemployment rate remained at a high level. As a result, after the epidemic was declared as a pandemic in 2020, the economic growth performances, inflation, and unemployment rates of the countries were adversely affected.

However, it is a considerable development that Türkiye achieved a growth rate of 11 percent with the monetary and fiscal policies implemented in 2021 after the economic slowdown in 2020. Undoubtedly, measures to ensure fiscal discipline were also effective in this process. The increase in inflation in Türkiye during the pandemic period, especially the exchange rate, the increase in food and global commodity prices, and the uncertainty about the end of the pandemic were the main factors.

**Table 4:** Growth, Inflation, and Unemployment Data in Selected World Economies

Countries	Development	Inflation	Unemployment
USA	2.3 (2019) -3.4 (2020) 5.7 (2021)	1.8 (2019) 1.2 (2020) 4.7 (2021)	3.7 (2019) 8.1 (2020) 5.5 (2021)
European Union	1.8 (2019) -6.0 (2020) 5.4 (2021)	1.6 (2019) 0.5 (2020) 2.6 (2021)	6.7 (2019) 7.0 (2020) 7.0 (2021)
China	6.0 (2019) 2.2 (2020) 8.1 (2021)	2.9 (2019) 2.4 (2020) 1.0 (2021)	4.5 (2019) 5.0 (2020) 4.8 (2021)
India	3.7 (2019) -6.6 (2020) 8.9 (2021)	3.7 (2019) 6.6 (2020) 5.1 (2021)	5.3 (2019) 8.0 (2020) 6.0 (2021)
England	1.7 (2019) -9.3 (2020) 7.4 (2021)	1.7 (2019) 1.0 (2020) 2.5 (2021)	3.7 (2019) 4.5 (2020) 4.5 (2021)
Japan	-0.2 (2019) -4.5 (2020) 1.6 (2021)	0.5 (2019) -0.0 (2020) -0.2 (2021)	2.4 (2019) 2.8 (2020) 2.8 (2021)
Russia	2.2 (2019) -2.7 (2020) 4.8 (2021)	4.5 (2019) 3.4 (2020) 6.7 (2021)	4.5 (2019) 5.6 (2020) 5.0 (2021)
Türkiye	0.9 (2019) 1.8 (2020) 11.0 (2021)	15.2 (2019) 12.3 (2020) 19.6 (2021)	13.7 (2019) 13.1 (2020) 13.4 (2021)
World	2.6 (2019) -3.3 (2020) 5.8 (2021)	2.2 (2019) 1.9 (2020) 3.4 (2021)	5.4 (2019) 6.6 (2020) 6.2 (2021)

**Source:** World Bank Open Data, <https://data.worldbank.org/>

Decreased demand due to restrictions and temporary/permanent closures of businesses have been the main factors in increasing Türkiye's unemployment rate during the pandemic. World economies need a long time to recover, and in this context, structural policies need to be carefully calibrated in many economic and social aspects.

## CONCLUSION

It is not the first time that epidemic diseases have been seen in the history of the world. The increasing importance of infectious diseases seen in different time periods over the centuries reveals the importance of international cooperation rather than individual efforts in the field of health. It is because infectious diseases are globalized. Since the spread of infectious diseases is generally through travel, it affects many sectors, such as health,

transportation, tourism, and education. Therefore, it is imperative that the decisions to be taken in the field of global health are taken in a way that affects all actors in a wide framework. It is because when a country is infected with an epidemic, it has negative effects in many ways, such as reducing the country's national income and increasing the budget expenditures. In other words, it causes global public damage.

Fundamental problems such as the financing shortage in local and national public goods are also present in global public goods. In this context, international cooperation gains importance, and organizations such as the World Bank and the World Health Organization should allocate more funds to the fight against the epidemic. The economic growth data of the countries should be examined well, and the share of the countries with stronger economies in the presentation of health-related GPGs should be increased. Also, it is essential to establish a system that can make good observations in countries in the prevention of infectious diseases and to develop an international mechanism that can simultaneously announce this information flow to all countries of the world.

The concept of patent rights is also one of the important issues that await an urgent solution in the prevention/spread of infectious diseases. It is because the countries that develop vaccines or drugs against epidemics are generally developed countries with strong technological infrastructure. Underdeveloped countries are deprived of these solutions due to their patent rights. Even if it is necessary to have patent rights in other sectors, rigid attitudes should not be adopted in the health sector, at least for humanitarian reasons. Different solutions can be produced, such as selling patented drugs or vaccines against infectious diseases at very low prices to underdeveloped countries. It may also be rational to impose a global tax in all countries of the world, transfer the proceeds from these taxes to an international joint fund, and distribute the patented vaccine or drug to all countries of the world by purchasing the patent right from the relevant country. This fund can even be used for R&D expenditures against all kinds of diseases (infectious diseases, cancer, etc.).

One of the main problems with the spread of infectious diseases is the non-transparent behavior of countries. Since some countries are concerned about the deterioration of their international political and economic relations, the first outbreak of the epidemic is concealed. Therefore, as soon as an infectious disease emerges in a country, a reporting system should be

established by analyzing the results well, and mechanisms for prompt reporting to WHO should be made operational.

The fact that there are curfews in Türkiye, as in the world, has negatively affected other economic and social variables, especially the supply-demand balance. Thousands of workplaces were closed, and the supply chain was adversely affected. The policy recommendations that can be implemented in the event of a pandemic in the future in the world are as follows:

- Policies that reduce total demand and increase total supply should be followed, and measures should be taken to prevent a recession in this process.
- In case exporters suffer losses due to the disruption of international trade, measures should be taken to increase exports (providing incentives for exporters, providing cheap credit, etc.), and these measures should continue for a long time until the effects of the pandemic weaken.
- Support should be increased for sectors affected by the pandemic, especially transportation and tourism.
- It is important to take measures to effectively operate the supply chain. Since the production-consumption leg will be affected if the supply chain does not work effectively, this process will create a spread effect and adversely affect the entire economy.
- The labor market has been one of the markets that have been adversely affected by workplace closures/restrictions. Measures should be taken to protect the labor market.
- Hospitals have been in a very important position in all countries in the fight against the Covid-19 pandemic. Therefore, countries such as Türkiye (as in the case of city hospitals) need to produce policies to maintain this advantage in the health sector.

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**CHAPTER 2**

**THE PLACE OF RESEARCH AND DEVELOPMENT  
ACTIVITIES IN THE DEFENSE INDUSTRY: COMPARISON  
OF OECD COUNTRIES**

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## INTRODUCTION

Wars and various terrorist incidents cause defense services to retain their importance from past to present throughout the world. Defense services are as old as human history. Although the cold war is over, the importance of defense has not decreased. In fact, countries have started to look for a new model and system to increase their defense capacities. In the public economy, the defense service is included in the full public goods and services group (Stiglitz, 1994; Cullis, Jones, 1998; Bulutoğlu, 2008). Due to this feature, it is a service supplied by the state. One of the elements that determine a country to have a strong defense is the defense industry. A strong defense industry requires advanced technology equipment. It is increasingly important for countries to have a strong and advanced defense industry with advanced technologies. Acting with this awareness, countries are focusing on state-funded defense research and development (R&D) in order to develop new generation technologies, provide digital and information technologies to increase efficiency and effectiveness in modern defense systems. The relationship between economic growth and technological development at the macro economy level is also valid at the sectoral level. Developed after 1980 Solow model, as in the Romer model (İdris, 2003; Romer, 1990) models of economic growth, technological development and an important role in enhancing economic growth, it is stated that growth should be considered a key element of the technology. The source of technological development and innovation is R&D. The development of advanced technology production in the defense industry also depends on the extent of defense R&D activities. For this reason, the innovation resulting from R&D activities in the defense industry, advanced technological equipment and systems do not only strengthen this sector. With its spreading effect, it gives impulse to advanced technological developments in other areas of the economy. The best example of this situation can be given for the United States (USA). After the Second World War, the United States allocated significant amounts to the financing of military science and technology. At the same time, the defense sector has become the first key customer of the new technology. This situation has prepared the ground for many technological developments such as the Internet. For this reason, as a result of R&D activities in the defense industry, let's deconstruct innovation with advanced technologies and systems not only strengthen this sector. With its spreading effect, it gives impetus to advanced technological developments in other areas of the economy. The best example of this situation can be given for the United States (USA). After the Second

World War, the United States allocated significant amounts to the financing of military science and technology. At the same time, the defense sector has become the first key customer of the new technology. This situation has prepared the ground for many technological developments such as the Internet. Therefore, when the positive effects of having a high-tech defense industry on other sectors of the economy are taken into account, the focus is on the research of tools that will provide this. Defense R&D is also included as the basic tool. The aim of this study is to examine the relationship between the strong defense industry and defense R&D, which is indispensable for all countries, although its relative importance varies according to countries, within the scope of OECD member countries. The fact that a significant part of the OECD countries consists of NATO members and countries that have a leading position in military expenditures and the defense industry caused them to be selected in the study. R&D for defense in a country consists of the sum of public sector R&D and private sector R&D. In this study, public R&D is examined because the state is in the position of supply of defense services and the weight of applications is in public R&D. Public R&D is defiantly examined. In the following part of the study, first of all, the defense industry and its importance, its contributions to both the military and civilian fields are explained. In the following section, R&D, which is a source of technological development in the defense industry, their effects on the economy, the opinions and studies claimed in this field are explained. Then, the location of defense R&D in OECD countries was examined through data. The data obtained from the country applications were evaluated in the conclusion section.

## **1. DEFENSE INDUSTRY AND ITS IMPORTANCE**

As in the past, defense is among the most basic services of the states today. Since each country has to provide its services to the defense as full public goods and services, it has to allocate part of its budget to defense services. With these expenditures, they have to create a defense system and provide the necessary military equipment and personnel.

Worldwide military expenditures increased to US \$ 2113 billion in 2021 year. It exceeded US \$ 2 trillion for the first time. Its share in the global gross domestic product has increased to 2.2%. Despite the economic fluctuations caused by the Covid-19 pandemic, this upward outflow has remained unchanged. However, the increase of military expenditures in the world to 2 trillion dollars is also considered as a lost opportunity to meet the

goals of the 2030 sustainable development goals and the 2015 Paris climate change agreement on the agenda (SIPRI, 2022: 10). With the end of the Cold war, military expenditures around the world tended to decrease for a while, but they started to increase again. Looking at the share of defense expenditures in total public expenditures in the central administration budget in the 2000s, Table 1 shows that some countries are increasing the share of defense expenditures in public expenditures, while others are trying to maintain the same levels. In 2011, the ranking of the five countries with the highest military expenditures in public expenditures was Israel (14.49), South Korea (12.97), the United States (12.44), Colombia (10.18) and Chile (9.89). In 2021, this ranking was realized as Israel (12.14), South Korea (10.47), Colombia (9.57), USA (8.32) and Greece (6.57). The countries in the ranking are the same, and only in 2021 Greece rose to the fifth place. In addition, countries other than Greece have shown a decrease in this share. In these decreases, the Covid-19 pandemic has had the effect of changing the priority within the budget components.

The differences between the countries are based on factors such as the historical past, geographical location, political interests of the countries, apart from the economic structure of the countries. According to the existence of these factors, the share allocated to defense expenditures from the state budget is shown in the figures in Table 1. For example, the share of military expenditures in Turkey is higher than in countries such as Australia, Austria, Great Britain, and Canada. Also, Israel is one of the most remarkable countries.

Unlike other expenditures, cost-effectiveness analysis is not taken into account in defense expenditures. Because it may not be correct to base the evaluation of alternative defense programs according to their relative benefits on simple economic calculation (Stiglitz, 1994: 386).

**Table 1:** Share of Military Expenditures in Public Expenditures in OECD Countries (%)

Country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	1,55	1,52	1,45	1,43	1,37	1,46	1,54	1,53	1,50	1,45	1,48
Australia	4,84	4,57	4,49	4,81	5,22	5,59	5,44	5,13	4,82	4,50	4,63
Belgium	1,90	1,84	1,80	1,75	1,69	1,68	1,70	1,71	1,71	1,76	1,91
Canada	2,87	2,73	2,51	2,58	2,88	2,86	3,34	3,23	3,14	2,68	2,74
Chile	9,89	8,86	8,63	8,25	7,63	7,59	7,61	7,33	7,04	7,15	5,90
Columbia	10,18	10,85	10,91	9,94	9,94	10,24	10,94	8,75	9,57	10,52	9,57
Czechia	2,50	2,38	2,38	2,27	2,26	2,51	2,45	2,68	2,81	2,81	3,01
Chine*	7,63	6,81	6,27	7,01	7,53	7,08	5,33	5,10	4,91	4,68	-
Denmark	2,33	2,33	2,20	2,08	2,04	2,19	2,25	2,53	2,65	2,60	2,56
Estonia	1,66	1,88	1,90	1,91	2,01	2,05	2,01	2,36	2,16	1,69	1,66
Finland	2,78	2,75	2,70	2,53	2,57	2,55	2,52	2,55	2,53	2,66	3,55
France	3,36	3,28	3,23	3,26	3,30	3,38	3,38	3,31	3,32	3,25	3,21

Germany	2,67	2,76	2,64	2,60	2,58	2,59	2,61%	2,63	2,80	2,73	2,52
Greece	4,58	4,55	4,55	4,64	4,81	5,15	5,29	5,60	5,58	4,62	6,53
Hungary	2,11	2,09	1,88	1,71	1,80	2,14	2,21	2,43	2,74	3,46	3,21
Ireland	1,15	1,21	1,24	1,23	1,18	1,19	1,17	1,13	1,14	0,97	0,98
Israel*	14,49	13,95	13,71	14,69	14,49	14,41	14,19	13,52	13,13	11,61	12,14
Italy	3,00	2,82	2,75	2,52	2,40	2,72	2,78	2,81	2,71	2,68	2,64
Japan	2,50	2,46	2,41	2,48	2,52	2,48	2,47	2,60	2,66	2,29	2,47
S. Korea	12,97	12,71	12,57	12,80	12,64	12,62	12,33	12,25	11,79	11,03	10,47
Latvia	2,69	2,45	2,52	2,50	2,77	4,01	4,37	5,42	5,36	5,22	4,76
Lithuania	1,91	2,18	2,20	2,59	3,31	4,44	5,28	5,93	5,91	4,93	4,80
Luxemb- urg	0,91	0,86	0,87	0,90	1,03	0,95	1,20	1,18	1,28	1,16	1,26
Mexico	1,68	1,69	1,83	1,84	1,70	1,81	1,70	1,86	2,02	2,58	2,40
Nether- lands	2,80	2,69	2,55	2,58	2,59	2,72	2,78	2,93	3,21	3,16	2,86
New Zealand	2,94	3,01	2,95	3,02	2,97	3,09	3,20	3,35	3,59	3,36	3,14
Norway	3,33	3,29	3,23	3,23	3,11	3,21	3,46	3,59	3,68	3,52	3,62
Poland	4,06	4,18	4,14	4,47	5,13	4,72	4,59	4,93	4,72	4,73	4,63
Portugal	4,01	3,91	4,18	3,46	3,71	4,47	3,69	4,08	4,20	3,85	4,03
Slovak Republic.	2,58	2,62	2,30	2,28	2,44%	2,62	2,68	2,94	4,02	4,11	3,44
Slovenia	2,54	2,36	1,74	1,92	1,91	2,18	2,23	2,25	2,44	2,07	2,45
Spain	2,89	2,93	2,78	2,78	2,90	2,68	2,99	3,01	2,93	2,61	2,70
Sweden	2,27	2,27	2,20	2,27	2,20	2,16	2,12	2,12	2,28	2,24	2,43
Switzer- land	2,21	2,11	2,19	1,97	2,01	2,05	2,05	2,06	2,18	2,33	2,02
Turkey	6,12	5,88	5,67	5,66	5,46	5,88	6,15	7,30	7,54	7,16	6,27
England	5,74	5,54	5,46	5,31	5,08	5,01	4,96	5,00	5,17	4,56	4,66
US	12,44	12,02	11,25	10,42	9,89	9,62	9,36	9,35	9,60	8,20	8,32

\*The World Bank. <https://data.worldbank.org/indicator/MS.MIL.XPND.ZS>

Source SIPRI

In order for countries to provide an effective defense service, they need to have a strong defense industry. The defense industry supplies goods and services to the armed forces. The defense industry is divided into three basic groups from a functional point of view. These are; i) Auxiliary equipment such as weapon systems, command and control, ii) Intelligence and early warning systems, communication systems, iii) General purpose products (e.g. car, fuel, medical supplies) (Lifshitz, 2003:143). In the defense industry, public, private, large and small firms operate.

Unlike other industries, the defense industry is a politicized, protected industry where prices are determined by protracted negotiations and performance maximization takes precedence over cost minimization. In a market with these characteristics, but concentrated, many opportunities and resources for innovation arise (Poole and Bernard, 1992:339).

With the 1990s, the end of the cold war period also affected the defense industries of the countries. However, this effect differed among countries. Important arms producing countries have felt the need to reduce their military expenditures due to the contraction in these products in their domestic markets. However, these countries have increased international sales

of high-performance weapons by enabling countries that prefer to import military equipment to obtain high-performance weapons at lower prices. In this case, it has been suggested that the fact that countries in this context can buy high-performance weapons from abroad at lower prices may hinder technological development in defense (Jan, 2003:351). Because the absence of the defense industry of the countries is necessary, but it is not enough, it was born out of the need to create high-tech defense industries. Since the 1990s, expanded economic and industrial development in the field of defense has enabled some developing countries to transform into new industrialized countries (Jan, 2003:351).

The sector where the transition from traditional production to technology-intensive production is intensively experienced is defense. The defense industry is one of the areas where advanced technology is used. Especially today, a strong defense of a country depends on high-tech defense equipment. The role of the Internet, which is a product of advanced technology in wars and defense today, is undeniable. It is seen that different nomenclatures have been made for Internet-based defense. For example, the United States calls cyber war and China calls it informed war. These refer to sensitive military and critical infrastructure assets, as well as battlefield communications and satellite intelligence (NATO, 2007). The efficiency of military investment expenditures is determined by the basic infrastructure of the development of defense technology (Jan, 2005: 184). Science and technology have enabled them to create new military and intelligence capabilities that contribute into many other aspects of military utility.

First of all, the defense industry, which has high technology, provides advantages against possible threats that will strengthen the country's defense. The country's dependence on other countries in the field of defense will decrease. The issue of dependence in the field of defense is not new, but has been seen as a problem for countries that have been in the position of importers since the past. For example, the embargo imposed by France on Israel in 1967 and Britain's reluctance to sell advanced tanks created an impetus for the expansion of the Israeli defense industry. The strategy of self-sufficiency of the defense industry and getting rid of dependence on foreigners in the majority armament systems is aimed (Lifshitz, 2003: 225).

With the 1990s, the increasing globalization phenomenon has also affected the defense industries of the countries. The desire for privacy and technology control that was inherent to the creation of national security capabilities is no longer incompatible with this globalized and open

commercial market (Hermann, 2008: 371). According to some authors, globalization blurs the Decoupling between a domestic and a foreign defense company (Guay, 2007: 2). Countries can look more warmly at foreign company partnerships to develop their own defense industries. The creation of a defense industry in a country will also benefit the national economy in many ways:

- The purchase of military equipment and systems from abroad primarily reduces the purchase of weapons with scarce foreign exchange resources. Moreover, the necessary resources to import intermediate goods and investments for sustainable economic growth will be decreased. Although there is no increase in investment equal to a decrease in military imports, it is clear that there will be a leak in consumption and other imports due to military imports. Lower military imports will reduce currency shortages (Looney, 1998: 118).
- Military support played an important role in the early development of the information age. For example, it is observed that China's efforts in R&D and informatics are actively developing space-related technologies, which is a critical area (Erickson and Walsh, 2008: 356).
- The countries technology-intensive defense industry also contributes to the overall economic goals of the country. The application of national defense research results to non-military applications also accelerates the development of private sectors. If national defense spending is based on the assumption that it is a necessity, coordination of this industry should be ensured with other goals of the government, such as improving demand within the country, stimulating the development of industry and reducing unemployment (Jan, 2005: 186-188).
- Defense industry technologies can have a dual use feature. Dual-use technology plans can free up defense technology resources, nurture capabilities, and promote resource sharing (Jan, 2005: 186).

The main way to create a high-tech defense industry is to increase R & D in this area.

## **2. DEFENSE R&D AND THE SITUATION IN OECD COUNTRIES**

Under this heading, firstly, the literature containing the basics of defense R&D and the studies carried out in this field is included. Later, the development of defense R&D in OECD countries will be investigated.

### **2.1. Defense R&D**

Historically, it is observed that there is a close connection between technological development and military or related to war expenditures. It is observed that many major developments on the battlefield have significant effects not only on the sovereign powers, but also on the civilian economy. There are a number of difficulties in the whole defense R&D. Molas-Gallart (1999) is an R&D military or civilian? In general, two elements are taken into account in the distinction about which it is. These are the purpose and financing of the research. In this context, the authors state that the OECD approach is insufficient. As a reason, they point to the inadequacy of the OECD approach, especially in the context of the increasing importance of dual-use technologies and research. When determining defense R&D by the OECD, the reason for defense is primarily taken into account, regardless of whether they will have civilian applications or their content. The criterion of who will finance is not taken into account (Molas-Gallart, 1999: 9).

High-tech production depends on R&D activities. Military and political analysts have the opinion that R&D investments can provide significant technological advantages against potential enemies (Sargent, 2020: 1). High R&D investments in the defense industry will not only contribute to the military field, but will also contribute to other civilian sectors. Defense R&D is an area that often plays a central role in evaluating the performance of general R&D activities, which provides governments with dominance with the outputs they provide. International cooperation on the development of future weapons, burdened with increasing political and managerial complexities, indicates that R&D in the field of defense will be even more widespread (Mowery, 2012: 1714).

Whether Defense R&D will cause a negative 'distorting effect' on the economy in the form of 'crowding out' and negative external effects has been an issue in this area. For example, Buck et al. (1993) concluded in their studies that there is no relationship between defense and civilian R&D expenditures in the long term, that is, there is no exclusion effect. Morales-Ramos (2002), on the other hand, state that the indirect negative exclusion

effects do not outweigh the positive direct exclusion effects in their analysis for the United Kingdom in comparison with other countries. Therefore, it was considered that defense R&D could be associated with a clear positive impact on growth in the UK context (Dunne and Braddon, 2008: 38).

Defense R&D and the development of the industry have been noteworthy affected by the cold war. Although there has been a change in military policies since 1989, the role of defense research in national defense systems continues or even increases (Molas-Gallart, 1999: 3). Privacy is still important, but it is no longer considered a priority. This creates a result that also diminishes the difference between civilian research and military research. But the differences have not completely disappeared (Dunne, Braddon, 2008: 19). However, it is also a fact that in the fields of innovation and technology, the discrimination between the military and the civilian is rapidly becoming much more difficult. Today, military and civilian research and production activities can be more integrated (Molas-Gallart, 1999: 4-5). This integration may also be necessary from an economic point of view. If very little of the defense R&D produces output that can be priced in the conversional markets, it will also become difficult to establish the economic value of the products of these large amounts of investments made by the public (Mowery, 2012: 1714).

Defense-related R&D investments have overly influenced innovations in civilian economies more broadly in several OECD countries, including the United States, the United Kingdom and France. Although the scope and nature of this impact may be unclear and open to debate, politicians in industrialized economies have stated that the conclusions to be drawn from the implementation of defense-related and other mission-oriented R&D programs can also be applied to issues such as climate change (Mowery, 2012: 1703).

They could potentially have more implications than the projected size of defense R&D. Various civilian applications of defense R&D will increase productivity in the civilian sector, thus contributing to economic growth at the macro level (Herrera and Gentilucci, 2013: 18). The benefits of defense R&D for the civilian economy include direct and indirect effects such as spreading positive externalities (spillovers) in the form of technology transfer to the commercial sector (spin-off).

In explaining the effects of defense technologies on the civilian sector, the spin-off was more relevant in the 1950s. Alic et al. (1992) stated that the spin-off paradigm is not valid in military expenditures in their studies.

The reasons put forward for the invalidity of the technology transfer (the spin-off) effect can be listed as follows (Guichard, 2005: 195-196):

- The disappearance of the “general similarity” between civilian and military technologies and the phenomenon of differentiation of the ways of managing technological change has weakening power of the effect of spin-off.
- Although the main purpose of military R&D is to develop more effective weapons, the success of programs in the field is evaluated accordingly, taking into account the breadth of resources used, it is impossible to ignore the overall economy. The main goal of military R&D is to develop more effective weapons.
- Firm structures that serve both military and civilian needs will lead to excessive use of economies of scale.
- Since military technology is more advanced than commercial ones, defense R&D is especially beneficial for the commercial sector and can contribute to major advances in this area.
- Unless a dual-use strategy is developed, the effects of spin-off and externality dissemination can have unpredictable consequences in reality (Dunne and Braddon, 2008: 14-16).

Due to the new developments in technology and the impact of the policies followed in the field of defense in the world, the “dual use” policy has been supported on the effects of defense R&D on the economy. Today, defense production and research are increasingly intertwined with civilian activities. Studies on this subject also focus on dual use. Studies on this subject also focus on dual use. Guichard (2005) states that the creation of civil and military innovation structures lies in the integration around the basic concept of dual use in a comparative analysis of the innovation systems of France and the USA,

The dual use of defense R&D is defined as the way to manage research, innovation and production of defense systems aimed at creating economies of scale, economies of scope and expansions in the civilian sector. For the successful implementation of dual use, it is necessary to analyze national innovation systems and national competitiveness. Even if technology makes it possible to build bridges between the civilian and military spheres, dual - use is not, in essence, a technological problem. Basically, taking advantage of dual use is a matter of organization, that is, coordination,

collective action and incentives. It should be noted again that the integration of military and civilian innovation structures will provide many economic opportunities for dual-use policy not only in research, but also in all processes of innovation (Guichard, 2005:197).

The formation of the concept of dual use in defense R&D is a result of strategic studies conducted in the context of the concern for spreading of weapons through international transfers of "dual-use products and technologies. In recent years, these dual-use technologies, the concept of "military technical revolution known as the emerging and rapidly growing as a result of the changing international context of the preferred forces, military, technological and financial problems faced by organizations are used to offer a viable solution to a lot more (Paillard and Butler, 2016: 10).

After the cold war, the transformation of non-defense technology into defense has been replaced by the tendency to transform from defense to civilian technology. While there has been a decrease in barriers between civilian and military technologies due to the cold war and an increase in attempts to develop dual-use technologies, financial and structural factors have diminished the importance of military R&D relative to civilians. In addition, an increase in new industries such as information technology and communications, which are less strict in their civil-military distinctions than the traditional industry, has increased dual use (Dunne and Braddon, 2008: 48).

Starting from the 1980s, in the 1990s, many countries have directed to dual use in defense R&D more widely. China has carried out reforms in the field of defense after 1990. The most notable of these reforms is the dual-use approach in defense R&D. The most notable of these reforms is the dual-use approach in defense R&D (Erickson and Walsh, 2008: 350). A similar transformation is observed in the UK. In terms of technology transfer, the UK has gradually implemented the logic from the spin-off policy to the military sector, which is based on expanding the R&D base. Between defense and industry, initially market-oriented liberal's relationship is inspired by the invisible hand, although flexible organizational strategic interactions between the public and private sector information sharing and supply given more weight in a gradual transition to a new approach to intelligent to be made known as (Avadikyan and Cohendet, 2009: 490-493).

## 2.2. Related Literature

Studies related to the defense industry and defense R&D are limited and are generally observed to have been conducted after the 1980s. In Kennedy's (1987) extensive analysis, it is stated that there are rises and falls of great powers linked to military expenditures, and in these cases, military technology and innovations are an important component. Poole and Bernard (1992) production data for Canada in the period 1961-1985 made based on the multiple regression analysis in the defense industry, military production, four industries (aerospace, electronics, marine, and chemical) concluded that the total had a negative impact on productivity. Especially in the aerospace and electronics industries, this effect is more pronounced. Molas-Gallart (1999) study of quantitative analysis of defense spending, defense R&D is not obliged to, because they are easy definition of the opinion that, based on these challenges and defense R&D has focused on the definition of.

Jan (2005) evaluated the effectiveness of investments made in military fields to improve military technology in terms of the largest arms importers. In his study, in which he makes proposals for Taiwan, it is stated that independent R&D is the only way to defend. Guichard (2005) conducted a study titled repositioning defense R&D within the French innovation system. In this study, it is aimed to develop institutional models and tools that can realize dual use in defense R&D. In the study conducted by Erickson and Walsh (2008), China's strategies for developing defense and space capacity in the past and currently, its gradual approach to defense industry and space R&D and comparison of these R&D efforts with the American approach were made. As a result of the study, an assessment of the prospects for future US–China competition and / or cooperation in the field of defense and space R&D is realized. Mowery (2012) examined the characteristics of defense and R&D programs in industrial economies based on a set of sub-countries where reliable long-term data on defense R&D expenditures are available. In the study, the characteristics that distinguish defense-oriented R&D from R & D included other industries are emphasized. In addition, the study points out some important differences in the structure of defense-related R&D programs among OECD economies.

Studies on Turkey in this regard are quite limited. Ersöz and Karaman (2011) evaluated the development of defense capacity in Turkey from the perspective of innovation. They analyzed the European innovation scores data with a multidimensional scale and a k-tool set. They concluded that Turkey is in the same cluster as Poland, Portugal, Romania, Slovakia and Croatia and

that Turkey's innovation performance is lower than the EU. K orođlu and Eceral (2015) examined the relationship between human capital and innovation capacity in the defense and aerospace industry for Turkey. As a result, firms' R&D personnel and the share of capacity they have concluded that there was a statistically significant relationship between firms' innovation.

### **2.3. Defense R&D in OECD Countries**

In OECD countries, the case of defense R&D can be evaluated by looking at indicators such as the share of defense R&D in budgets of the countries OECD and defense R&D in total R&D.

The level of a country's military R&D funding demonstrates its national choices regarding security and alliances (Guichard, 2005: 195). The defense R&D activities which are funded by governments in OECD countries are indicated in Table 2. Defense R&D funds was increased in the majority of countries between 2013 and 2021 years. The top 10 ranking for 2013 is the United States (48248,8, \$), South Korea (3076,39 \$), the UK (2255,39 \$), Germany (1260,03 \$), Turkey (1746,70 \$), Japan (1674,55), France (1185,52\$), Australia (300,13\$), Sweden (270,34 \$) and China (210,88). A similar ranking applies to the year 2021. In Sweden alone, defense R&D funding has fallen, but is still higher than in many countries. From these indicators, it can be seen that the funds allocated by larger economies for defense R&D activities (except for Turkey) are higher. Again, it is seen that Greece has allocated a significant share to defense R&D activities after 2016.

China is one of the countries that attract attention in terms of defense R&D. throughout the 2000s, China has been the country that has a large share of defense R&D. Although countries such as Sweden and Canada are a more neutral country, they seem to allocate significant budgets to defense R&D. This situation is due to the fact that the countries in question want to benefit from the economic benefits of the defense industry. Although Sweden reduced its defense spending after the cold war, Forsvarets Forskningsanstalt (FOA), as a subsidiary organization of the Ministry of National Defense, did not defense R&D, and even concentrated on R&D in innovative and basic technologies (Jan, 2005: 192).

In Europe, defense R&D is concentrated in three countries (France, Germany and the UK).

**Table 2:** Defense R&D Funds Allocated by Governments in OECD Countries (US Dollars)

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	0,36	1,23	1,09	3,20	5,962	6,27	6,43	5,538	6,78
Australia	300,13	309,47	356,13	333,63	368,46	338,04	289,05	340,97	
Belgium	5,28	5,28	3,24	2,94	3,18	3,63	5,39	27,52	
Canada	245,33	223,97	204,32	181,31	..	..	..	..	
Chile	0,21	0,25	0,159	0,341	0,199	0	0,004	..	
Czechia	31,48	30,10	28,32	25,15	29,161	28,66	27,18	25,561	20,52
China*	210,88	187,90	187,74	406,06	512,27	528,33	778,55	637,78	604,49
Denmark	8,08	8,57	8,81	8,49	8,48	8,34	8,74	9,44	10,18
Estonia	1,37	3,53	3,90	6,00	4,72	10,34	4,97	7,29	7,41
Finland	43,62	48,02	41,05	39,09	45,50	50,83	52,40	46,96	48,28
France	1185,52	1228,09	1258,11	1239,31	1437,96	1269,90	1448,37	1695,24	2162,75
Germany	1260,03	1279,37	1062,77	963,54	1441,94	1265,05	1774,18	1838,86	1942,53
Greece	5,76	1,52	1,34	14,36	25,50	31,81	32,75	37,66	36,67
Hungary	2,73	1,04	4,33	1,36	3,85	0,27	0,27	4,63	13,95
Italy	91,55	95,37	85,55	72,95	70,61	72,24	75,31	67,77	74,95
Japan	1674,55	1594,19	1466,56	1020,28	1177,39	1003,30	1234,56	1214,26	1090,40
S. Korea	3076,39	2884,30	2969,31	3068,09	3271,77	3476,62	3813,92	4468,18	..
Latvia	0,82	1,40	1,80	2,79	..	..	..	..	2,31
Lithuania	0,18	0,06	0,26	0,68	0,41	0,41	0,82	22,58	7,13
Mexico	13,43	12,04	11,56	9,39	8,46	7,69	10,01	9,81	9,65
Netherlands	73,79	73,90	76,06	75,06	66,45	76,93	80,78	132,16	118,01
Norway	110,15	110,21	110,43	112,40	113,02	114,68	99,86	102,88	321,78
Poland	181,08	201,99	210,12	534,55	367,94	193,29	253,35	183,10	31,19
Portugal	2,45	3,73	3,72	3,68	3,81	4,4	3,50	2,80	..
Slovak Rep.	8,26	8,04	12,66	9,48	10,44	12,01	16,35	14,28	..
Slovenia	2,00	0,56	0,56	0,43	0,77	0,89	2,06	2,22	4,54
Spain	124,11	109,79	129,34	91,10	96,22	85,99	139,43	136,88	96,34
Sweden	147,97	142,30	125,15	130,70	85,48	91,58	108,34	98,54	92,65
Switzerland	..	22,00	20,03	..	19,15	19,07	21,22	24,37	34,02
Turkey	1746,70	709,26	738,95	947,87	1330,51	1603,78	1510,81	902,90	1900,96
UK	2255,39	2489,45	2364,59	2311,97	2288,49	2260,96	1374,10	1348,63	..
US	48248,8	46570,3	47927	53248,3	53868,5	64049,5	65596,8	73782,5	68993,9

**Source:** OECD, Research and Development Statistics (RDS) Database, [https://stats.oecd.org/Index.aspx?DataSetCode=GBARD\\_NABS2007](https://stats.oecd.org/Index.aspx?DataSetCode=GBARD_NABS2007).

The largest share belongs to the United States, and in 2020, the share of the United States in total defense R&D expenditures of OECD countries is about 85%. The history of R&D activities in the defense industry of the USA dates back to the past. For more than 70 years in the U.S. defense-related R&D in information processing, communications, networks, satellites, fighter planes and bombers, aircraft carriers, submarines, tanks, missiles, tactical and strategic nuclear weapons, drones, advanced materials, autonomy, and other weapons and has provided breakthroughs in technology. Towards the end of the cold war, when defense spending was intense, global military R&D expenditures exceeded \$120 billion annually, while the US 'share was 35% (Dunne and Braddon, 2008: 4).

The United States has revised its defense science technology in the 2000s. Basic and applied research and advanced technology development strategy and previously while later, demonstration/validation, engineering and manufacturing development, R&D, testing/assessment, management and operational support, such as a wide area has turned into more specific and system development (Department of Defense, 2000).

Another indicator that will be used to measure the resources allocated to defense R&D in the budgets of countries is the share of defense R&D expenditures in total R&D expenditures. Data on this indicator are contained in Table 3. In the period 2014-2021, this share is very low in some countries, while it is high in countries such as China, France, Turkey, and the United States. As the USA is a country that allocates a higher share to defense expenditures in total budget expenditures (Table 1), it is observed that it shows a higher share to defense R&D expenditures. Some countries, such as China, have increased their defense R&D while decreasing their defense spending.

Both the EU (27) and the OECD average increased in 2021 compared to 2014. While the EU (27) average was 3.78% for 2021, the OECD average was 19.09%. The EU (27) average is significantly lower than the OECD average. There are two factors that affect this result. Firstly, it is the Decoupling of the UK, which has the highest share in defense R&D among the EU countries, from the union. Another factor is that the United States allocates a lot of funds for defense R&D in order to maintain its leading status in the world in the military field.

**Table 3:** The Share of Defense R&D Expenditures in Total R&D Expenditures (%)

Country	2014	2015	2016	2017	2018	2019	2020	2021
Austria	0,04	0,03	0,09	0,17	0,18	0,18	0,15	0,17
Australia	6,53	7,72	7,38	7,37	7,23	6,21	6,18	6,42
Belgium	0,15	0,10	0,09	0,09	0,10	0,14	0,70	0,82
Canada	2,89	2,57	2,24	..	..	..	..	..
Chile	0,03	0,02	0,04	0,02	0,00	0,00	..	..
Czechia	1,41	1,32	1,18	1,26	1,17	1,07	0,99	0,83
China	2,56	2,53	5,25	6,44	6,96	9,83	8,07	7,97
Denmark	0,31	0,32	0,33	0,32	0,31	0,32	0,32	0,35
Estonia	1,33	1,49	2,27	1,88	3,38	1,74	2,39	2,23
Finland	2,14	1,86	1,93	2,21	2,43	2,47	1,98	2,15
France	6,63	7,18	7,17	7,97	6,74	7,48	8,56	10,66
Germany	3,83	3,12	2,68	3,83	3,25	4,35	4,20	4,34
Greece	0,12	0,09	0,92	1,75	1,73	1,55	1,55	1,39
Hungary	0,15	0,60	0,13	0,40	0,03	0,03	0,29	1,17
Iceland	0,00	0,00	0,00	0,00	0,00	0,00	..	..
Ireland	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Israel					13,43	13,25	12,08	-
Italy	0,83	0,75	0,62	0,60	0,61	0,59	0,48	0,51
Japan	4,42	4,36	2,97	2,74	2,18	2,25	1,39	1,39
South Korea	13,48	13,48	14,01	15,00	15,81	16,29	16,62	..
Latvia	0,02	0,10	0,25	0,15	0,15	0,27	7,04	2,21
Lithuania	1,83	1,93	2,66	..	..	..	..	1,61
Luxembourg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Mexico	0,17	0,16	0,15	0,16	0,15	0,21	0,21	0,21
Netherlands	1,22	1,26	1,24	1,10	1,18	1,25	1,93	1,58
New Zealand	0,00	0,00	0,00	0,00	..	..	..	..
Norway	3,98	3,79	3,68	3,45	3,50	3,00	2,94	3,10
Poland	4,77	5,05	15,49	9,24	5,83	4,69	3,53	5,00
Portugal	0,34	0,32	0,31	0,32	0,36	0,29	0,24	0,24
Slovak Rep.	1,37	1,88	1,53	1,69	1,85	2,35	1,97	1,93
Slovenia	0,21	0,21	0,16	0,28	0,29	0,60	0,59	1,11
Spain	1,26	1,42	1,00	1,08	0,94	1,49	1,38	0,96
Sweden	3,75	3,34	3,42	2,20	2,38	2,82	2,52	2,20
Switzerland	0,48	0,42	..	0,34	0,35	0,38	0,41	0,57
Turkey	11,36	10,69	13,07	17,33	20,01	18,72	13,38	28,39
England	16,85	16,13	15,79	15,01	14,04	8,45	8,45	..
US	40,99	41,60	42,65	43,55	46,72	46,92	47,14	47,12
AB 27 Avg.	3,02	2,84	2,94	3,32	2,84	3,39	3,43	3,78
OECD Avg.	17,65	17,95	18,69	18,58	20,26	19,85	18,97	19,09

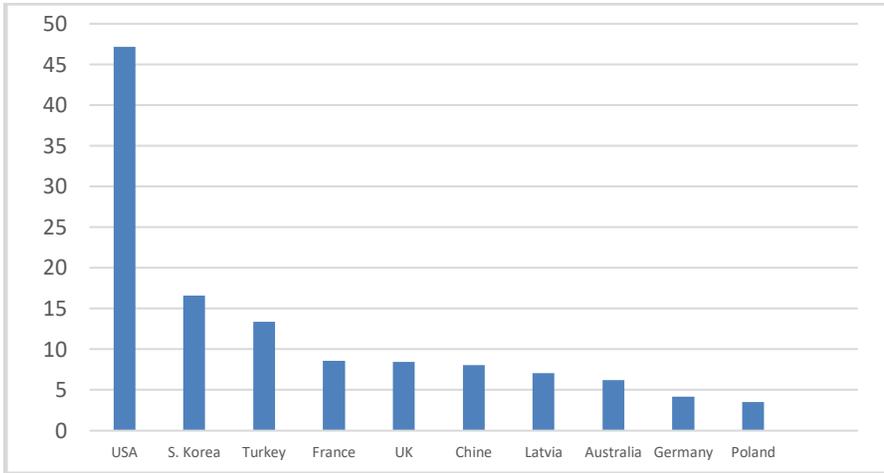
Source: OECD, Research and Development Statistics (RDS) Database, [https://stats.oecd.org/Index.aspx?DataSetCode=GBARD\\_NABS2007](https://stats.oecd.org/Index.aspx?DataSetCode=GBARD_NABS2007)

The ranking of the top 10 countries with the highest share in total R&D expenditures is shown in Figure 1. The country in first place is the USA. South Korea is in second place, while Turkey is in third place. Then France and England are following these countries. Turkey ranked second between 2017 and 2019. In addition, there has been a significant change in the way of growth in Turkey in the 2000s. For example, the share of defense R&D expenditures in total R&D expenditures in Turkey increased from 11.36% in 2011 to 28.39% in 2021.

As can be seen from the data in Tables 2 and 3, the United States is the country with the highest defense R&D like defense expenditures. In the 2000s, the United States provided about two-thirds of its total annual R&D expenditure to companies engaged in defense R&D. Since the Second World War, the United States has maintained the status of having the highest level of defense R&D expenditures in the world. After the Second World War, the increase in funding for American military science and technology has been unprecedented in world history. In addition, the ministry of defense supported research on semiconductors and became the first key customer of the new technology. This situation has prepared the ground for the development of the Internet. Today, as can be seen in Table 3, the United States provides significant resources to defense R&D. However, unlike the EU countries, the US devotes 40% less resources to areas other than defense than the EU (Steinbock, 2014: 4-5).

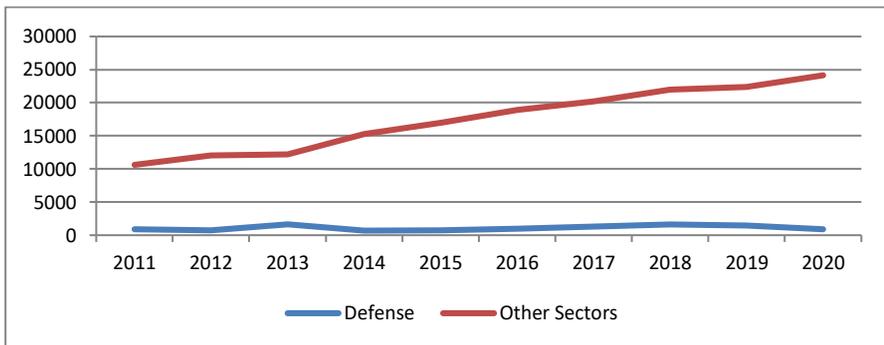
Turkey is among the countries that allocate high resources in defense R&D as well as in defense expenditures Turkey's high ranking in defense R&D, especially in the field of defense, in order to increase the market, share in international markets in the field of defense, to diversify the product portfolio of the defense industry in order to support the policies have had the effect.

**Figure 1:** Countries with the Highest Defense R&D Budget (2020, %)



It is observed that countries such as China, South Korea, as well as Turkey, attach importance to R&D activities in order to provide advanced technology in the defense industry. Although there has been a significant increase in defense R&D in Turkey in 2000s, it can be said that there is still a significant difference compared to R&D expenditures in other sectors. In addition, there is no parallel between the budget of defense R&D expenditures and non-defense R&D expenditure budgets in all years (Figure 2). Based on the fact of the importance of high technology in the defense industry in Turkey, it would be useful to allocate more share to defense R&D.

**Figure 2:** R&D Expenditures in Defense and Other Sectors (Million U.S. Dollars)



**Source:** OECD, Research and Development Statistics (RDS) Database has been prepared using the information.

It is seen that there is a parallel between the importance that countries attach to defense R&D and the development of this industry. This situation is observed in the ranking of defense companies around the world. As can be seen in Table 4, US companies are in the first place. Although the US allocates large resources to defense R&D studies, it is initially seen as a burden for the state budget, it is seen that it can compensate a larger part of the resources through sales to other countries. The UK is another country in the top 10 with a company. China, which has shown increases in defense R&D expenditures, has managed to take part in this ranking with three companies. All three countries are countries with high defense R&D.

**Table 4:** Defense Industry Companies Ranked in the Top 10 in the World (2020-2021)

2020	2021	Company	Country	2020 Defense Revenue	2021 Defense Revenue	Defense Revenue Change %
1	1	Lockheed Martin	USA	62,562.00	64,458.00	3
2	2	Raytheon Technology	USA	42,000.00	41,852.00	0
3	3	Boeing	USA	32,400.00	35,093.00	8
4	4	Northop Grumman	USA	31,400.00	31,429.00	0
5	5	General Dynamics	USA	29,800.00	30,800.00	3
6	6	Aviation Industry Corporation of China	China	25,468.59	30,135.22	18
7	7	BAE Systems	UK	23,502.38	25,775.20	10
10	8	China State Shipbuilding Corporation Limited	China	16,017.53	18,517.72	16
8	9	China North Industries Group Corporation Limited	China	15,249.27	17,711.93	16
9	10	L3 Harris Technologies	USA	14,936.00	14,924.00	0

**Source:** DefenseNews, 2022. <https://people.defensenews.com/top-100/>

## CONCLUSION

Defense services have always been a topic on the agenda of countries. Lastly, despite the end of the cold war, defense is still a priority area for countries, as seen in the Ukrainian-Russian war. These developments show that the cold war has turned into a new dimension. In 2021, the countries with the highest share of defense expenditures in total public expenditures in OECD countries; Israel, G. It is listed as Israel, S. Korea, Colombia, USA and Greece. The provision of defense services at a level that meets the expectations of countries largely depends on the defense industry potential

that countries have. Technological developments in the world have enabled the transition from traditional production to technology-intensive production in the field of defense. Globalization has accelerated this process. Countries are trying to provide the necessary equipment for defense from their own domestic market and to gain a foothold in the world defense markets. This situation will reduce the economic and political dependence of countries on foreign countries, as well as contribute to the country's economy. Nowadays, the defense power of a country is determined by high-tech defense rather than the numerical quantity of military equipment. The fact that countries have strong defenses largely depends on their provision of high-tech defense. The realization of these objectives depends on the expansion of R&D activities in the field of defense. Developing countries are also making efforts to increase their defense capabilities to the level that developed countries have. Although there are economic and cultural political differences between countries, each country unites in developing defense R&D when it comes to creating a military force equipped with advanced technologies. R&D carried out in the military field can create a positive impact on the civilian sector. The civilian applications of the innovation formed as a result of defense R&D will increase productivity in the civilian sector. The benefits of defense R&D on the civilian economy can be in the form of providing technology transfer to the commercial sector (spin-off) and spreading positive externalities (spillovers). Technology transfer was more relevant in the 1950s. With the influence of new developments in technology and the policies followed in the field of defense in the world, defense R&D has supported the “dual use” policy in the civilian sector. Today, defense production and research are increasingly intertwined with civilian activities. Studies on this subject also focus on dual use. Defense R&D investments have influenced innovations in civilian economies more broadly in several OECD countries, including the United States, the United Kingdom and France

When OECD countries are compared in terms of the funds by governments for defense R&D, the top ten countries are the USA, South Korea, the UK, Germany, France, Turkey, Japan, China, Australia and Sweden. Another indicator that will be used to measure the resources allocated to defense R&D in the budgets of countries is the share of defense R&D expenditures in total R&D expenditures. While this share is very low in some countries, it is high in countries such as China, France, Turkey, the USA and the UK. The United States is a country that allocates a higher share of defense expenditures in total budget expenditures, as well as a high share of

defense R&D expenditures. In addition, in the USA, about two-thirds of the total annual R&D expenditures were allocated to companies engaged in defense R&D in the 2000s. Although the US defense industry has allocated large resources for R&D studies, it can get back a larger part of the resources it spends with the sales it makes to other countries. In the countries that are in the top ten in the ranking of defense companies around the world, the USA is mainly located. British and Chinese companies have taken placed among these companies. Looking at the country's practices, considering the contribution of the high-tech defense industry to both the country's defense and the benefits it will provide in the economy in general, it can be said that allocating more resources to defense R&D, especially in developing countries, will be beneficial.

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## CHAPTER 3

### ECONOMIC ANALYSIS OF PIPELINE GAS TRANSITIONS FROM EASTERN MEDITERRANEAN TO EUROPE

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## INTRODUCTION

Europe's so-called diverging from Russian gas becomes evident particularly in times of geopolitical conflicts when Russia cuts NG flow to Europe. This was experienced two times due to conflict with Ukraine since 2006 (Pascual and Zambetakis, 2009) and now Europe faces the third one which has turned into a war due to the United States' (US) strategy of encircling Russia from East and West.

Dividing East and West, Ukraine with high Russian influence is located on the geopolitical fault line. Russia's intervention of Ukraine took place after US and NATO activities in Ukraine broke this line. This caused economic sanctions against Russia which turned into an energy crisis for Europe as gas flows to Germany via the Nord Stream line have declined to less than 20%. While supply and stock problems could not meet the increasing demand in Europe, the tension created by the northern flow paved the way for astronomical increases in gas prices. Gas supply and price volatility in the European gas markets (see Appendix A) has become uncertain (EC, 2022a). These recent developments have put Europe's energy security at risk and is likely to reflect on economic growth. Thus, alternative gas resources were needed to avert economic crisis.

The large quantities of proven gas reserves in the EM offshores had impelled suppliers to transit extra gas to a hub in Southern Europe (Ruble, 2017). Israel, the only country in the region to meet domestic demand and export extra gas (see Appendix C), needed a gas market for export, and diversification was the main driver of the EU gas policy (Mekhdiev et. al., 2018; Troulis, 2019). Although availability is five times less than the amount of Russian gas regularly supplied, any form of gas supply from wellheads of the Eastern Mediterranean offshores is vital for Europe's economy due to NG shortage. Germany signed gas deal with Egypt and Israel for LNG supply. Leviathan and Aphrodite pipeline gas liquefied at Idku and Damietta were transported to Europe. Egypt increased LNG exports to Europe by about 150% in the first half of 2022 (El Sawy, 2022). Although demand for LNG is high due to geopolitical conflict in Ukraine, it can be stabilized once the conflict ends. Subsequently, demand for NG via pipeline including Israeli NG exports may increase in the long term.

Previous research has demonstrated that for additional NG supply, the EM offshore gas reserves with a capacity of 15.50 billion cubic meters per year (bcm) are available. This can meet a maximum of 4.50% of total demand of Europe which is equivalent to 10% of Russian gas dependency.

Only from Leviathan field about 311 bcm of proven reserve will be available for exports after local needs are met and also 129 bcm from Aphrodite (BDO, 2017; Kozma, 2020). Ruble (2017) reported that potentially large quantities of NG was available for exports. Thus, NG or LNG is sufficient for transition to Europe if Greek Cyprus's Aphrodite and Israel's Leviathan NG sources jointly operate to meet the export capacity.

In the presence of energy crisis due to NG shortage, the EU countries increased LNG exports to ensure energy security. Global LNG export to Europe increased by 75% since March 2022 compared to 2021 (EC, 2022b) (see Appendix B). The United States (US), Qatar and Egypt are already supplying LNG to Europe. The 80% contracted Qatar needs to increase its gas production for more LNG supply. However, these supplies all together can meet only half of the demand. Therefore, Europe has to increase domestic production and import more pipeline fuel to fill gas storage plants to 90% survival level, according to IEA executive director Fatih Birol. Algeria plans to supply Europe 11 bcm/y NG equivalent LNG through Morocco and Spain (Calik, 2022). Unfortunately, the US and Qatar LNG supplies to Europe seem to be in the grip of long-term contracts (Stapczynski and Ratcliffe, 2022). This is an indicator of another dependency for Europe. Long term LNG contracts are also against the diversification policy and reduction in methane emissions.

Does Europe plan for a subsea pipeline from Egypt to Europe through Greece instead of the EM pipeline? Considering that the US has withdrawn from the EM pipeline project due to high costs, this option is uncertain as it may cost as much as the EM pipeline but has no EEZ conflict. If both the EM and one of the Turkish pipeline projects are to be implemented, a win-win strategy will give Turkey and Greece an opportunity to become gas hubs. Turkey with its existing pipeline infrastructure (see Appendix D) has a potential to become a gas hub in the region. On the other hand, although Cyprus did not have a capacity to carry the EM gas to Europe, a pipeline and LNG terminal at Vassilikos were under construction. However, gas transition through Turkey would be faster and cost effective. Thus, one Turkish transit pipeline route of which the Leviathan-Mersin lag is proposed by Delek Group (2020) is proposed. Mersin is particularly proposed as transition hub because of its geopolitical position as having the shortest distance to Turkish Cyprus with no EEZ conflict and short distance to TANAP pipeline at Seyitgazi. Previously proposed and evaluated two transitions, the EM pipeline and Egypt-Cartagana LNG shipping, are also included. LNG destination to Cartagana of Spain was proposed and economically evaluated using oil linked

NG prices (Mavruk, 2021). The first is reevaluated and the latter is adopted for comparison purpose. Previous research has also demonstrated economic values of proposed pipelines. For example, the cost for the EM pipeline was estimated to exceed \$5b in 2013 (Paltsev et al., 2013), and \$10b in 2020 (Ellinas, 2020). Aphrodite-Anamur pipeline was the most competitive option, amounting only to 10% of the cost of LNG (International Crisis Group, 2012), for which NPV was estimated as \$5.21b at 12% discount rate (Pourbozorgi & Çelik, 2014). In 2013, Turcas proposed construction of a direct pipeline from Iskenderun to Israel's Leviathan field. Such a pipeline could move up to 565 billion cubic feet (bcf) of dry gas per year and could be built at a cost of \$2.5b to \$4b (Azran and The Marker, 2014).

The purpose of this study is to estimate economic values of pipeline gas transitions from the Eastern Mediterranean offshore resources to Southern Europe in the presence of energy crisis in Europe. Net present values of seven pipelines are estimated. To determine which transition is more economically feasible for Europe, we have used two different price models and six different cost models to estimate net present values of seven natural gas pipelines six of which through Turkey and one through Greece. The study focuses on economic values of Mersin pipeline and the Eastern Mediterranean pipeline. Subsequently, each is compared with liquefied natural gas shipping from Egypt to Cartegana of Spain.

The rest of the article is organized as follows. In Section 2, cost and benefit models of economic evaluation are introduced. In Section 3, possibility of transitions, Europe's gas demand, proven NG potential in the EM offshores and NG pipeline infrastructures are discussed. In Section 4, economic values are estimated, and in the last section, the study concludes with some implications and suggestions.

## **1. METHODOLOGY**

The majority of papers analyzing economic value of NG transport projects via pipeline use NPV, cost/benefit analysis and internal rate of return. All these models are related to cost and benefit, and determine economic feasibility of pipeline projects. Benefits are usually estimated based on NG import price forecasts which may vary due to energy price volatility. Cost is estimated based on financial, capital (material, compressor), operating (working, fuel), feedstock, transit and hub costs. The key determinants of pipeline construction costs are diameter of pipeline, operating pressures, number of compressor stations, distance and terrain. Material (cost of steel)

and labour cost are two of the most important considerations as they constitute approximately 70-80 percent of the total construction cost (Przybyło, 2019). In this study, only NPV is used for economic evaluation which is the sum of the differences between discounted benefits and discounted costs over the number of years in a project period. Benefits are simply considered as revenues that can be generated during a project period. A project is economically viable if  $NPV > 0$  (Tangvitontham and Chaiwat, 2012). In all economic evaluations in this article, \$ represents USD, b billion and m million.

For economic evaluation, NPV was calculated by (1)

$$NPV = \sum_{t=0}^k \frac{B_t - C_t}{(1+i)^t} \quad (1)$$

where  $B_t$  is benefit and  $C_t$  cost for k years and  $i$  is the discount rate. NG revenue was estimated by (2) where NG transport volume was bcm per year and price was NG import price forecast in \$ per million British thermal units (\$/mmBtu). LNG revenues were estimated by (3) where LNG liquid cubic meter was equivalent to 23.12 mmBtu (Oxford Energy, 2018).

$$B_{t_{NG}} = NG \text{ transport volume} * NG \text{ price} / 28.26 \quad (2)$$

$$B_{t_{LNG}} = LNG \text{ transport volume} * NG \text{ price} / 23.12 \quad (3)$$

The financing cost was calculated by the number of years (t) times the fixed annual repayment or annuity (A) which was calculated using (4)

$$A = \frac{Pi}{1 - (1+i)^{-n}} \quad (4)$$

where P amount loaned,  $i$  interest rate, and  $n$  number of annuities and  $\frac{i}{1 - (1+i)^{-n}}$  was the capital recovery factor (Ruble, 2017). We assume that 50 percent of capital cost of proposed projects will be financed and loan will be paid back in ten years in USD. Considering pipeline project financing was approved in 2017 and might continue until 2024, a fixed annual interest rate of 1.50 percent was used in all proposed pipeline projects. According to Eurostat (2021), for new loans to corporations, average composite cost of borrowing indicator was 1.48 percent in the first six months of 2021.

Worldwide offshore pipeline projects were nearly twice more expensive than similar onshore projects. The capital cost of a gas pipeline included material, gas compressor, gas turbine and accessory costs. The last was a percent of the sum of the first three, which includes supervisory control and data acquisition and telecommunication, mainline valve, right of ways, engineering construction and management, environmental and permitting and contingencies (Aziaka, Tukur and Pilidis, 2019). Energy- and cost-efficient X80 linepipes were used for cost estimations. A deepwater cost/benefit analysis in 2019 by Steel Lazy Wave Risers indicated a 20% reduction in pipeline weight and an 11% reduction in material cost compared to X65. Lower weight decreases labour and maintainance costs (Klimpel, 2014).

An onshore pipeline development (capital) cost could be estimated using formula (5) of which the first term was material cost and the others were compressor costs.

$$C = 0.8(42675)\mu\delta + 3 * 10^7\alpha + 1500d\alpha \quad (5)$$

where  $\mu$  is the diameter (inches),  $\delta$  length (km),  $\alpha$  number and  $d$  power of the compressor stations estimated for each station (Sadeghi et al. 2017) at 100 mw (134102 horsepower), 110 mw (147400 horsepower) and 120 mw (160923 horsepower).

Operating cost in (6) was the sum of working costs and fuel cost. The working cost was a percent ( $\tau$ ) of the capital cost ( $C$ ) that was  $C\tau$  for an onshore pipeline.

$$O_p = C\tau + (1 - (1 - \kappa)^{\delta/\eta})NP \quad (6)$$

$\kappa$  is the rate of the NG utilized as fuel for the compressor stations (0.05 percent),  $N$  volume of NG (cm<sup>3</sup>),  $P$  cost of NG (\$/cm<sup>3</sup>),  $\eta$  distance (km) between the compressor stations.  $\kappa$  varies for common onshore pipeline (Ulvestad and Overland, 2012).

The feedstock costs depends on the extraction costs and processing costs which increased one and a half times Salameh and Chedid (2020)'s numbers. Feedstock cost of Sadeghi et al. (2017) was about three and a half times less and transit fees about four times less compared to today's prices. The two authors adopted a value of \$3/mmBtu, which was also used by Ruble (2017). We adopted \$4.50/mmBtu Leviathan well-head cost as the average

extraction cost for the gas in the Eastern Mediterranean region, which was equivalent to 15.84 cents per cubic meter. In our economic evaluation, we included feedstock costs of \$3.50, \$4.00 and \$4.50 for each year using formula (7).

$$F_c = \text{Cost (cents per cubic meter)} * \text{Volume of NG transport (bcm)} \quad (7)$$

Sadeghi et al. (2017) estimated NG transit fee between Iran and Europe as 7.10 cents per m<sup>3</sup> per 1000 km and Salameh and Chedid (2020) as 6.80 cents per m<sup>3</sup> per 1000 km between Lebanon and Egypt. Thus, we adopted the first to calculate transit fees using (8).

$$T_f = \text{Transit fee (cents per cm per thousand km)} * \\ \text{Volume(bcm)} * \text{Distance(km)} \quad (8)$$

Hub costs were also adopted from Salameh and Chedid (2020). A hub member pays €15200 per year for membership, €4350 per year as technical fees per license, and €0.005 per mwh as standard transaction fees based on NG volumes. We used Hebrew Energy (2021) conversion rates to find bcm equivalent of mmBtu for hub cost estimation. We used 50 percent plant efficiency which means 6.824284 mmBtu/MWh. To convert from bcm to MWh, we used 1 bcm=35714286 mmBtu and 1mwh=6.824284 mmBtu in 50 percent of efficiency, which gives 1 bcm=5233411 MWh approximately. Thus, 10 bcm equivalent 52334115 MWh was used for the first year hub cost estimates.

## 2. DATA

Data of this study includes NG price, amount of NG for transport, financial, capital, operating, feedstock, transit and hub costs. NG price data is generated based on the 2016 EU NG import price forecasts (\$/mmBtu) of World Energy Outlook (WEO ) for the 2025-2044 period. We found these forecasts to be more realistic than the others in which NG prices were below 2021 average floor gas price in Leviathan. This makes sense since increasing inflation will increase all costs.

The estimated NG prices increase to \$8.70/mmBtu by 2025 and \$11.98/mmBtu by 2044. Volume of gas to be transported was assumed to be

10 bcm in 2025 and doubled for the second phase starting in 2035 based on the EM pipeline project. The results of these estimations for the 2025-2044 period are shown in Table 1. Lifetime of gas reserves seems to be 25 years with local use and exports if no other reserve is explored.

**Table 1:** Natural Gas Prices for the 2025-2044 Period

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Price (\$/mmBtu)	8.7	9.02	9.34	9.66	9.98	10.3	10.42	10.54	10.66	10.78
Price (\$/m <sup>3</sup> )	0.308	0.319	0.331	0.342	0.353	0.365	0.369	0.373	0.377	0.382
Year	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Price (\$/mmBtu)	10.90	11.02	11.14	11.26	11.38	11.50	11.62	11.74	11.86	11.98
Price (\$/m <sup>3</sup> )	0.386	0.390	0.394	0.398	0.403	0.407	0.411	0.415	0.420	0.424

All costs and benefits are discounted at the US prime rate (best interest rates) for which long term forecasts were between 3.50 and 5.75 percent for the 2025-2031 period. The 2025 average was forecasted as 3.775 percent (YCharts, 2021b). We assumed that the prime rates would be constant at 5.75 percent up to 2044. Thus, we used these as discount rates for economic evaluation of the proposed transports of this study for the 2025-2044 period.

For pipeline construction, distance between compressors was assumed to be 192 km based on previous studies. For the EM pipeline nine compressors and for Mersin pipeline eight compressors were assumed. Data is replicated based on minimum, mean and maximum gas prices, different number of compressors, feedstock costs and discount rates after NG prices and different feedstock costs converted to (\$/m<sup>3</sup>) to match bcm volumes to be transported.

Figure 2 shows proposed six NG pipelines, five of which via Turkey and one via Greece. Of these via Turkey, three have a first segment as an offshore pipeline extending from Aphrodite and Leviathan to Anamur, Mersin and Iskenderun, one from Haifa to Yumurtalik which were proposed to counterbalance the EM pipeline. All these are subsequently ending in Melendugno. The fifth is an extension of Arab pipeline through TANAP and Nabucco NG pipelines to Baumgarten an der March. White line from Egypt to Cartegana shows LNG line. Cartegana is in the breakeven distance of the cost of LNG and NG transport from the EM region. Transport distances are

measured using Google Earth. Distances and routes of NG pipeline and LNG to Europe are described in Table D1 (see Appendix D).



**Figure 2:** Proposed NG pipelines and LNG route to Europe (Source: Own work via Google Earth)

### 3. ECONOMIC VALUES

Feedstock and hub costs are fixed for every pipeline evaluation. For example, hub cost was \$0.332m for the first year and \$11.38m over the 20 year period 2025-2044. Similarly, at 5.75 percent discount rate feedstock cost was \$1592m for the first year at \$4.50/mmBtu and \$31200m over the 20 year period. However, NG prices are not fixed over the forecast period. Volume to be exported also varies over the project period. The EM pipeline was expected to transport 10 bcm of gas in the first stage and to increase the capacity to 20 bcm in 2035. Annual volumes and export prices of NG are assumed to be the same for all pipelines. The amount of pipeline gas export is assumed to be the same as the LNG alternative.

We did not show economic value of Haifa-Yumurtalık pipeline because it was about the same as Leviathan-Iskenderun pipeline. The 2016 World Energy Outlook's New Policies Scenario forecasted that by 2025 gas prices would increase to \$8.70 per mmBtu in Europe and prices would reach \$11.50 per mmBtu by 2040 (Ruble 2017).

NG export revenues at different prices with respect to volume of exports are shown in Table 3 which represents revenue estimations from (5)

using the European Union NG import price forecasts by WEO (2016). Revenue for 2025 was estimated as \$3079m. Average of 2025 and 2040 forecasts, \$8.70 per mmBtu (\$0.3079/m<sup>3</sup>) and \$11.50 per mmBtu (\$0.4069/m<sup>3</sup>) were used to find annual average increase in NG prices. Approximately \$0.12 per mmBtu increase per year was assumed over the 2025-2044 period. These revenues were the same for all proposed pipelines in this article.

**Table 3:** Natural Gas Revenues

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Volume (bcm)	10	12	13	14	15	16	17	18	19	19.5
Price (\$/m <sup>3</sup> )	0.308	0.319	0.331	0.342	0.353	0.365	0.369	0.373	0.377	0.382
Revenue (million\$)	3079	3830	4297	4785	5297	5832	6268	6714	7167	7439
Year	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Volume (bcm)	20	20	20	20	20	20	20	20	20	20
Price (\$/m <sup>3</sup> )	0.386	0.390	0.394	0.398	0.403	0.407	0.411	0.415	0.420	0.424
Revenue (million\$)	7714	7800	7884	7968	8054	8138	8224	8308	8394	8478

Working cost was assumed as 3.50 percent of capital cost. Total capital cost was estimated as \$7.07b. Leviathan-Mersin segment was evaluated. Distances between two compressors are assumed as 192 km. Total capital cost, the sum of all construction costs, was \$6.66b. We assumed that Seyitgazi-Melendugno pipeline existed. Thus, we excluded it from the total cost which made \$3.55b, but we included it in the total to estimate operating cost.

Table 4 shows cost estimation results (million\$) for nine pipelines including their segments at 4.50/mmBtu feedstock cost over the 20 year period. The costs were discounted at 5.75 percent which was forecasted as constant up to December 2031.

**Table 4:** Cost Estimations of Pipelines

	EM	LM <sup>e</sup>	LMM <sup>f</sup>	AA <sup>g</sup>	AAM <sup>h</sup>	HaiY <sup>i</sup>	LJ <sup>j</sup>	LIM <sup>k</sup>	Arab+
Operating Cost	6449	3276	3959	1377	4389	1486	1486	4554	12203
Transit Cost	8348	0	24140	974	23880	0	0	24140	51952

Hub Cost	11	11	11	11	11	11	11	11	11
Feedstock Cost	31200	31200	31200	31200	31200	31200	31200	31200	31200
Financing Cost	2855	1183	1434 <sup>a</sup>	811	1367 <sup>b</sup>	980	980	980 <sup>c</sup>	5706 <sup>d</sup>
Capital Cost	7070	1812	3549 <sup>a</sup>	1667	3589 <sup>b</sup>	2262	2262	2262 <sup>c</sup>	10524 <sup>d</sup>
Total	55933	37482	64293	36040	64436	35939	35939	63147	111596

<sup>a</sup>For Leviathan-Seyitgazi. <sup>b</sup>For Leviathan-Ahiboz. <sup>c</sup>For Leviathan-Iskenderun lag. <sup>d</sup>For Homs-Baumgarten an der March. <sup>e</sup>Leviathan-Mersin. <sup>f</sup>Leviathan-Mersin-Melendugno. <sup>g</sup>Aphrodite-Anamur. <sup>h</sup>Aphrodite-Anamur-Melendugno. <sup>i</sup>Haifa-Yumurtalik. <sup>j</sup>Leviathan-Iskenderun. <sup>k</sup>Leviathan-Iskenderun-Melendugno.

High feedstock and transit costs require high NG prices for the pipeline projects to be economically feasible. If pipeline transit fee was waived, the developer firm revenues would substantially increase. For example, with LeMerno project, developer firms could save about \$26b over the 20 year period. This figure would be about the same for the other possible pipelines through Turkey to Europe.

Experts reported 2020 wellhead price at Leviathan to be \$4.50/mmBtu. With 2025-2030 NG price forecasts \$5.10-\$7.00/mmBtu and 2020 costs, no new pipeline project seemed to be economically viable. With feedstock cost at \$4.50/mmBtu (15.92 cents/m<sup>3</sup>), pipelines were feasible for the project period except for the Arab pipeline. At this cost and minimum NG price no pipeline project was economically feasible.

**Table 5:** Economic Values

Price	Feedstock cost	The EM pipeline			LMM pipeline			Egypt-Cartegana LNG				
		3.5	4	4.5	3.5	4	4.5	2.30	2.55	2.82	Liq. Cost	Price
10.30 mean	NPV	1.6	0.4	-0.8	.004	-1.2	-	21.3	17.3	13.4	NPV	14.17 Mean
11.98 max	NPV	26.9	23.5	20.0	16.0	12.6	9.1	53.3	47.0	40.6	NPV	19.89 Max

Table 5 indicates NPVs (\$billion) of the proposed transitions at 5.75% discount rate and different feedstock costs (\$/mmBtu), which were projected to increase. At the minimum price and 3.775 percent discount rate (2025 average) for all feedstock costs, both pipelines had no economic value. Table 5 also shows economic values of LNG transport from Egypt to Southern

Europe which includes a gas pipeline from Leviathan wellhead extending to Egypt and two LNG carriers from Idku and Damietta to Cartegana of Spain. The updated costs (\$/mmBtu) of LNG supply to Europe were feedgas 4.50, liquefaction 2.82, transport 0.43, regasification and grid 0.70 and wage: 0.03. Thus, total unit cost was \$8.48/mmBtu (Mavruk, 2021). Economic values of LNG were estimated at the minimum, mean and maximum prices, 5.75 percent discount rate and different liquefaction costs. The results indicated that LNG had no economic value at the minimum price. NPV was estimated as \$13.40b at the mean price. When compared with the offshore EM gas pipeline, the NPV of LNG was \$14.15b higher at the mean price and \$20.6b higher at the maximum price. The EM project would start having an economic value in 2031 at \$10.42 NG price whereas Turkey route in 2036 at \$11.02 price. In both, internal rate of return was greater than discount rate (not shown).

## CONCLUSION

Geopolitical conflict between Russia and Ukraine escalated tensions to international level, which caused uncertainty in gas supply and price volatility in the European gas markets. Economic sanctions against Russia cut off NG flow to Europe, which diverted Europe to gas alternatives from Eastern Mediterranean offshores such as LNG and pipeline NG. To determine which one is more economically feasible, we have used two different gas prices (NG and LNG) and seven different costs. The pipelined NG prices were generated based on the EU NG import price forecasts and LNG prices based on brent crude oil spot prices.

Methodology is based on highly technical cost equations which include financing, operating, capital, hub, feedstock and transit costs whereas LNG cost included feedgas, liquefaction, transport, regasification and grid, and labour costs. Economic values of six pipeline gas transitions from the EM offshores to Italy through Turkey are estimated. Net present values of these transitions were about the same except for the Arab pipeline which was not economically feasible due to long distance and transit costs.

From suppliers sights, LNG transport has a twice better economic value than the EM pipeline and four times better economic value than a Turkish transit pipeline from the Leviathan and Aphrodite to Southern Europe. This occurs at the highest feedstock cost and maximum NG price in the final year of the project. When transit fee is waved, the proposed Turkish pipeline becomes more cost-effective compared to the EM pipeline. In short

term, no offshore pipeline project linked to Europe seems to be economically viable due to high costs. Gas prices are also projected to increase in the long term. Based on the NG import price forecast for Europe, the EM project seems to have an economic value in 2031 at the mean NG price and so does Turkey route in 2036 but at a higher price. It seems that breakeven gas prices will be in double digits for economic viability of a new pipeline project. The gap between breakeven gas prices of the three transitions increased as feedstock cost increased.

Due to pipeline NG shortage, Europe has to pay at least twice more for LNG than pipeline natural gas to avert economic recession. Diverting from Russian gas, the European countries will become dependent on the US and Qatar LNG for at least two decades. If gas shortage persists, economic recession will be inevitable. Consequently, economic well-being of European society will be diminished.

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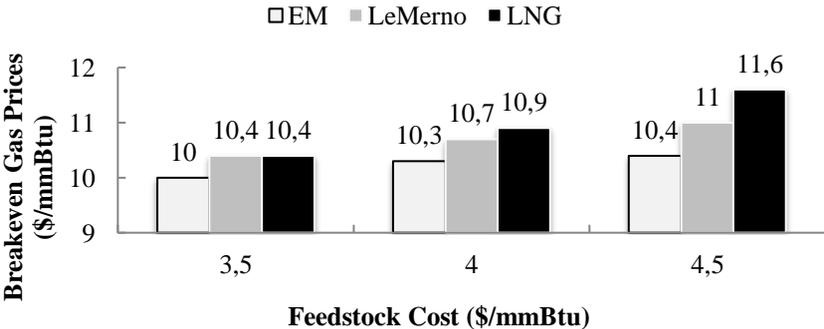
**APPENDIX A**

Spot prices on the European gas hubs remained high and volatile in 2022 Q1. As a five-fold increase year-on-year within a range of 95-100 €/MWh (14.20-14.95 \$/mmBtu) was observed, Dutch TTF price reached a high 183 €/MWh (27.35 \$/mmBtu) in 2022 Q2, according to European Commission, EC (2022a). In August 2021, the EU natural gas import price had jumped to \$15.49/mmBtu, an increase of 441 percent compared to August 2020 price of \$2.86/mmBtu (YCharts, 2021a). Substantially lower natural gas import price forecasts are reported while natural gas costs are increasing in the EM.

The EU natural gas import price increased about 4.50 times in the last year. According to Ellinas (2020), gas cost reached \$4.50/mmBtu at the Leviathan platform and the pipeline up to Greece cost \$3.50/mmBtu. Thus, NG price in Europe will need to be greater than \$8/mmBtu on average over a 20-year period between 2025-2044 to make the project profitable.

NG price change can be related to different factors such as crude oil prices, weather conditions, extraction costs, feedstock costs, labor costs, transport costs, quantities of supply and demand, natural gas storage (Gori, 2014), consumption due to population growth (Şengül & Tuncer, 2006). Increase in consumption may be related to low supply prices (Heidari, Katircioglu & Saeidpour, 2013), industrialization and urbanization (Gori, 2014).

Figure A1 illustrates approximate breakeven gas prices of pipelines and LNG at different feedstock costs. The gap between breakeven gas prices increased as feedstock cost increased. LeMerno in Figure A1 is used for Leviathan-Mersin-Melendugno.



**Figure A1:** Breakeven Gas Prices at Different Feedstock Costs

## **APPENDIX B**

NG and LNG demands and imports in Europe has been increasing. European commission (2022) reported that in the first months of 2022, the EU spent €78 billion on gas imports, of which €27 billion was on Russian gas imports. EU net gas imports increased by 10% during this period, whereas LNG imports were up by 72% year-on-year. According to IGU 2020 LNG World Report, NG gas import to Europe increased from 46.90 million tons in 2018 to 85.90 million tons in 2019. NG import requirements for Europe are expected to increase by 45 bcm (over 10 percent) in the next five years. Russia's pipeline exports to Europe are predicted to oscillate between 170-200 bcm, supplied through a combination of long-term contracts, short-term auctions and direct spot sales to the European hubs. About 86 percent of NG trading in Europe takes place in only two hubs - TTF in Netherlands and NBP in the UK (Inogate 2016). The EU plans to diversify the trade to more hubs. For example, Spain has the largest regasification capacity and increased its liquefaction capacity so that it can welcome gas supplies in either form. Italy is already connected to Trans Atlantic Pipeline (TAP), where the EM pipeline may join to support the supply to European gas network. Azeri gas supplies may increase by 8 bcm via TAP.

## **APPENDIX C**

Israel is the only country in the EM to meet domestic demand and to export extra gas. Israel's demand for NG is projected to be 20.50-35.30 bcm in the 2025-2040 period. Total local demand is about 505 bcm for the next two decades. Of this, 143 bcm from Leviathan and 60 bcm from Karish/Tanin and the remaining 302 bcm from Tamar. The remaining gas reserves in Leviathan is 621 bcm out of total 983 bcm including all other fields. Israeli gas export quota is maximum 50 percent due to 50 percent minimum supply requirement to local markets (BDO, 2017; Jones, 2013). Therefore, only about 311 bcm from Leviathan will be available for export, i.e. 15.50 bcm in the next two decades. This is exactly 10% of Europe's NG import from Russia in 2021 (Ingram, 2022).

The most significant two offshore natural gas fields in the EM are Zohr and Leviathan with estimated gas reserves of 850 bcm and 605 bcm. Other gas fields are Tamar 318 bcm, Calypso 170-230 bcm, Glaucus 142-227 bcm and Aphrodite 129 bcm. Zohr falls in Egypt EEZ and is the largest field in the EM. However, only about 400 bcm is available for export (Ruble,

2017). Estimated NG potential in GRC offshore reaches 60 tcf where Noble, Eni and Total have bid for blocs (Ayat, 2013).

Egypt is the only country to have two liquefaction plants in the Eastern Mediterranean (Kozma, 2020), namely Idku and Damietta. These LNG plants are operating for liquefaction with a capacity of 12.20 million tons per annum (mtpa). According to the alliance's project NG will flow from Leviathan and Aphrodite fields to these plants via an offshore pipeline and subsequently transported as LNG to Southern Europe. Sufficiency of gas in these fields for the transition was proven.

## **APPENDIX D**

Turkey's pipeline infrastructure exists for a possible transition to Europe. As of 2018 a map of natural gas pipelines in Turkey is provided by Ağralı, Üçtuğ and Türkmen (2018) which gives a clear map of possible connections for proposed transit pipelines through TANAP to Europe. This map shows that an NG pipeline exists from Mersin to Adana-Sivas route. However, there is no direct connection from Mersin to TANAP through Karaman. Leviathan-Mersin pipeline is to connect Mersin to Karaman-Konya-Afyon line and from Afyon to Seyitgazi (TANAP). If pipeline size is too small to carry Leviathan gas to TANAP, an independent pipeline 42"-48" can be connected to Seyitgazi which has 6 bcm/y entry capacity (Oxford Energy, 2018). Aphrodite-Anamur pipeline can be connected directly to Ahiözü (TANAP) through Anamur-Karaman line or to Seyitgazi through Anamur-Karaman-Konya-Afyon line.

1330 of 2465 km Leviathan-Mersin pipeline is assumed to be new construction. It may connect to TANAP in Seyitgazi which is 1135 km to Melendugno. Leviathan-Mersin pipeline starts at Leviathan passing through Eastern Mediterranean EEZ borderlines and ends at Mersin. We propose two possible routes for this pipeline to Italy; the first option is to connect to TANAP in Seyitgazi from Taşucu in Mersin and the second option is to directly connect from Mersin to existing TANAP through Adana-Sivas route. Italy connection exists through TANAP and TAP pipelines. On the first route, Mersin-Taşucu, Taşucu-Karaman, Afyon-Seyitgazi NG pipelines do not exist. However, Karaman-Konya-Afyon line exists in between. Depending on pipeline size it may be connected to existing line. Leviathan-Mersin lag was projected by Delek Group (2020).

GRC having NG sources and joint operations with Israel has a potential to become a gas hub in the region. However, being a transit country

already with 73 percent of World NG sources and three continents around, Turkey also has an unignorable geopolitic position to become a gas hub with its pipeline infrastructure and investments. Three cooperative projects of the EM gas resources were reported by Prontera and Ruszel (2017). Two of them were Israel-Turkey offshore pipelines with 5-11 bcm/y gas capacity due to scarce gas markets in the region with an estimated year of operation 2023-2025. All three pipeline projects are economically evaluated in this study.

**Table D1:** NG pipeline and LNG alternatives to Europe

Pipelines	Pathway	On/off shore	Through	Destination	Onshore length km	Offshore length km
EM	Leviathan-Vassilikos-Mediterranean sea-Crete-Agios Fokas-Gulf of Patras-Thesproita	Offshore	Crete	Greece	600	1300
Leviathan-Mersin	Leviathan-Mediterranean sea-Mersin	Offshore	Mediterranean Sea	Turkey	-	450
Leviathan-TANAP-TAP	Leviathan-Mersin-Taşucu-Seyitgazi-Kipoi-Fier-Melendugno	Offshore - Onshore	Levant-Turkey-Greece-Albania	Italy	1735	730
Arab connection-NABUCCO	Arish-Aqaba-Amman-Homs-Tripoli-Kilis-Sivas-Ahiboz-Baumgarten an der March	Onshore	Jordan-Lebanon-Syria-Turkey-Bulgaria-Romania-Hungary	Austria	2838	230
Leviathan-İskenderun	Leviathan-Mediterranean sea-İskenderun	Onshore	Mediterranean Sea	Turkey	-	480
Leviathan-TANAP+TAP	Leviathan-İskenderun-Yumurtalık-Sivas-Ahiboz-	Offshore - Onshore	Israel-GRC-Lebanon-Syria(Mediterranean Sea)-Turkey	Italy	2750	620

	Melendugno					
Aphrodite- GRC-TANAP- TAP	Aphrodite- Vassilikos- Girne- Anamur- Ahiboz- Kipoi-Fier- Melendugno	Offshore - Onshore	GRC-TRC- Turkey-Greece- Albania	Italy	1850	460
Haifa- Yumurtalık	Haifa- Yumurtalık	Offshore	Mediterranean Sea	Turkey	-	480
Leviathan- TANAP-TAP	Haifa- Yumurtalık- Sivas- Melendugno	Offshore - Onshore	Israel-Lebanon- Syria-Turkey	Italy	1950	585
Leviathan- IDKU	Leviathan- IDKU	Offshore	Israel	Egypt		430
Damietta&Idku -Cartegana	Mediterranea n sea	LNG ship	Mediteraanean	Spain	-	2887

Table D1 shows transit options and distances which are measured using Google Maps. Pipeline development costs are also estimated up to TANAP (Sivas, Ohiboz, Seyitgazi) and up to Yumurtalık and Iskenderun. The postponed Nabucco pipeline is connected to Arab line which existing infrastructure would take it over to final destination. Arab pipeline connection cost is estimated for Homs-Kilis and Kilis-Yıldızeli lines assuming the other parts exist. Existing part is that Gaziantep NG pipeline is connected to Adana-Sivas NG route and to TANAP.

But these are not the only pipelines to subsequently transport natural gas to Europe through Turkey. The Iraq-Turkey, Arab (3-5 bcm) and Turkmenistan NG pipelines (Anadolu Agency, 2013) are other options. Baku-Tbilisi-Erzurum NG pipeline flowing (6,6 bcm), and Iran (a capacity of 10 bcm) and Blue Stream with a capacity of 16 bcm (TR MFA, 2009) would support the gas transition to Europe. Thus, the sum of supplies would be greater than the proposed transport volumes of NG over the 20 year period given that the difference between production plus imports and consumption plus export commitments is positive. All these show enough evidence for sufficient gas supply through Turkey to Europe. From the resource, technical, commercial and market sights, Turkey route project is economically feasible and has low or no risks. However, multinational political issues are mainly the obstacles (Akyener, 2016).

**CHAPTER 4**

**USING BETA REGRESSION TO INVESTIGATE THE  
FACTORS AFFECTING UNEMPLOYMENT IN TURKEY**

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## INTRODUCTION

Unemployment is a fact that should be taken into account for the growth of the nation and is a significant economic variable for economic decision-making units. The proper presentation of the measures that will aid in lowering unemployment and increasing employment is crucial. It is possible to claim that Turkey's fundamental economic issues and the adopted macroeconomic policies are the root causes of the country's unemployment issue. There have been several research on the variables influencing the unemployment rate. These variables include inflation, interest rates, currency exchange rates, exports, the industrial production index, and others.

Boz (2013) analyzed the real exchange rate effect on unemployment in Turkey for 2003:1-2012:3. Real exchange rate and unemployment were shown to be negatively correlated in the study, which took into account the unemployment rate as a function of national income, labor force, and real exchange rate. Results that support the idea have been produced, and it has been determined that rising real exchange rates have a decreasing influence on unemployment. In addition, Güney and Balkaya (2019) investigated the effects of income, price, real effective exchange rate and labor cost variables on unemployment. The short- and long-term relationship between the unemployment rate for the 2005:1-2016:3 period was examined with the ARDL bounds test and error correction model, and it was found that there is a positive relationship between the real effective exchange rate and unemployment on the long view.

Uysal and Erdogan (2003) examined the relationship between unemployment rate and inflation in Turkey between 1980 and 2002 with the Philips curve. It was discovered after using a non-linear inverse model that the variables influencing the Philips curve had a negative connection, despite the low coefficient of determination. Ümit and Bulut (2013), for the quarterly data of the 2005:1-2010:3 period, discussed the effects of variables such as the industry productivity index, real wage index, growth rate, consumer price index (CPI), etc. on unemployment using the partial least squares method. At the end of the study, it was displayed that CPI has a significant effect on the unemployment rate in the present and each lag period. Selim and Ayvaz Güven (2014) conducted an econometric analysis using CPI, real effective exchange rate and unemployment data between 1990 and 2012. Consequently, it was revealed that a long-term relationship could not be determined between these variables. However, a causality was obtained from the real effective exchange rate to unemployment and CPI. Ayvaz Güven and Ayvaz (2016),

using annual inflation and unemployment data for the years 1990-2014, examined the short and long-term relationships between these variables with time series analysis. In addition, with the Granger causality test, they revealed a causality relationship between the unemployment to the inflation rate.

Polat (2019) discussed the relationship between unemployment and inflation for NUTS-2 regions in Turkey with panel data analysis for the period 2008-2017. According to the estimation results based on the fixed effects model, a negative relationship was revealed. Kopuk (2020) examined the effects of inflation and unemployment on economic growth between 1990 and 2018. It has been found through econometric modelling that inflation causes unemployment and that both factors have a limiting impact on economic growth. Karadağ Ak (2021), discussed the effects of economic growth and inflation on unemployment for 2005:1-2020:9 with the ARDL model. As a consequence of the study, it has been shown that there is a positive association between unemployment and inflation as well as a cointegration relationship between the unemployment rate, inflation rate, and economic growth.

Akcan and Ener (2018) performed variance decomposition and effect-response analysis to reveal the changes and effects in unemployment rates for 2000:1-2015:3 period. According to the analyses done, the real exchange rate, loan volume, growth rate, and export rates are the factors that have the biggest impact on changes in the unemployment rate. Öztürk and Demir (2018) examined the effects of changes in the exchange rate on unemployment as well as the changes in exports and imports for the 2010:1-2017:3 periods. As a result of the causality analysis, a bidirectional relationship was obtained between the unemployment rate and exports.

Pehlivan, Bingöl, and Özbay (2017) looked at the connections between unemployment, interest rates, and economic development over the years 1980–2016. It was discovered that there was a short- and long-term association between the variables after time series and causality analysis were conducted. Furthermore, it has been found that there is a unidirectional connection between interest and unemployment and a bidirectional causation between unemployment and economic growth.

Eser (2021) discussed the variables such as BIST 100 index, export and import index, industrial production index, consumer price index, etc. as variables affecting the unemployment rate between 2009-2019 and analyzed them with gray relationship analysis.

In this study, the factors affecting unemployment in Turkey for the period 2014-2022 were examined. Beta regression analysis was used to model the consumer price index, nominal interest rate, real effective exchange rate, export, and industrial production index variables as the factors that are assumed to have an impact on the unemployment rate. In addition, linear regression analysis was also applied for these variables and compared with beta regression.

### 1. BETA REGRESSION

In situations where a continuous dependent variable assumes the values in the unit interval (0,1) like proportions, rates, or fractions, linear regression analysis may not be appropriate for modelling the dependent variable. Additionally, this type of variable may be asymmetrical, and this situation may cause inferences requiring normality assumptions may be deceptive. If this is the case, beta regression analysis is suitable to model the response variable. The beta regression model assumes that the dependent variable follows beta distribution, and the density function of the distribution can be represented as follows (Ferrari and Cribari-Neto, 2004):

$$f(y; p, q) = \frac{\Gamma(p + q)}{\Gamma(p)\Gamma(q)} y^{p-1}(1 - y)^{q-1}$$

for  $0 < y < 1, p > 0, q > 0,$  (1)

where  $\Gamma(\cdot)$  is the gamma function and  $p$  and  $q$  are shape parameters. The mean and variance of  $y$  are given below:

$$E(y) = \frac{p}{(p + q)}$$
$$Var(y) = \frac{pq}{(p + q)^2(p + q + 1)}$$

The distribution may take on a broad range of forms, from left- to right-skewed, relying on the combination of the beta density parameters, and this trait makes the distribution adaptable for modelling dependent variables that indicate proportions or rates. To build a regression structure in terms of the mean of the dependent variable along with a precision parameter, Ferrari and Cribari-Neto (2004) suggested a different parameterization of beta density as follows:

$$f(y; \mu, \varphi) = \frac{\Gamma(\varphi)}{\Gamma(\mu\varphi)\Gamma((1-\mu)\varphi)} y^{\mu\varphi-1} (1-y)^{(1-\mu)\varphi-1},$$

for  $0 < y < 1$ ,  $0 < \mu < 1$ ,  $\varphi > 0$  (2)

In (2),  $\mu = \frac{p}{(p+q)}$  and  $\varphi = p + q$ . After this reparameterization, the mean and the variance of  $y$  are given as

$$E(y) = \mu$$

$$Var(y) = \frac{\mu(1-\mu)}{(1+\varphi)}$$

Here,  $\mu$  is the mean of  $y$  and  $\varphi$  can be stated as the precision parameter. It can be said that the variance of  $y$  is the function of the mean of  $y$  and the precision parameter  $\varphi$ . Keeping the value of  $\mu$  constant, the variance decreases as the value of  $\varphi$  increases.

Suppose that  $y_1, y_2, \dots, y_n$  are independent random variables and they follow the beta density given in (2) with mean  $\mu_t$  and unknown precision parameter  $\varphi$ . To model the mean response, beta regression can be defined as follows:

$$g(\mu_t) = \sum_{i=1}^k x_{ti}\beta_i = \eta_t \quad (3)$$

In (3),  $\beta = (\beta_1, \beta_2, \dots, \beta_k)^T$  is the vector of unknown regression parameters,  $x_{t1}, x_{t2}, \dots, x_{tk}$  are observations on  $k$  explanatory variables ( $k < n$ ),  $\eta_t$  is the linear predictor for observation  $t$  and,  $g(\cdot)$  is strictly monotonic and twice differentiable link function connecting the dependent variable and the linear predictor. This model assumes that the precision parameter is constant and does not change across all observations. In situations, where the precision parameter varies throughout the observations, it is required to model the precision parameter with a regression structure which is similar to the structure of the mean response as follows:

$$h(\varphi_t) = \sum_{i=1}^s z_{ti}\theta_i = \vartheta_t \tag{4}$$

In (4),  $\theta = (\theta_1, \theta_2, \dots, \theta_s)^T$  is the vector of unknown parameters,  $z_{t1}, z_{t2}, \dots, z_{ts}$  are observations on  $s$  explanatory variables ( $k+s < n$ ),  $\vartheta_t$  is the linear predictor for  $t$ , and  $h(\cdot)$  is a link function. Several link functions can be used, such as logit, probit, complementary log-log etc.

For this type of beta regression model, the log-likelihood function may be defined as follows (Simas et al., 2010):

$$\ell(\beta, \theta) = \sum_{i=1}^n \ell_i(\mu_i, \varphi_i) \tag{5}$$

where  $\ell_i(\mu_i, \varphi_i)$  has the following form:

$$\ell_i(\mu_i, \varphi_i) = \log\Gamma(\varphi_i) - \log\Gamma((1 - \mu_i)\varphi_i) + (\mu_i\varphi_i - 1)\log y_i + ((1 - \mu_i)\varphi_i - 1)\log(1 - y_i) \tag{6}$$

In (6),  $\mu_i = g^{-1}(\eta_i)$  is the function of  $\beta$  and  $\varphi_i = h^{-1}(\vartheta_i)$  is the function of  $\theta$ . To estimate the parameters, the maximum likelihood method is used.

To assess the best prediction performance among estimation models, the root mean square error (RMSE) can be calculated. This measure is obtained using the following formula:

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n e_i^2} \tag{7}$$

As previously mentioned, using beta regression to build an estimation model enables the creation of a parameter estimator that is more effective and accurate than the ordinary least square method in cases where the observed dependent variables have an asymmetrical distribution or there is a heteroscedasticity problem. By pointing out this point, in the literature, to create an estimation model for response or dependent variable having values in the open unit interval, beta regression is used in many application areas such as agricultural science (Yellareddygaru et al, 2016 ), medical science

(Swearingen et al, 2011; Seow et al, 2012; Souza et al, 2018; Babajanpour et al, 2021), natural sciences (Geissinger et al, 2022), social sciences (Koç, 2019; Unlu and Aktas, 2017; Smithson and Verkuilen, 2006), health systems (Hunger et al, 2011; Şenel and Cengiz, 2016 ), finance (Cook et al, 2008; Bladt et al, 2022; Sihombing, 2022), environmental science (Mandal et al, 2016), transportation (Chen et al, 2017), education (Masserini et al, 2017).

## 2. ANALYZES OF UNEMPLOYMENT IN TURKEY WITH BETA AND LINEAR REGRESSION

Among the factors affecting the unemployment rate in Turkey for 2014-2022 period, the consumer price index (or inflation), nominal interest rate, real effective exchange rate, export and industrial production index variables were considered. Data were taken from EVDS on a monthly basis. The R program's "betareg" package (Cribari-Neto and Zeileis, 2010). was used for the analyses. Table 1 contains a list of the names, abbreviations, and symbols of each variable.

**Table 1:** Definitions of Variables

Variables	Abbreviations	Symbols
Unemployment rate	UR	Y
Consumer price index	CPI	X <sub>1</sub>
Nominal interest rate	NIR	X <sub>2</sub>
Real effective exchange rate	RER	X <sub>3</sub>
Export	EXP	X <sub>4</sub>
Industrial production index	IPi	X <sub>5</sub>

The correlation matrix, which reveals the relationships between the independent and the dependent variables, is as in Table 2.

**Table 2:** Correlation Matrix of Variables

		UR	CPI	NIR	RER	EXP	IPi
UR	Pearson Correlation	1	0.351**	0.396**	-0.556**	-0.565**	0.227*
	p		0.000	0.000	0.000	0.000	0.022
CPI	Pearson Correlation	0.351**	1	0.496**	-0.873**	0.179	0.739**
	p	0.000		0.000	0.000	0.071	0.000
NIR	Pearson Correlation	0.396**	0.496**	1	-0.629**	-0.043	0.472**
	p	0.000	0.000		0.000	0.671	0.000
RER	Pearson Correlation	-0.556**	-0.873**	-0.629**	1	0.068	-0.736**
	p						

	$p$	0.000	0.000	0.000		0.500	0.000
<b>EXP</b>	Pearson Correlation	-0.565**	0.179	-0.043	0.068	1	0.018
	$p$	0.000	0.071	0.671	0.500		0.858
<b>IPI</b>	Pearson Correlation	0.227*	0.739**	0.472**	-0.736**	0.018	1
	$p$	0.022	0.000	0.000	0.000	0.858	

It is clear that all of the independent factors described have a considerable impact on the unemployment rate. Additionally, the reel effective exchange rate's strong correlation with the CPI, NIR, and IPI suggests that the variables may be multicollinear. Since the VIF (Variance Inflation Factor) value was higher than 10 and the matching beta coefficient in the beta and linear regression models was not significant, the reel effective exchange rate was eliminated from the model as a consequence of the analyses performed.

In addition, due to the high values of some variables, analyzes were carried out by taking the logarithm of all independent variables. In the application of Beta regression, the link function must first be determined. The calculated AIC and BIC values for different link functions are given in Table 3.

**Table 3:** Information Criteria for Different Link Functions in the Beta Regression Model

Link Functions	AIC	BIC
logit	-685.6352	-669.8854
probit	-684.3767	-668.6269
<b>cauchit</b>	<b>-694.3228</b>	<b>-678.5729</b>
cloglog	-686.1114	-670.3615
loglog	-683.0540	-667.3041
log	-686.6085	-670.8186

It is widely acknowledged that the model that best describes the data set is the one that has the lowest AIC and BIC values among the alternatives. As can be seen in Table 3, the cauchit function was determined as the link function giving the smallest information criterion, and the cauchit function was used in the next steps.

The estimates, standard errors, Z test and  $p$  values of Beta regression coefficients according to the mean model with cauchit link are given in Table 4.

**Table 4:** Beta Regression Coefficients (mean model with cauchit link)

Variables	Estimate	Std. Error	Z value	P(> z )
Intercept	12.40950	1.50072	8.269	<2e-16
CPI	0.68157	0.07897	8.631	<2e-16
NIR	0.18299	0.07063	2.591	0.00957
EXP	-3.63811	0.32261	-11.277	<2e-16
IPI	-0.60158	0.17284	-3.481	0.00050

The consumer price index, nominal interest rate, export, and industrial production index variables can all be considered significant based on the aforementioned data.

Pseudo  $R^2$ , which is an indicator of the extent to which the changes in the unemployment rate are explained by the independent variables and also the goodness of fit to the model was found to be 0.6729. This means that the data of corresponding variables fit well the model.

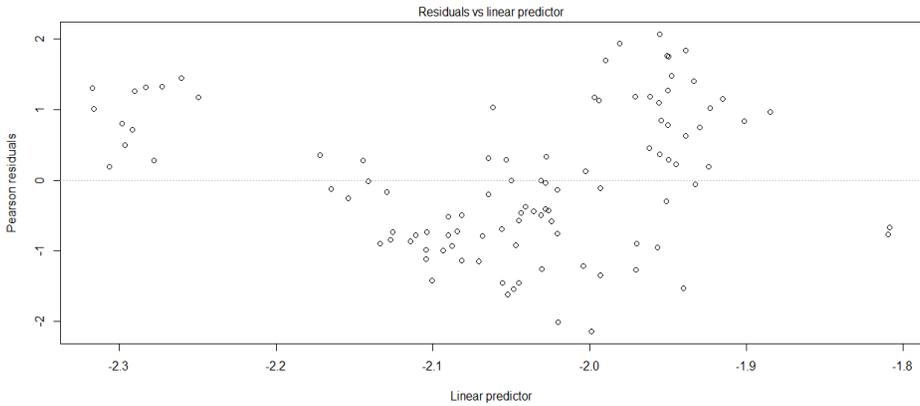
Since the  $p$  value obtained as a result of the Breusch-Pagan test for the heteroscedasticity assumption, which has an important part among the model assumptions, is  $0.419 > 0.05$ , it can be said that there is no heteroscedasticity and the variance of the errors is constant.

The VIF used to investigate the existence of multicollinearity among the independent variables are as follows:

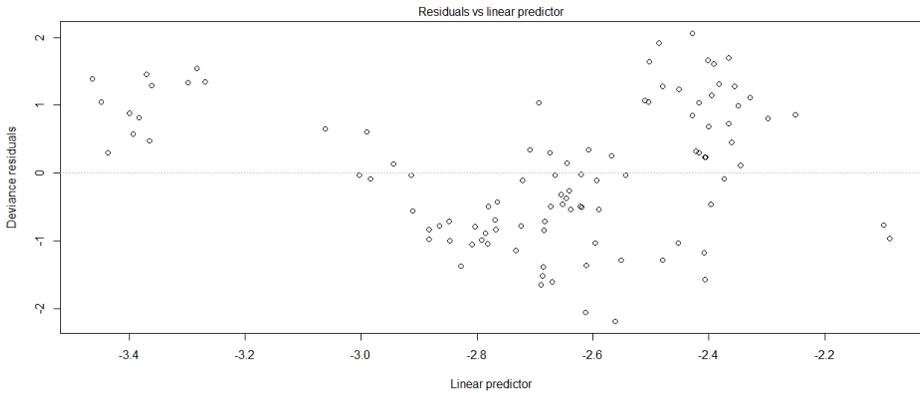
	CPI	NIR	EXP	IPI
VIF:	1.936547	1.354720	1.046802	1.909116

It is said that there is no multicollinearity between the independent variables because all VIF values are less than 5.

Since the result of the Kolmogorov-Smirnov test applied for the assumption of normality is  $p=0.4574 > 0.05$ , it can be said that the distribution of the errors conforms to the normal distribution.



(A)



(B)

**Figure 1:** Beta regression residual plots

It may be concluded that the regression model is good since there is no pattern in the A and B error plots, which are the beta regression residual plots in Figure 1 that demonstrate whether the errors associated with any two observations are not dependent in the distribution. It can be said that the Pearson or deviation residuals are independent of each other and the variance is constant.

When the explanatory variables affecting the unemployment rate are also modelled with linear regression, the following results are obtained.

**Table 5:** Linear Regression Coefficients

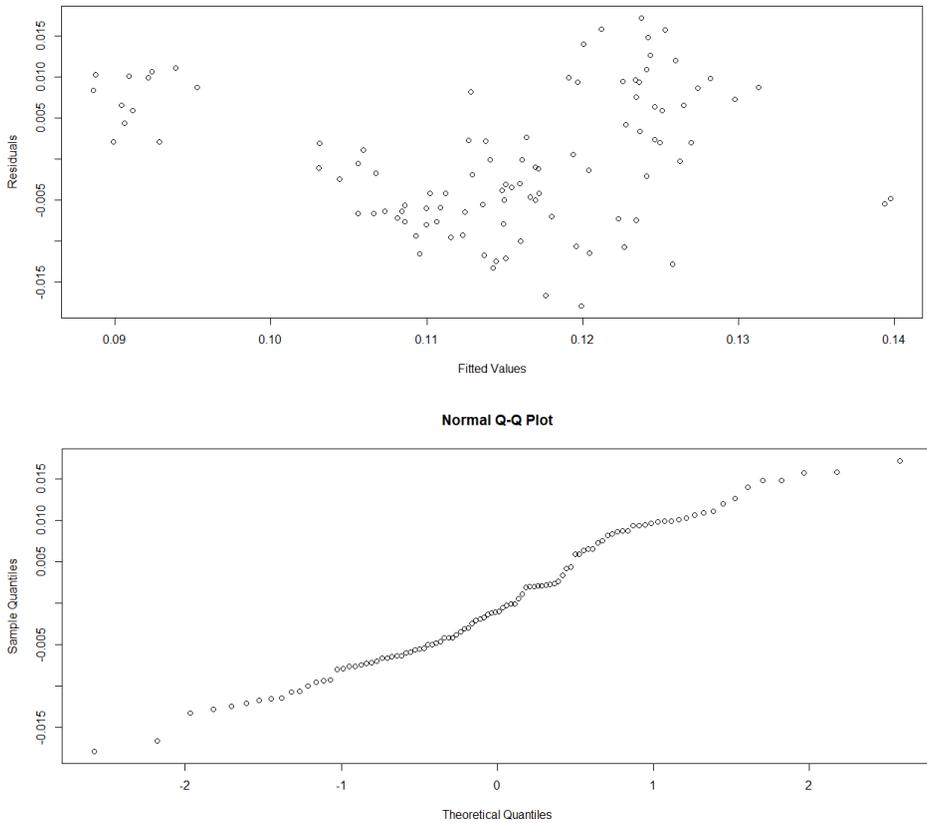
Variables	Estimate	Std. Error	t value	P(> t )
Intercept	0.659536	0.065712	10.037	<2e-16
CPI	0.027601	0.003811	7.243	1.05e-10
NIR	0.005907	0.003539	1.669	0.098383
EXP	-0.124255	0.012801	-9.707	5.77e-16
IPI	-0.032007	0.008427	-3.798	0.000254

According to Table 5, it can be said that NIR variable is not significant unlike the result of beta regression. Adjusted  $R^2$  was found to be 0.6269. This means that the data of corresponding variables fit well the model. However, it was smaller than the Pseudo  $R^2$  value of the beta regression. This shows that beta regression is better than linear regression as a model fit.

When the linear regression model assumptions are examined, it can be said that there is no heteroscedasticity since  $p=0.41 > 0.05$  as a result of the Breusch pagan test used in the analysis of heteroscedasticity. Considering the multicollinearity, it can be said that there is no multicollinearity between the independent variables because all VIF values are less than 5 according to the following VIF values.

	CPI	NIR	EXP	IPI
VIF:	2.508443	1.558379	1.004596	2.309100

Since the result of the Kolmogorov-Smirnov test applied for the assumption of normality is  $p < 2.2e-16$ , it can be said that the distribution of the errors does not fit the normal distribution. Finally, the  $d$  value obtained as a result of the Durbin Watson test performed to examine whether there is a relationship between the error terms is 0.36 and since the  $p < 2.2e-16$ , it can be said that there is a positive autocorrelation between the error terms. Fitted values vs. residuals and normal Q-Q plot for linear regression are given in Figure 2.



**Figure 2:** Linear regression residual plot used to reveal the independence of error terms and normal Q-Q plot of residuals

While the RMSE value in (7) calculated for the linear model is about 0.008263, it is 0.007640 for the beta regression. The fact that the RMSE value is smaller in beta regression than in linear regression and that some assumptions required for linear regression are not provided are among the reasons why beta regression is preferred.

## RESULTS AND DISCUSSION

A significant issue that must be addressed is unemployment, which is one of the main elements influencing the economic situation of nations. The policies that will be put into place in this area are anticipated to improve the labor market. There are several studies analyzing their impacts in the literature since factors like inflation, interest rates, and the country's export and industrial production index are crucial factors for the unemployment rate.

The factors influencing the unemployment in Turkey were examined and their impact on unemployment was investigated in this study. First, a model is developed to try to predict how the consumer price index (inflation), nominal interest rate, real effective exchange rate, export, and industrial production index would affect the unemployment rate. Real effective exchange rate variable on unemployment was not statistically significant, hence they were removed from the models as a consequence of the research. Since the unemployment rate has a range of values from 0 to 1, it is considered that using a beta regression model as opposed to a linear regression would result in a more efficient and accurate parameter estimate. The validity of the required assumptions for both models was investigated. As a result, it was concluded that the obtained regression model could not be a reliable estimation tool because of the smaller  $R^2$  and the absence of normality and autocorrelation assumptions in linear regression.

Compared to similar studies on unemployment, it is similar to the study of Karadağ Ak (2021), in which the effect of Inflation (CPI) on unemployment, which is one of the variables affecting unemployment, is positive. In addition, according to the results of the analysis, the Nominal Interest Rate (NIR) has a positive effect on unemployment, but its effect is not very high. According to the Granger causality analysis of Pehlivan, Bingöl, and Özbay (2017), similarly, there is a one-way causality running from Nominal Interest Rate (NIR) to unemployment. In this study, the effect of Export (EXP) on unemployment is negative and differs from the results of Akcan and Ener (2018) impact-response analysis. In their study, the reaction of exports to unemployment is positive for every period. Finally, among the significant variables, the Industrial Production Index (IPI) is also a variable that affects unemployment, similar to Eser (2021).

Thus, when the impacts of the aforementioned factors on the unemployment rate were investigated using both linear and beta regression models, it was discovered that they were statistically significant. However, it is determined that the linear regression model cannot be a trustworthy estimation tool and that the Beta regression model should be used after looking at the essential assumptions for the models. Additionally, in order to show the impact of these factors, it is crucial to apply comparable estimation models in the studies that will be conducted to lower the unemployment rate. Also, in terms of the effects of the variables discussed on unemployment, some policies can be developed by taking into account all the work done in

this field, and the level of unemployment rate can be brought to the desired level with the correct and timely implementation of these policies.

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## **CHAPTER 5**

### **THE ROLE OF TAXES FOR A SUSTAINABLE ENVIRONMENTAL PURPOSE AND AN ASSESSMENT OF ENVIRONMENTAL TAXATION IN TURKEY**

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## INTRODUCTION

One of the issues addressed in order to achieve the sustainable development goal is the environment. In this case, the issue of how to provide a sustainable environment in terms of sustainability of development comes to the fore.

Since the environment is of a consumable nature, it needs protection. One of the main reasons for the consumption of the environment is economic activities. The environment is damaged through both production and consumption activities and solutions are sought for the sustainability of the environment at the global level. In fact, economic activities that cause the search for a sustainable environment are also one of the tools used to provide a sustainable environment. That is, this time the public aspect of the economic relationship is used; that is, fiscal liabilities and the profitability of economic relations in the private sphere are affected. In this sense, it is caused that some economic relations are not established or reduced at all.

Although the history of suggesting taxes as a tool for the purpose of sustainable environment is quite old; The role of taxes in achieving this goal has always been up-to-date. However, when the studies of OECD and EU on this subject are evaluated, it is seen that apart from the classical classification of taxes as income taxes, wealth taxes and consumption taxes, a conceptualization has been made as environmental taxes and taxes with the environment. Beyond that, there is a conceptualization of environmental taxes and definitions of environmental taxes. When these definitions are examined, it is seen that a classical tax definition is not preferred in terms of environment and the objectives of the tax are also included in the definition.

After these explanations in this study, which investigates the use of taxes as a tool for the sustainable environment, it is also aimed to make an evaluation about environmental taxation in Turkey. For this purpose, in the first part of the study, a conceptual analysis will be made in the context of environment and taxes.

In the second part of the study, the evaluation of a sustainable environmental purpose in terms of tax purposes will be included.

In the third part of the study, especially the taxes in the Turkish Tax System will be examined and it will be tried to determine what environmental taxes and taxes related to the environment (environmentally related tax) are.

## 1. TAX AS A “TOOL” FOR CONCEPTUAL REVIEW AND A SUSTAINABLE ENVIRONMENTAL PURPOSE

It is seen that the doctrine deals with *the use of tax as an aid in reaching certain purposes*, and it is understood that tax is envisaged as a tool in achieving these specific purposes<sup>2</sup>.

### 1.1. Conceptual Discussion

It is striking that there is no common concept of use/preference in the literature regarding taxes associated with the environment. In academic studies and research, it has been determined that the concepts such as *green tax (yeşil vergi<sup>3</sup>)*, *eco-taxes (eko-vergiler)<sup>4</sup>*, *ecological taxes (ekolojik vergiler<sup>5</sup>)*, *environmental taxes (çevresel vergiler<sup>6</sup>, çevre vergileri<sup>7</sup>, çevre vergisi<sup>8</sup>)*, *environmental fiscal obligations (çevresel malî yükümler<sup>9</sup>)* are included.

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<sup>2</sup> Henry Laufenburger, “Verginin, İktisadi ve İçtimai Siyasetin Vasıtası Olarak Kullanılması”, Translator: Bedî Necmettin Feyzioğlu, **Ankara Üniversitesi Hukuk Fakültesi Dergisi**, Volume: 6, No: 1, 1949, pp. 225-235, p. 232-233.

<sup>3</sup> See: OECD, **Environmental Taxation: A Guide for Policy Makers**, September 2011, <https://www.oecd.org/env/tools-evaluation/48164926.pdf>, 14.04.2021, (**“Environmental Taxation”**); OECD, **Employment Implications of Green Growth: Linking Jobs, Growth, and Green Policies**, OECD Report for the G7 Environment Ministers, June 2017, <https://www.oecd.org/environment/employment-implications-of-green-growth-oecd-report-g7-environment-ministers.pdf>, 31.06.2022.

<sup>4</sup> Ali Erbaş, “Ekolojik Çevre Güvenlik Vergisi Sistemine İlişkin Öneriler”, **Vergi Raporu**, Year: 16, No.: 102, March 2008, pp. 37-41, p. 38.

<sup>5</sup> Ersan Öz, Hüseyin Kutbay, “Ekolojik Vergileme: Seçilmiş Bazı Dünya Ülkeleri ile Türkiye Verilerinin Karşılaştırılması”, **Eskişehir Osmangazi Üniversitesi İİBF Dergisi**, 11(1), April 2016, pp. 247-271; Tarık Jamali, **Ekolojik Vergiler (Çevre Vergileri)**, Ankara, Yaklaşım, 2007.

<sup>6</sup> Ali Değirmendereli, “Türk Vergi Sisteminde Uygulanan Bazı Vergilerin Çevresel Vergi Kavramı Açısından Değerlendirilmesi”, **Vergi Sorunları Dergisi**, No.: 174, March 2003, pp. 115-128; Erbaş, **op. cit.**, p. 38; Yusuf Şahin, “Türk Vergi Sisteminin ‘Çevresel Vergiler’ Açısından Değerlendirilmesi”, **Vergi Sorunları Dergisi**, No.: 133, October 1999, pp. 119-137.

<sup>7</sup> Cenker Göker, “Çevre Vergileri Üzerine Kavramsal Bir Deneme: Terminoloji ve Uyumlaştırma Problemleri”, **Ankara Barosu Dergisi**, 2014/3, pp. 137-157, (**“Çevre Vergileri Üzerine Kavramsal Bir Deneme”**); Cenker Göker, **Yönlendirici Vergilendirme**, Ankara, Turhan, 2011, p. 65, (**“Yönlendirici Vergilendirme”**); Esra Ekmekçi, **Küreselleşme ve Vergilendirmede Yeni Eğilimler**, İstanbul, Kazancı Hukuk No.: 167, 2003, p. 22; Şahin Akkaya, **Yerelden Küresel Çevre Vergileri: İktisadi Bir Analiz**, İstanbul, Filiz, 2017, (**“Çevre Vergileri”**); Şahin Akkaya, Ufuk Bakkal, “Çevre Vergileri ve Çifte Yerar,” **İstanbul Üniversitesi İktisat Fakültesi Mecmuası**, Volume: 55, No.: 2, September 2011, pp. 1-22.

<sup>8</sup> Ali Çelikkaya, “Avrupa Birliği Üyesi Ülkelerde Çevre Vergisi Reformları ve Türkiye’deki Durumun Değerlendirilmesi”, **Anadolu Üniversitesi Sosyal Bilimler Dergisi**, Volume: 11, No.: 2, 2011, pp. 97-120. Also see: Erdem Ercan, “Türkiye’de Çevre Vergileri mi Çevre Vergisi mi?”, **TBB Dergisi**, No.: 119, 2015, pp. 209-226, (**“Çevre Vergileri”**).

In the study titled “*Environmental Taxation: A Guide for Policy Makers*” published by the OECD, it is seen that the concepts of environmental tax and environmentally related taxes are included<sup>10</sup>. Although the same concepts are not used in the Turkish Tax Law doctrine, it has been determined that other classifications like the aforementioned OECD classification have been put forward<sup>11</sup>. In addition, OECD has developed the concept of environmental taxation to be inclusive<sup>12</sup>. In this context, it is preferred to use *environmental taxation* concepts to express both environmental taxes and environmentally related taxes in this study.

### 1.1.1. Environmental Taxes

The definition of *environmental taxes* is included in the OECD Report for the G7 Environment Ministers titled “*Environmental Fiscal Reform: Progress, Prospects and Pitfalls*” published by the OECD in June 2017. The definition is as follows: “*Environmental taxes, a subset of market-based instruments, are taxes whose tax base is a physical unit (or a proxy of it) that has a proven specific negative impact on the environment.*”<sup>13</sup> The definition of environmental taxes in the same Report cannot clearly link the tax to the extent of environmental damage or external cost; however, it may be useful to specify that it refers only to the tax base instead, and that environmental taxes are, however, generally taxes aimed at improving the harmonization of tax rates with (marginal) external costs<sup>14</sup>.

In the “*Environmental Taxes: A Statistical Guide*” published by the European Commission; the definition of environmental taxes is as follows: “*A tax whose tax base is a physical unit (or a proxy of a physical unit) of something that has a proven, specific negative impact on the environment,*

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<sup>9</sup> Esra Ekmekci Çalıcıoğlu, Gülsen Güneş, “Çevresel Mali Yükümler, Çevre Katkı Payı, Geri Kazanım Katılım Payı-Çevre ve Mevzuat Gerçekleri”, Prof. Dr. Süheyl Donay’a Armağan, İstanbul, Filiz, 2020, pp. 3-58, p 3.

<sup>10</sup> See: OECD, “*Environmental Taxation*”.

<sup>11</sup> Akkaya, “*Çevre Vergileri*”, p. 26-27; Salih Turhan, “Maliye Politikası ve Çevre Kirliliği”, İstanbul Üniversitesi İktisat Fakültesi Maliye Araştırma Merkezi Konferansları: Prof. Dr. Bedî N. Feyzioğlu’na Armağan, No.: 35, 1993, pp. 125-136, p. 129-130, (“*Çevre Kirliliği*”).

<sup>12</sup> See: OECD, “*Environmental Taxation*”.

<sup>13</sup> See: OECD, *Environmental Fiscal Reform: Progress, Prospects and Pitfalls*, OECD Report for the G7 Environment Ministers, June 2017, <https://www.oecd.org/tax/tax-policy/environmental-fiscal-reform-g7-environment-ministerial-meeting-june-2017.pdf>, 21.03.2021, (“*Environmental Fiscal Reform*”). In this Report, reference is made to the definition of environmentally related taxes in the Statistical Terms Dictionary prepared by the OECD.

See: OECD, “Environmentally Related Taxes”, *Glossary of Statistical Terms*, <https://stats.oecd.org/glossary/detail.asp?ID=6437>, 2005, 12.09.2022.

<sup>14</sup> See: OECD, “*Environmental Fiscal Reform*”.

and which is identified in ESA<sup>15</sup> as a tax”<sup>16</sup>. In that case, the environmental taxes base consists of the damage and level of a person or institution to the environment<sup>17</sup>. In the same Guide<sup>18</sup>, it is stated that environmental taxes are sometimes synonymous with *Pigou tax (pollution tax)*<sup>19</sup>. Because, thanks to the work of A. C. Pigou, environmental taxes have entered the public economy literature and this type of taxes is expressed as *Pigou type taxes*<sup>20</sup>. *Pigou tax* refers to a tax applied to a market activity that produces negative externalities<sup>21</sup> and is imposed to encourage the prevention or mitigation of a harm that causes an environmental externality (environmental damage)<sup>22</sup>.

*Environmental externalities*, which are referred to in determining the base of environmental taxes, refer to the compensated or uncompensated environmental impacts in production and consumption that affect consumer benefit and operating costs outside the market mechanism<sup>23</sup>. Environmental economic theory defines externalities as a cost or benefit that is not transferred through prices and negative externalities, or social costs are related to the environmental consequences of production and consumption<sup>24</sup>. In this context, the Pigou tax serves to equate marginal social costs with marginal social benefits<sup>25</sup>. Because, in the presence of negative externalities, the social cost of a market activity is not covered by the private cost of that activity<sup>26</sup>.

One of the areas where externalities show themselves most is the environment<sup>27</sup>. Environmental damage refers to the economic and social costs

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<sup>15</sup> European System of National and Regional Accounts.

<sup>16</sup> This Guide has emerged as a result of the process of updating Eurostat’s 2001 statistical guide on environmental taxes. **See:** European Commission, **Environmental Taxes: A Statistical Guide**, <https://ec.europa.eu/eurostat/documents/3859598/5936129/KS-GQ-13-005-EN.PDF>, 22.04.2021, (“*Environmental Taxes*”).

<sup>17</sup> Turhan, “*Çevre Kirliliği*”, p. 129.

<sup>18</sup> **See:** European Commission, “*Environmental Taxes*”. **See also:** Göker, “*Yönlendirici Vergilendirme*”, p. 65.

<sup>19</sup> **See also:** Jamali, **op. cit.**, p. 119.

<sup>20</sup> Akkaya, “*Çevre Vergileri*”, p. 25.

<sup>21</sup> **See:** European Commission, “*Environmental Taxes*”.

<sup>22</sup> **See:** OECD, “Pigouvian Tax”, **Glossary of Statistical Terms**, <https://stats.oecd.org/glossary/search.asp>, 02.05.2021.

<sup>23</sup> **See:** OECD, “Environmental Externalities”, **Glossary of Statistical Terms**, <https://stats.oecd.org/glossary/search.asp>, 04.05.2021.

<sup>24</sup> **See:** European Commission, “*Environmental Taxes*”.

<sup>25</sup> Şahin Akkaya, “An Instrument of Limiting Carbon Emissions: Carbon Tax”, **İstanbul Üniversitesi Siyasal Bilgiler Fakültesi Dergisi**, No.: 23-24, October 2000-March 2001, pp. 23-33, p. 31.

<sup>26</sup> **See:** European Commission, “*Environmental Taxes*”.

<sup>27</sup> Fatih Can, “Çevre Politikasının Ekonomik Araçları”, **Niğde Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi**, 9(3), July 2016, pp. 58-73, p. 70.

that are not directly imposed on the people or institutions that cause this damage, but also on the society<sup>28</sup>. In this sense, it is stated in the doctrine that waste tax can be used as a tool to internalize environmental damage<sup>29</sup>. In our opinion, this way, which is suggested as waste tax in the doctrine, corresponds to environmental taxes in the context of OECD and EU studies.

Because, to apply the waste tax, just as stated in the definition of environmental taxes, it is necessary to know the wastes left to the natural environment by the polluting units that constitute the tax base. Pigou type environmental tax cannot be applied in cases where the amount of waste generated by polluting units cannot be measured with the current technological possibilities<sup>30</sup>.

In the light of these explanations, considering the definition given above, it is thought that it is possible to equate environmental taxes with Pigou tax. In addition, it is considered that it is possible for environmental taxes to have a directive effect on the economic and social costs of the society due to environmental damage, to the detriment of those who harm the environment.

### 1.1.2. Environmentally Related Tax

In the report titled “*Environmentally Related Taxes in OECD Countries: Issues and Strategies*” published by the OECD in 2001, the following definition was given: “*An environmentally related tax is defined as any compulsory, unrequited payment to general government levied on tax-bases deemed to be of particular environmental relevance*”<sup>31</sup>. This definition of environmental taxes is also included in the OECD Report for the G7 Environment Ministers, also published by the OECD<sup>32</sup>. In the continuation of

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<sup>28</sup> Turhan, “*Çevre Kirliliği*”, p. 127.

<sup>29</sup> Akkaya, “*Çevre Vergileri*”, p. 26.

<sup>30</sup> Akkaya, “*Çevre Vergileri*”, p. 26.

<sup>31</sup> See: OECD, **Environmentally Related Taxes in OECD Countries: Issues and Strategies**, 2001, [https://read.oecd-ilibrary.org/environment/environmentally-related-taxes-in-oecd-countries\\_9789264193659-en#page1](https://read.oecd-ilibrary.org/environment/environmentally-related-taxes-in-oecd-countries_9789264193659-en#page1), 19.03.2021, (“*Environmentally Related Taxes in OECD Countries*”).

<sup>32</sup> *Environmentally related taxes are defined as “any compulsory, unrequited payment to general government levied on tax-bases deemed to be of particular environmental relevance.”* See: OECD, “*Environmental Fiscal Reform*”. For the definition of environmentally related taxes in that Report, a reference is made to the Statistical Glossary of Terms published by the OECD in 2004. See: OECD, “Environmentally Related Taxes”, **Glossary of Statistical Terms**, <https://stats.oecd.org/glossary/detail.asp?ID=6270>, 2004, 14.04.2022. For a similar definition, see also: OECD, **Policy Instruments for the Environment: Database Documentation**, [http://www.oecd.org/environment/tools-valuation/PINE\\_Metadata\\_Definitions\\_2016.pdf](http://www.oecd.org/environment/tools-valuation/PINE_Metadata_Definitions_2016.pdf), 21.04.2022, (“*Policy Instruments for the Environment: Database Documentation*”).

the same Report, it is stated that there is no clear link with external costs in environmentally related taxes, and regardless of whether the tax rates are compatible with the purpose of environmental protection policy and external costs, environmental taxes especially focus on situations that affect the environment. Finally, it has been argued that unless marginal external cost pricing is referred to in the Report, the use of the concept of environmentally related taxes is preferred, and if the concept of environmental taxes is used, a rather narrow field would be preferred to explain and advance policy implementations<sup>33</sup>.

In addition, in the more recent OECD study on *“Policy Instruments for the Environment: Database Documentation”* published in 2016, it has been determined that the scope of the definition of environmental taxes has been expanded. With the expression as *“Environmentally related taxes are defined as any compulsory, unrequited payment to government levied on tax bases deemed to be of environmental relevance, (...)”* in the definition made<sup>34</sup>, it is concluded that for environmentally related taxes, no special environmental interest is sought, but an ordinary interest is considered sufficient.

In that case, the base of taxes related to the environment is the input of substances that harm the environment. Production methods that harm the environment are subject to more tax liabilities, based on the assumption that they harm the environment<sup>35</sup>.

In the doctrine, it is stated that the tax in the form of special consumption tax, by being applied on goods and services, can be a tool in the internalization of environmental damage<sup>36</sup>. In our opinion, this way, which is suggested as special consumption tax in the doctrine, corresponds to environmentally related taxes in the context of OECD and EU studies.

## **1.2. Scope of Implementation of Tax as A “Tool” For A Sustainable Environmental Purpose**

Based on OECD data, environmental policies have become more stringent<sup>37</sup> in the last two decades. In this context, all tools of environmental

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<sup>33</sup> See: OECD, *“Environmental Fiscal Reform”*.

<sup>34</sup> See: OECD, *“Policy Instruments for the Environment: Database Documentation”*.

<sup>35</sup> Turhan, *“Çevre Kirliliği”*, p. 129.

<sup>36</sup> Akkaya, *“Çevre Vergileri”*, p. 26.

<sup>37</sup> Stringency is defined as the degree to which environmental policies put an explicit or implicit price on polluting or environmentally harmful behavior. See: OECD, **Environmental Policy Stringency Index**, <https://www.oecd->

policy aim to improve the well-being of people and the environmental sustainability of the economy and could direct household behavior<sup>38</sup>.

For a sustainable environmental purpose, *fiscal methods* can be used as well as technological and legal methods<sup>39</sup>. As a matter of fact, it is stated that the instruments related to fiscal policy and environmental pollution are taxes and fees, licenses, subsidies and tax facilities, public real expenditures, and administrative measures<sup>40</sup>.

According to OECD, economic instruments consisting of fiscal and other economic incentives (effluent taxes or charges on pollutants and waste, deposit-refund systems and tradable pollution permits, etc.) is envisaged as an instrument of environmental protection policy<sup>41</sup>.

In the *“Environmental Taxes: A Statistical Guide”* published by the European Commission states that economic instruments in pollution control and natural resource management have become an increasingly important part of environmental policy in the EU and OECD countries, and that these economic instruments are related to environmental taxes, fees and charges, tradable permits, deposit-refund systems, and subsidies<sup>42</sup>.

In addition, the OECD study, *“Making Taxation and Environmental Policies Mutually Reinforcing”*, states that in the last decade, economic instruments have played a growing role in the environmental policies of OECD countries, and the increasing role of environmental taxes as a distinguishing feature<sup>43</sup>. In this context, in the study called *“Taxation, Innovation and the Environment: A Policy Brief”*, also prepared by OECD is expressed that there is an increasing movement towards environmentally related taxation (and tradable permits) in OECD economies, although it cannot be considered as a single tool to overcome all kinds of environmental

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ilibrary.org/environment/data/oecd-environment-statistics/environmental-policy-stringency-index\_2bc0bb80-en, 27.10.2022, (*“Environmental Policy Stringency Index”*).

<sup>38</sup> See: OECD, **Environmental Policy Stringency**, <https://www.compareyourcountry.org/environmental-policy-stringency-indicators>, 20.05.2022, (*“Environmental Policy Stringency”*).

<sup>39</sup> Jamali, **op. cit.**, p. 66-76.

<sup>40</sup> Turhan, *“Çevre Kirliliği”*, p. 129.

<sup>41</sup> See: OECD, “Economic Instruments (Environmental Protection Policy)”, *Glossary of Statistical Terms*, <https://stats.oecd.org/glossary/detail.asp?ID=723>, 28.09.2022.

<sup>42</sup> See: European Commission, *“Environmental Taxes”*.

<sup>43</sup> See: OECD, **Making Taxation and Environmental Policies Mutually Reinforcing**, <http://www.oecd.org/ctp/tax-policy/taxationandenvironmentalpolicies.htm>, 11.05.2021, (*“Making Taxation”*).

challenges<sup>44</sup>. In the doctrine, it has been stated that the expenses made for the elimination of environmental pollution; in other words, taxes and duties similar to taxes are quite functional in terms of liability of damages to those who cause them<sup>45</sup>. It is stated that States have various instruments, including regulations, information programs, innovation policies, environmental subsidies, and environmental taxes; however, it was noted that taxes, in particular, are an important part of this toolkit<sup>46</sup>.

In addition, it is seen that the concept of *green tax*, developed by the OECD, is used as *a fiscal method* and a new generation economic tool in the fight against environmental pollution<sup>47</sup>. As a matter of fact, the environmental policy supported by environmental taxes can create positive changes on the preferences in the production and consumption stages in the long run<sup>48</sup>.

After these explanations, it should be stated that the generally accepted strategy for externalities expressing the damage functions is to make the people or institutions that cause these losses to pay for the costs incurred for reducing environmental pollution based on the *principle of compensation*<sup>49</sup>.

In addition, it has been argued that environmental taxes come to mind first because of their various advantages, to make the external cost arising from environmental pollution a part of the internal cost<sup>50</sup>.

### 1.2.1. “Polluter Pays” Principle

*Polluter pays principle*<sup>51</sup> is accepted as the moral and economic basis of environmental taxes<sup>52</sup>. It is stated that there is a link between the polluter pays principle and environmentally related taxes, and this principle is defined and explained in the study titled “*Guiding Principles on the International Economic Aspects of Environmental Policies*” published by the OECD in 1972. The definition in question is as follows: “(P)olluter should bear the

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<sup>44</sup> See: OECD, **Taxation, Innovation and the Environment: A Policy Brief**, <https://www.oecd.org/environment/tools-evaluation/48178034.pdf>, 14.05.2021.

<sup>45</sup> Turhan, “*Çevre Kirliliği*”, p. 129.

<sup>46</sup> See: OECD, “*Environmental Taxation*”.

<sup>47</sup> Ekmekci, **op. cit.**, p. 26.

<sup>48</sup> Hüseyin Güçlü Çiçek, Sema Dirgen Öz, “Çevreyle İlgili Vergilerin Ekonomik Büyüme ve İstihdam Üzerindeki Muhtemel Etkileri: Çifte Kazanç Tartışmaları”, **Vergi Sorunları Dergisi**, No.: 396, September 2021, pp. 13-27, p. 25.

<sup>49</sup> Turhan, “*Çevre Kirliliği*”, p. 128.

<sup>50</sup> Akkaya, “*Çevre Vergileri*”, p. 27.

<sup>51</sup> For more detailed information see: Ekmekci, **op. cit.**, p. 25.

<sup>52</sup> In the work, this principle is examined based on ecological taxes. See: Jamali, **op. cit.**, p. 113.

expenses of carrying out the above mentioned measures decided by public authorities to ensure that the environment is in an acceptable state<sup>53</sup>”. In this context, the polluter pays principle means that the costs of the measures to be taken to reduce pollution are borne by the polluters, according to the extent of the harm done to society or exceeding an acceptable pollution level (standard)<sup>54</sup>. By this principle, the cost of the measures taken is reflected in the cost of the goods and services that cause pollution in production or consumption<sup>55</sup>.

In the doctrine, a rational environmental policy, a maximum bearable pollution limit in terms of medicine and biology; in other words, it was stated that it should set a standard for environmental quality<sup>56</sup>. In that case, with the polluter pays principle, those who cause negative effects on others bear the costs incurred to compensate for these negative effects and must bear these costs within their own structure<sup>57</sup>.

In order to ensure that the polluter pays, in addition to the order and control method, the method used as a complement to pollution charges and especially taxes are applied<sup>58</sup>.

Due to the non-excludable nature of environmental goods, which are public goods since no property rights are granted, externalities arise, and the production process and consumption of goods often entail external environmental costs<sup>59</sup>. In this context, environmental taxes support the polluter pays principle, which states that the costs of pollution prevention and inspection should be reflected in the prices and outputs of goods and services that cause pollution because of their production or consumption<sup>60</sup>. In the doctrine, it is stated that the form of the polluter pays principle reflected in practice is the Pigou tax (pollution tax)<sup>61</sup>.

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<sup>53</sup> See: OECD, “*Environmentally Related Taxes in OECD Countries: Issues and Strategies*”.

<sup>54</sup> See: OECD, “Polluter-Pays-Principle”, **Glossary of Statistical Terms**, <https://stats.oecd.org/glossary/detail.asp?ID=2074>, 02.05.2021.

<sup>55</sup> See: OECD, “*Environmentally Related Taxes in OECD Countries: Issues and Strategies*”.

<sup>56</sup> Turhan, “*Çevre Kirliliği*”, p. 128.

<sup>57</sup> Jamali, **op. cit.**, p. 113.

<sup>58</sup> Nükhet Turgut, “Kirlenen Öder İlkesi ve Çevre Hukuku”, **Ankara Üniversitesi Hukuk Fakültesi Dergisi**, Volume: 44, No.: 1, 1995, pp. 607-654, p. 641.

<sup>59</sup> Joa Nicolaisen, Andrew Dean, Peter Hoeller, “Economics and the Environment: A Survey of Issues and Policy Options”, **OECD Economic Studies No. 16**, 1991, <https://www.oecd.org/eco/greeneco/34281824.pdf>, 21.04.2021.

<sup>60</sup> See: OECD, “*Making Taxation.*”

<sup>61</sup> Jamali, **op. cit.**, p. 119.

### 1.2.2. “User-Pays” Principle

In the *user-pays principle*, which is another type of the polluter pays principle, the cost of exhaustion of natural capital is imposed on the natural resource user<sup>62</sup>.

The polluter pays and user pays principles serve to include the inclusion of goods or services in their costs in the form of social costs that hinder a sustainable environmental purpose; in other words, internalize the social costs by adding them to the economic costs<sup>63</sup>. According to these explanations, it is understood that both principles are directly related to environmental taxation.

### 1.2.3. Changing the Tax Burden in Favor of Environmental Taxation

Increasing evidence of the effectiveness of environmental taxes as a means of reducing environmental damage in OECD countries<sup>64</sup>.

According to the OECD, there are multiple alternative options when deciding on the use of revenues from environmentally related taxes according to the specific, economic, fiscal, and environmental situation of each country:

- It can alleviate the budget deficit.
- It can contribute to the budget surplus.
- It can finance discretionary increases in government spending.
- It can reduce distortions (efficiency losses) in the labor or capital markets.
- It can address competitiveness concerns.
- It can encourage the reduction of other taxes to ensure public acceptance of environmental taxes.
- It can be used to reduce other taxes<sup>65</sup>.

In addition, in OECD’s study titled *The Problem of Green Growth within the scope of Environmental Taxation*, it is stated that increasing or more effective use of environmental taxes can encourage growth-oriented

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<sup>62</sup> See: OECD, “User-Pays Principle”, **Glossary of Statistical Terms**, <https://stats.oecd.org/glossary/detail.asp?ID=2827>, 02.05.2021.

<sup>63</sup> Turhan, “*Çevre Kirliliği*”, p. 127.

<sup>64</sup> See: OECD, “*Making Taxation*”.

<sup>65</sup> See: OECD, “*Environmentally Related Taxes in OECD Countries*”.

reform by removing the tax burden on corporate or personal income<sup>66</sup>. Because environmentally related taxation, regardless of whether this is the intended purpose of the tax, will increase the cost by preventing the consumption and production of polluting products or activities<sup>67</sup>. In the doctrine, it is stated that with the taxes levied on production and consumption, which cause environmental destruction, both the financing of the negative situation arising from production and consumption and the change of the behavior of institutions and people are tried<sup>68</sup>.

It should be noted here that the total amount of environmental taxes in the EU in 2020 was approximately 82.2 billion Euros higher than in 2002<sup>69</sup>.

## 2. EVALUATION OF A SUSTAINABLE ENVIRONMENTAL OBJECTIVE ON THE BASIS OF TAX OBJECTIVES

In doctrine and judicial decisions, it is stated that taxes are collected for various purposes, and it is seen that these purposes are included in the definition of tax. In this context, it is understood that tax has non-fiscal purposes as well as fiscal purposes.

### 2.1. Fiscal Purpose

The tax is the source of the income needed in the fulfillment of the public services undertaken by the State<sup>70</sup>. The first of the objectives of the tax is<sup>71</sup>, the payment of public expenses (*kamusal masrafların ödenmesi*<sup>72</sup>), to

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<sup>66</sup> See: OECD, **Green Growth Challenge: Shifting the Tax Burden in Favour of Environmentally Related Taxation**, <http://www.oecd.org/env/tools-evaluation/environmentaltaxation.htm>, 03.05.2021, ("*Green Growth Challenge*").

<sup>67</sup> See: OECD, "*Green Growth Challenge*".

<sup>68</sup> İbrahim Organ, "Amaç Çevreyi Korumak mı, Yoksa Diğer Harcamaları Finanse Etmek mi?: Avrupa Birliği ve Türkiye Çevre Vergilerinin Karşılaştırılması", **Vergi Sorunları Dergisi**, No.: 227, August 2007, <http://www.vergisorunlari.com.tr/makale/amac-cevreyi-korumak-mi-yoksa-diger-harcamalari-finanse-etmek-mi-avrupa-birligi-ve-turkiye-cevre-vergilerinin-karsilastirilmasi/2083>, 19.09.2022.

<sup>69</sup> See: EUROSTAT, **Environmental Tax Statistics**, [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Environmental\\_tax\\_statistics#Environmental\\_taxes\\_in\\_the\\_EU](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Environmental_tax_statistics#Environmental_taxes_in_the_EU), 02.06.2022, ("*Environmental Tax Statistics*").

<sup>70</sup> Yusuf Karakoç, **Vergi Hukuku (Genel Vergi Hukuku) Bilgisi**, Ankara, Yetkin, 2020, p. 142.

<sup>71</sup> Nazan Susam, **Kamu Maliyesi: Temel Kavram ve Esaslar**, 3rd Edition, İstanbul, Beta, 2019, p. 232, 243.

<sup>72</sup> Hakkı Musaballı, **Vergi Hukuku ve Türk Vergi Sistemi**, İstanbul, Sadrettin Tosbi Yayın ve Yardım Vakfı Nr.: 4, Selçuklu, 1978, p. 9.

finance public services (*kamu hizmetlerinin finansmanını sağlamak*<sup>73</sup>), providing the necessary economic resources for public activities (*kamusal faaliyetler için gerekli ekonomik kaynakların sağlanması*<sup>74</sup>) or the meeting public needs (*kamusal giderlerin karşılanması*<sup>75</sup>).

This situation can also be envisaged by the fact that everyone is held responsible for paying taxes to meet public expenditures in the article 73/1 of the Constitution, which is stated to regulate taxation for fiscal purposes. This purpose of the tax is expressed in the doctrine as the *fiscal purpose*<sup>76</sup> and the *fiscal function of the tax*<sup>77</sup>.

It is stated that the fiscal purpose of tax constitutes the first<sup>78</sup>, classical<sup>79</sup>, traditional<sup>80</sup>, main<sup>81</sup> and most important<sup>82</sup> purpose of tax. In this context, it is stated that tax is a tool that provides income to the State to provide the expenditures required by public activities. In addition, meeting the public expenditures is considered as a feature of the tax<sup>83</sup>. In that case, individuals participate in the financing of public services through taxes<sup>84</sup>.

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<sup>73</sup> S. Ateş Oktar, **Vergi Hukuku**, 16th Edition, İstanbul, Türkmen, 2022, p. 4, (*"Vergi Hukuku"*).

<sup>74</sup> Elif Binhan Yılmaz, **Maliye**, 4th Edition, İstanbul, Der, 2020, p. 100.

<sup>75</sup> Akif Erginay, **Kamu Maliyesi**, 15th Edition, Ankara, Savaş, 1994, p. 19, (*"Kamu Maliyesi"*); Nihal Saban, **Vergi Hukuku**, 9th Edition, İstanbul, Beta, 2019, p. 22; Selim Kaneti, **Vergi Hukuku**, 2nd Edition, İstanbul, Filiz, 1989, p. 34; Selim Kaneti, Esra Ekmekci, Gülşen Güneş, Mahmut Kaşıkçı, **Vergi Hukuku**, 2nd Edition, İstanbul, Filiz, 2022, p. 5; Susam, **op. cit.**, p. 243; Şerafettin Aksoy, **Kamu Maliyesi**, 4th Edition, İstanbul, Filiz, 2011, p. 171, (*"Kamu Maliyesi"*). **Also see:** Constitutional Court, decision dated 27.09.2012 and numbered 2011/16-2012/129; Official Gazette dated 22.11.2013 and numbered 28829.

<sup>76</sup> Aksoy, *"Kamu Maliyesi"*, p. 170; Oktar, *"Vergi Hukuku"*, p. 33; Salih Turhan, **Vergi Teorisi ve Politikası**, 6th Edition, İstanbul, Filiz Kitabevi, 1998, p. 32, (*"Vergi Teorisi"*); Selahattin Tuncer, **Kamu Maliyesi**, 3rd Edition, İstanbul, Yalkın Ofset, Eskişehir İktisadi ve Ticari İlimler Akademisi No. 41, 1972, p. 166; Yılmaz, **op. cit.**, p. 100-101. For the study in which the expression of *tax with fiscal purpose (malî gaye güden vergi)* is used in the doctrine, **see also:** Laufenburger, **op. cit.**, p. 226.

<sup>77</sup> Oktar, *"Vergi Hukuku"*, p. 14-15; Susam, **op. cit.**, p. 231.

<sup>78</sup> Yılmaz, **op. cit.**, p. 100.

<sup>79</sup> Tuncer, **op. cit.**, p. 166.

<sup>80</sup> Aksoy, *"Kamu Maliyesi"*, p. 170.

<sup>81</sup> Tuncer, **op. cit.**, p. 166.

<sup>82</sup> Aksoy, *"Kamu Maliyesi"*, p. 171; Susam, **op. cit.**, p. 232, 243.

<sup>83</sup> Turhan, *"Vergi Teorisi"*, p. 21-22.

<sup>84</sup> Muallâ Öncel, Ahmet Kumrulu, Nami Çağan, Cenker Göker, **Vergi Hukuku**, 28th Edition, Ankara, 2019, p. 4.

## 2.2. Non-Fiscal Purpose

Even if it is expressed in different ways, the fiscal purpose of the tax is one; however, in the light of doctrine and judicial decisions, it is seen that tax has more than one non-fiscal purposes.

In Article 73/2 of the Constitution, it is stated that the social objective of fiscal policy is a fair and balanced distribution of the tax burden. In the doctrine, it is stated that with this Constitutional provision, the *non-fiscal*<sup>85</sup>, *economic*<sup>86</sup>, *social*<sup>87</sup>, *extra-fiscal*<sup>88</sup> *purpose of tax* is regulated.

In this context, the state uses its taxation authority for fiscal, economic and social purposes to meet public expenditures<sup>89</sup>. It should be noted that it is not possible to use a limited counting method for non-fiscal purposes of tax.

Because the number of non-fiscal purposes of tax can change rapidly, and new purposes that were not important or unknown until now may emerge. In this context, tax is not collected for purely fiscal purposes as a means of generating income but has the characteristic of being a fiscal instrument that includes many purposes<sup>90</sup>. For this reason, it is stated that taxes are collected for different purposes other than economic and social purposes<sup>91</sup>.

## 2.3. Evaluation

The distinction between fiscal and non-fiscal purposes of tax arises from what is intended by taxation. Because with the use of taxation authority, it can be aimed to generate income only or to direct the society to certain behavioral patterns<sup>92</sup>.

When evaluated together with the explanations above, it is concluded that the purpose of a sustainable environment does not directly coincide with the fiscal purpose of tax.<sup>93</sup> Based on the classifications made in the doctrine,

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<sup>85</sup> Aksoy, "*Kamu Maliyesi*", p. 172; Tuncer, *op. cit.*, p. 176; Turhan, "*Vergi Teorisi*", p. 32; Yılmaz, *op. cit.*, p. 100. For the study in which the expression of *tax without fiscal purpose* is used in the doctrine, *see also*: Laufenburger, *op. cit.*, p. 226.

<sup>86</sup> For the view in the doctrine stating that the second purpose of tax is *economic*, *see*: Tuncer, *op. cit.*, p. 167.

<sup>87</sup> Oktar, "*Vergi Hukuku*", p. 33-34; Tuncer, *op. cit.*, p. 176. For the view in the doctrine stating that the third purpose of tax is *social policy*, *see*: Tuncer, *op. cit.*, p. 167.

<sup>88</sup> Oktar, "*Vergi Hukuku*", p. 33-34; Tuncer, *op. cit.*, p. 176.

<sup>89</sup> Leyla Ateş, *Vergilendirmede Eşitlik*, İstanbul, Derin, 2016, p. 93-94.

<sup>90</sup> Aksoy, "*Kamu Maliyesi*", p. 178-179.

<sup>91</sup> Susam, *op. cit.*, p. 247.

<sup>92</sup> Göker, "*Yönlendirici Vergilendirme*", p. 7.

<sup>93</sup> In the Statistical Guide on Environmental Taxes published by the European Commission in 2013, it is stated that the concept of environmental taxes can be interpreted as referring to

it is concluded that the aim of combating environmental pollution is included in other purposes of tax/other tax purposes/ taxation as social engineering tool<sup>94</sup>. Because in the doctrine, it is stated that one of the other tax purposes is *various purposes such as combating environmental problems*<sup>95</sup> or that one of the non-fiscal purposes of the tax is the *protection of the environment*<sup>96</sup>. In this context, the taxes, which were initially imposed only to provide income for public expenditures, have become an environmentally sensitive political tool that protects the environment over time<sup>97</sup>. In other words, the understanding that taxes play a very important role in intervening in economic and social life and sometimes in realizing political purposes, apart from being a means of generating income, has developed. As a result of this new understanding, *environmental taxes* have emerged<sup>98</sup>.

In addition, in taxation as a social engineering tool, the concept of *regulatory and guiding taxation* emerges. ***In regulatory/guiding taxation***, the State acts in addition to generating income for fiscal purpose or only to achieve a specific purpose. In the taxation, the State ensures that certain behaviors of taxpayers are encouraged, rewarded, or deterred, punished directly or indirectly through taxes<sup>99</sup>. It is claimed that one of the directive taxation areas is ***the environmental protection area***<sup>100</sup>.

For these reasons, it is thought that the taxes foreseen for the purpose of sustainable environment, which is our study subject, and the taxation authority used in this field are ***guiding***<sup>101</sup>.

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environmental taxes instead of fiscal purposes. **See.:** European Commission, ***“Environmental Taxes”***.

<sup>94</sup> For a similar view, see: Jamali, **op. cit.**, p. 101.

<sup>95</sup> Susam, **op. cit.**, p. 248.

<sup>96</sup> In the examination of other purposes of the tax, it was stated that the State may intervene in the production areas that harm the environment with taxes. **See.:** Hüseyin Şen, İsa Sağbaşı, ***Vergi Teorisi ve Politikası***, 3rd Edition, Ankara, Arıkan, 2017, p. 22, 26.

<sup>97</sup> M. Erkan Üyümez, “Bir Çevre Vergisi Olarak Motorlu Taşıtlar Vergisi: AB ve Türkiye Uygulamalarının Karşılaştırmalı Analizi”, **Ç.Ü. Sosyal Bilimler Enstitüsü Dergisi**, Volume: 25, No.: 3, 2016, pp. 427-440, p. 428.

<sup>98</sup> Değirmendereli, **op. cit.**, p. 116.

<sup>99</sup> Göker, ***“Yönlendirici Vergilendirme”***, p. 19.

<sup>100</sup> Göker, ***“Yönlendirici Vergilendirme”***, p. 64-70. It is also stated in the doctrine that environmental taxes are dominated by the guiding element. **See:** Değirmendereli, **op. cit.**, p. 117.

<sup>101</sup> In the *Environmental Taxes: A Statistical Guide* published by the European Commission; it is stated that many taxes manifest themselves for various purposes. These various tax purposes can be both to influence behavior by making a product more expensive to use, and to generate revenue. **See:** European Commission, ***“Environmental Taxes”***.

In this context, we believe that environmental taxes and environmentally related taxes conceptualized by OECD and EU have a *deterrent*<sup>102</sup> and, in some cases, **punitive** nature.

The importance of both national and international activities for a sustainable environmental purpose is increasing day by day. In fact, with the 2000s, it is seen that this century is characterized as the *environmental age*<sup>103</sup>. It is even claimed that the meanings expressed as *participation in ecological sustainability* can be added as one of the tax payment obligations<sup>104</sup>.

In addition, the need for guiding taxes is felt most in *environmental protection* activities<sup>105</sup>. In this context, it is stated that the expectation that taxes can be an effective tool in the solution of environmental problems brings about a transition from some fiscal taxes to environmental taxes in practice<sup>106</sup>.

For these reasons, it is thought that a sustainable environmental purpose, which is among the other purposes of the tax, will be considered as one of the non-fiscal purposes of the tax, and a classification system will develop in this way, even if not today.

Here, the result for environmental taxes, which was tried to be explained in the previous part of the study, becomes more evident. Because in environmental taxes, the guiding tendency is much higher, and the fiscal purpose of the tax is postponed. Although there is a guiding purpose in environmentally related taxes, it can be stated that both fiscal and non-fiscal purposes of the tax are combined.

Finally, in the light of the first part of the study and the explanations in this part, it is seen that both the OECD and the EU generally engage in definition activities in their tax-based studies aimed at sustainable environmental purposes. In this context, it is seen that the distinction between taxes and fees and charges is revealed, and the focus is on the tax base and results from an environmental point of view. In other words, it is understood

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<sup>102</sup> According to the OECD, in the context of environmental concern, environmental taxes provide a price signal that helps polluters consider the costs of pollution on the environment when making production and consumption decisions. **See:** OECD, *“Making Taxation”*. **Also see:** European Commission, *“Environmental Taxes”*. In another study by the OECD, it was stated that environmentally related taxes are a tax that increases the cost of a polluting product or activity, which tends to deter production or consumption, regardless of the purpose behind the introduction of the tax. **See:** OECD, *“Policy Instruments for the Environment: Database Documentation”*.

<sup>103</sup> O. Wilson Edward, “Çevre Çağı”, **Foreign Policy**, Year: 3, No.: 9-10, 2000, p. 33-35; transmitted: Ekmekci, **op. cit.**, p. 21.

<sup>104</sup> Billur Yaltı, **Vergi Yükümlüsünün Hakları**, 1st Edition, İstanbul, Beta, 2006, p. 1.

<sup>105</sup> Göker, *“Yönendirici Vergilendirme”*, p. 70.

<sup>106</sup> Üyümez, **op. cit.**, p. 428.

that the purposes of collecting fees and charges, together with taxes, are kept out of the scope of evaluation. In this context, all fiscal liabilities that meet an environmental area, regardless of the purpose they are taken, are included in the environmental scope. In addition, it should be noted that both the OECD and the EU have focused more and more specifically on the consequences of environmentally related taxes on environmental pollution.

### 3. ENVIRONMENTAL TAXATION IN TURKEY

It is concluded that there are fiscal liabilities specified in the article 73/3 of the Constitution of the Republic of Turkey (*Constitution*), in which tax duty is regulated, in the form of taxes, fees, duties and similar fiscal liabilities.

Taxes are unrequited<sup>107</sup> and therefore not on a provision basis<sup>108</sup>. In this context, tax duty does not include the right to demand tax return<sup>109</sup>.

In all studies prepared by the OECD, the difference in the principle of return is based on the distinction between taxes and fees-charges<sup>110</sup>. A similar situation applies to EU studies as well<sup>111</sup>.

In addition, in Article 56 of the Constitution, which regulates *health services and environmental protection*, it is stipulated that everyone has the right to live in a healthy and balanced environment and it is the duty of the State and citizens to develop the environment, protect environmental health and prevent environmental pollution. In this context, in the establishment of

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<sup>107</sup> Aksoy, "*Kamu Maliyesi*", p. 142; Şerafettin Aksoy, *Vergi Hukuku ve Türk Vergi Sistemi*, 6th Edition, İstanbul, Filiz, 2010, p. 5, ("*Vergi Hukuku*"); Kaneti, *op. cit.*, p. 4; Kaneti et. al, *op. cit.*, p. 5; Yılmaz, *op. cit.*, p. 92.

<sup>108</sup> Aksoy, "*Vergi Hukuku*", p. 3; Musaballı, *op. cit.*, p. 9; Oktar, "*Vergi Hukuku*", p. 5.

<sup>109</sup> Erginay, "*Kamu Maliyesi*", p. 19; Fritz Neumark, *Vergi Politikası*, Translator: İclâl (Feyzioğlu) Cankorel, İstanbul, Filiz, 1975, p. 19; Turhan, "*Vergi Teorisi*", p. 21-22.

<sup>110</sup> According to the OECD, taxes are unrequited because taxpayer benefits are not proportional to their payments, and a redistributive element must be present for a payment to be considered a tax. Fees and charges, on the other hand, refer to mandatory payments made to the State, more or less in proportion to the services rendered. In this context, the main difference between taxes and fees/charges is utilization. Taxes are used to finance general (or specific) Government expenditure, increase revenue, while fees/charges are paid for Government services involving a special benefit. See: OECD, "*Policy Instruments for the Environment: Database Documentation*".

<sup>111</sup> According to the European Commission, the criteria to be used in separating taxes from fees and charges are explained with the help of a table.

In this context, in taxes, there should be no connection between the payment made and the service provided, or even if such a connection exists, it should not be proportional to the cost of the service provided. In fees/charges, there should be a link between the payment and the service provided, and the payment should be proportional to the cost of the service provided. See: European Commission, "*Environmental Taxes*".

this right, which is envisaged for everyone by the Constitutional provision in Turkish law, the result is that the State imposes a tax duty on individuals to fulfill its own duty.

While explaining the environmental taxation in Turkey below, the classification adopted by the OECD and the EU will be considered. In addition, in this context, the taxes, fees and charges stated in the OECD's *Policy Instruments for the Environment (PINE<sup>112</sup>)* database will be taken into consideration.

### 3.1. Environmentally Related Taxes in Turkey

According to the statistical data published by the OECD, Turkey's environmental policy stringency increased **2.25** times from 1990 (0.8%) to 2012 (1.8%)<sup>113</sup>. In addition, Turkey's environmental policy stringency has increased continuously since 2012, except for 2018, and reached **2.89%** in 2020<sup>114</sup>. Therefore, it can be stated that Turkey's environmental policy stringency has increased **3.5** times in this 30-year period. However, Turkey's environmental policy stringency in 2020 has lagged the OECD member countries' average of 3.15%. In addition, according to OECD data, the ratio of the revenue of environmentally related taxes to the gross domestic product is **2.63%**<sup>115</sup> in 2020<sup>116</sup>, which is higher than the average of OECD member countries, which is 1.35%<sup>117</sup>. It should also be noted here that the total environmental tax revenue in the EU in 2020 constituted 2.2% of the EU GDP<sup>118</sup>.

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<sup>112</sup> See: OECD, **Database on Policy Instruments for the Environment**, <https://pinedatabase.oecd.org>, 11.07.2022.

<sup>113</sup> See: OECD, **Environmental Policy Stringency**, <https://www.compareyourcountry.org/environmental-policy-stringency-indicators/en/0/all/default/2012>, 10.09.2022.

<sup>114</sup> See: OECD, **"Environmental Policy Stringency Index"**.

<sup>115</sup> Also see: OECD, **"Green Growth Challenge"**.

<sup>116</sup> In Turkey, these rates were 1.08% in 1994; 1.18% in 1995; 1.77% in 1996; 1.92% in 1997; 1.79% in 1998; 2.53% in 1999; 2.41% in 2000; 2.65% in 2001; 3.45% in 2002; 4% in 2003; 3.50% in 2004; 3.93% in 2005; 3.10% in 2006; 2.97% in 2007; 3.22% in 2008; 3.34% in 2009; 3.71% in 2010; 3.46% in 2011; 3.25% in 2012; 3.49% in 2013; 3.25% in 2014; 3.30% in 2015; 3.26% in 2016; 3.09% in 2017; 2.30% in 2018 and 2.09% in 2019. See: OECD, **Environmentally Related Tax Revenue %GDP**, <https://stats.oecd.org/Index.aspx?DataSetCode=ERTR>, 21.08.2022.

<sup>117</sup> Also see: OECD, **Data-Environmental Tax**, <https://data.oecd.org/envpolicy/environmental-tax.htm>, 12.10.2022, (**"Data-Environmental Tax"**).

<sup>118</sup> See: EUROSTAT, **"Environmental Tax Statistics"**.

Again, according to OECD data, the ratio of the revenues of environmentally related taxes to the revenues of all taxes in Turkey in 2020<sup>119</sup> is **11.01%**<sup>120</sup>, which is higher than the average of OECD member countries by 4.56%<sup>121</sup>. It should be noted here that the OECD country with the highest ratio of environmentally related tax revenue to all tax revenue is Turkey.

Apart from this, studies on PINE are carried out by the OECD, primarily in cooperation with the European Environment Agency<sup>122</sup>. In this framework, a database has been established that collects detailed information about environmental protection and natural resource management policy tools and environmental taxes in OECD countries since 1996<sup>123</sup>.

The PINE database collects important quantitative and qualitative information on policy instruments identified in the form of environmentally related taxes, fees, and charges, environmental subsidies, tradable permits, deposit-refund systems, and voluntary approaches<sup>124</sup>. It has been stated that environmentally related taxes, fees, and charges, which are stated as policy tools based on PINE, increase the cost of products or activities that pollute the environment, and as a result, their consumption and production are hindered, *regardless of whether the tax is intended or not*<sup>125</sup>.

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<sup>119</sup> In Turkey, these rates were 6.69% in 1994; 7.22% in 1995; 9.57% in 1996; 9.48% in 1997; 8.70% in 1998; 11.22% in 1999; 10.25% in 2000; 10.45% in 2001; 14.48% in 2002; 16.03% in 2003; 15.15% in 2004; 16.98% in 2005; 13.28% in 2006; 12.97% in 2007; 14.04% in 2008; 14.33% in 2009; 15.03% in 2010; 13.44% in 2011; 13.13% in 2012; 13.87% in 2013; 13.30% in 2014; 13.22% in 2015; In 2016, 12.96%; 12.53 percent in 2017; 9.59% in 2018; 9.04% in 2019. **See:** OECD, **Environmentally Related Tax Revenue % of Total Tax Revenue**, <https://stats.oecd.org/Index.aspx?DataSetCode=ERTR>, 21.08.2022.

<sup>120</sup> **Also see:** OECD, *“Green Growth Challenge”*.

<sup>121</sup> **Also see:** OECD, *“Data-Environmental Tax”*.

<sup>122</sup> **See:** OECD, **The OECD Database on Policy Instruments for the Environment: How to Update and Complement the Information**, [http://www.oecd.org/environment/tools-evaluation/PINE\\_UserGuide\\_2016.pdf](http://www.oecd.org/environment/tools-evaluation/PINE_UserGuide_2016.pdf) 14.05.2022.

<sup>123</sup> **See:** OECD, **Policy Instruments for the Environment (PINE)**, <http://www.oecd.org/environment/indicators-modelling-outlooks/policy-instrument-database/>, 20.08.2022.

<sup>124</sup> Environmental impact area, industrial and household expenditure classification is used in the classification of these tools. **See:** OECD, *“Policy Instruments for the Environment: Database Documentation”*. **Also see:** OECD, **Database on Policy Instruments for the Environment**, <https://pinedatabase.oecd.org/Default.aspx?isid=2b8a8db7-8c40-4074-9860-530d5c5ca05c#>, 19.09.2022.

<sup>125</sup> **See:** OECD, **Policy Instruments for the Environment: Database 2017**, [http://www.oecd.org/environment/tools-evaluation/PINE\\_database\\_brochure.pdf](http://www.oecd.org/environment/tools-evaluation/PINE_database_brochure.pdf), 16.05.2022, (*“Policy Instruments for the Environment: Database 2017”*).

### 3.1.1. Tax on Motor Vehicle Ownership

In the PINE database, *tax on motor vehicle ownership* is included as one of the environmentally related taxes applied in Turkey<sup>126</sup>. In this context, *motor vehicles tax*, regulated by the *Motor Vehicles Tax Law No. 197*<sup>127</sup> in the Turkish Tax System, is included in the category of environmentally related taxes<sup>128</sup>. According to Article 3 of the Motor Vehicles Tax Law, taxpayers are real and legal persons whose motor vehicles are registered and registered in the relevant registries. In addition, according to Article 9 of the Motor Vehicles Tax Law, motor vehicle tax is a tax that is accrued and collected from taxpayers every year.

In the doctrine, it is stated that the motor vehicle tax is an indirect regulation within the scope of environmental fiscal liabilities under the name of tax. In this sense, the motor vehicle tax has not been directly evaluated as an environmental tax<sup>129</sup>.

### 3.1.2. Special Consumption Tax on Vehicles

In the PINE database, motor vehicles purchase tax, which is stated to have been replaced by the *special consumption tax on vehicles* as of 08/2002, is included as one of the environmental taxes applied in Turkey<sup>130</sup>. Because in the Turkish Tax System, *Special Consumption Tax Law No. 4760*<sup>131</sup> entered into force on 01.08.2002, except for some articles. *Special consumption tax* regulated by the Special Consumption Tax Law is included in the category of taxes related to the environment<sup>132</sup>.

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<sup>126</sup> See: OECD, **Taxes, Taxbases-Main Characteristics: Turkey**, [https://pinedatabase.oecd.org/Query\\_2.aspx?QryCtx=1&isid=2b8a8db7-8c40-4074-9860-530d5c5ca05c](https://pinedatabase.oecd.org/Query_2.aspx?QryCtx=1&isid=2b8a8db7-8c40-4074-9860-530d5c5ca05c), 01.10.2022, (**"Taxes, Taxbases-Main Characteristics: Turkey"**).

<sup>127</sup> See: Official Gazette dated 23.02.1963 and numbered 11342.

<sup>128</sup> In the doctrine, it is stated that the taxation of motor vehicles provides an important fiscal resource in many countries, but it is also considered as an intervention tool in areas such as transportation, energy, and environment. See: Üyümez, **op. cit.**, p. 429. In addition, in the doctrine, it is stated that motor vehicle tax is not an environmental tax, but it is included in the classification of environmentally beneficial taxes, which have positive environmental consequences. See: Ercan, **"Çevre Vergileri"**, p. 216. It is also stated in the doctrine that the increase in environmental pollution is one of the factors that popularize the use of special consumption taxes for extra-fiscal purposes. See.: Şahin Akkaya, Mahmut Aktuğ, "Teorik Temelleri ve Gelişimi Bakımından Özel Tüketim Vergilerinin Analizi", **Maliye Çalışmaları Dergisi**, 65, 1-23, 2021, pp. 1-23, p. 4.

<sup>129</sup> Ekmekçi Çalıcıoğlu, Güneş, **op. cit.**, p. 19.

<sup>130</sup> See: OECD, **"Taxes, Taxbases-Main Characteristics: Turkey"**.

<sup>131</sup> See: Official Gazette dated 12.06.2002 and numbered 24783.

<sup>132</sup> It is stated in the doctrine that the special consumption tax, which also provides ease of implementation, has priority in terms of being an appropriate policy tool that can be used in making the external cost created by environmental problems a part of the internal cost. See.:

It should be noted here that the vehicle purchase tax collected from taxpayers for one time was first regulated by the **Financing Law No. 1318**<sup>133</sup>. However, the regulations regarding the vehicle purchase tax regulated in the Special Consumption Tax and Financing Law have been repealed. Current situation, in the List No. (2) - List No. (II) attached to the Special Consumption Tax Law, it has been stipulated that which tax rates will be applied to which motor vehicles to be taken once.

Therefore, with the legal changes, the collection of vehicle purchase tax under the name of special consumption tax continued<sup>134</sup>. In the doctrine, it is stated that the special consumption tax is an indirect regulation within the scope of environmental fiscal liabilities under the name of tax<sup>135</sup>.

### 3.1.3. Special Consumption Tax on Petroleum, Natural Gas and Fuels

In the PINE database, Petroleum Consumption Tax is included as one of the environmentally related taxes applied in Turkey and it was stated that this tax was replaced by the special consumption tax on oil and natural gas as of 2002<sup>136</sup>. In this context, *the fuel consumption tax* regulated by the **Fuel Consumption Tax Law No. 3074**<sup>137</sup>, which was repealed with the provision of Article 18/5 of the Special Consumption Tax Law, is also a tax related to the environment<sup>138</sup>. However, instead of the abolished fuel consumption tax, the fuels taxed in the Schedule No (1)-List (I)-List (A) and (B) Schedules attached to the Special Consumption Tax Law, again as a tax type with the environment.

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Akkaya, "**Çevre Vergileri**", p. 25. Also, in the doctrine, considering the fiscal purpose of the special consumption tax, it is stated that although there is no environmental tax, it is included in the classification of environmentally beneficial taxes that have positive environmental consequences. **See:** Ercan, "**Çevre Vergileri**", p. 220.

<sup>133</sup> **See:** Official Gazette dated 10.08.1970 and numbered 13575.

<sup>134</sup> Organ, **op. cit.**, <http://www.vergisorumlari.com.tr/makale/amac-cevreyi-korumak-mi-yoksa-diger-harcamalari-finanse-etmek-mi-avrupa-birligi-ve-turkiye-cevre-vergilerinin-karsilastirilmasi/2083>.

<sup>135</sup> Ekmekci Çalıcıoğlu, Güneş, **op. cit.**, p. 19.

<sup>136</sup> **See:** OECD, "**Taxes, Taxbases-Main Characteristics: Turkey**".

<sup>137</sup> **See:** Official Gazette dated 20.11.1984 and numbered 18581.

<sup>138</sup> In the doctrine, it has been argued that the implementation of the fuel consumption tax, triggering a more careful and conscious consumption awareness in people, and reducing the environmental damages arising from the consumption of fuel, it can be stated that the environmental benefit has emerged. **See:** Değirmendereli, **op. cit.**, p. 123.

However, it should be noted that in the Turkish Tax System, the collection of fuel consumption tax under the name of special consumption tax has continued<sup>139</sup>.

In the doctrine, it is claimed that the environmental pollution caused by energy products is the reason for the increase in tax rates on these products, and for these products to be taxed twice by applying both special consumption tax and value added tax many times. In addition, it is stated that the increased sensitivity about environmental pollution causes the special consumption tax rates on energy products to increase<sup>140</sup>.

#### **3.1.4. Environmental Cleaning Tax, Contribution Fee in Expenditures of Sewerage and Water Facilities**

Environmental cleaning tax is also expressed as *pollution (solid waste) tax* in the doctrine<sup>141</sup>. This tax is stipulated by the repeated article 44 of the ***Municipal Revenues Law No. 2464***<sup>142</sup>, which is in force in Turkish Law. In the aforementioned provision, it is stated that as one of the revenues of the municipalities, residences, workplaces and other buildings benefit from the environmental cleaning services of the municipalities, are subject to environmental cleaning tax. In the same article, it is stated that the environmental cleaning tax for the residences will be calculated ***per cubic meter based on the amount of water consumption***.

Apart from this, the *contribution fee in sewerage expenditures* is regulated in Article 87 of the Law on Municipal Revenues and the *contribution fee in water facilities expenditures* is regulated in the Article 88.

Again, from the regulations of the Law on Municipal Revenues, it is understood that water and sewerage services can be regulated by a separate law and water and sewerage administrations can be established in metropolitan municipality borders and adjacent areas.

In this context, it is seen that Article 44 of the Law on Municipal Revenues directly refers to the ***Law No. 2560 on the Establishment and Duties of the General Directorate of Istanbul Water and Sewerage Administration***<sup>143</sup>.

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<sup>139</sup> Organ, **op. cit.**, <http://www.vergisorumlari.com.tr/makale/amac-cevreyi-korumak-mi-yoksa-diger-harcamaları-finanse-etmek-mi-avrupa-birligi-ve-turkiye-cevre-vergilerinin-karsilastirilmasi/2083>.

<sup>140</sup> Akkaya, Aktuğ, **op. cit.**, p. 14, 20.

<sup>141</sup> Çelikkaya, **op. cit.**, p. 113.

<sup>142</sup> See: Official Gazette dated 29.05.1981 and numbered 17354.

<sup>143</sup> See: Official Gazette dated 23.11.1981 and numbered 17523.

In Article 13 of the Law on the Establishment and Duties of the General Directorate of Istanbul Water and Sewerage Administration, “*The charges* to be collected from the subscribers according to the tariff in return for the sale of water and the removal of used water” and “*The contribution fees* to be collected on behalf of the relevant municipality from those who benefit from the water and sewerage facilities in accordance with the Law on Municipal Revenues” are being determined as the revenues of the Istanbul Water and Sewerage Administration.

The concepts of *water consumption charge*, *wastewater user charges* and *charge on water pollution* are included in the PINE data<sup>144</sup>. In this context, environmental cleaning tax, which is described as a tax in the Turkish Tax System, has been evaluated in the *category of fee/charges* in the eyes of the OECD.

Because, according to the OECD, a wastewater payment that varies according to the volume of water consumed constitutes a fee/charge; while a wastewater payment that varies according to the amount of pollution produced is classified as a tax. From this point of view, it is stated that in the first case, the benefits provided to the taxpayers correspond to the volume of water consumed, while in the second case, the payment does not proportionally reflect the interests of the State and instead targets the pollution produced<sup>145</sup>.

In the doctrine, it is stated that the environmental cleaning tax, which is an additional type of income collected by the municipalities in Turkey and taken from water consumption, is not an environmental tax that will set an example for the environmental tax policy<sup>146</sup>.

In another view in the doctrine, it is stated that the environmental cleaning tax aims to internalize the negative externalities (pollution cost) created by the solid wastes and wastewater created by the consumption units, which cause direct water and soil pollution. However, it has been argued that it is possible to partially internalize the negative externality because the amount of the environmental cleaning tax is determined by taking the amount of water consumption as a basis, regardless of the solid waste amounts in the

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<sup>144</sup> In the PINE database, categories such as *aircraft noise charges*, *charge on air pollution*, *charge on fisheries*, *charge on water pollution* as fees/charges for fiscal liabilities other than taxes applied in Turkey. See: OECD, **Fees/Charges, Taxbases-Main Characteristics: Turkey**, [https://pinedatabase.oecd.org/Query\\_2.aspx?QryCtx=1&isid=2b8a8db7-8c40-4074-9860-530d5c5ca05c#](https://pinedatabase.oecd.org/Query_2.aspx?QryCtx=1&isid=2b8a8db7-8c40-4074-9860-530d5c5ca05c#), 21.06.2022, (“*Fees/Charges, Taxbases-Main Characteristics: Turkey*”).

<sup>145</sup> See: OECD, “*Policy Instruments for the Environment: Database Documentation*”.

<sup>146</sup> Şen, Sağbaş, **op. cit.**, p. 451.

houses, and in this context, the only environmental tax in the Turkish Tax System is the environmental cleaning tax<sup>147</sup>.

As mentioned above, the environmental cleaning tax applied in Turkey is not included in the tax classification in OECD data, since it is a tax that is taken according to the amount of water consumed and therefore does not change according to the amount of pollution produced.

In this context, it is thought that environmental cleaning tax, which is expressed as *direct regulation*<sup>148</sup> or *environmental fiscal liability under the name of tax*<sup>149</sup> on an environmental basis in the doctrine, cannot be considered within the scope of environmental taxes in accordance with the definitions made by OECD and EU.

### 3.2. An “Environmental Tax” in Turkey: Plastic Bag Fee

It is seen that the second article of the *Environmental Law No. 2872*<sup>150</sup>, which is in force in Turkish Law, defines the *sustainable environment*, which is one of the main subjects of this study. According to the legal definition, sustainable environment refers to the process of improvement, protection and development of all environmental values that make up the environment of both today and future generations in all areas (social, economic, physical, etc.) without compromising the existence and quality of the resources that future generations will need.

In 2018, some amendments were made in the Environmental Law with the *Law No. 7153 On the Amendment of the Environment Law and Some Laws*<sup>151</sup>. In this context, an amendment was made to the article 3/h of the Environmental Law, in which the principles are regulated. With the amendment, it has been stated that apart from the mandatory standards to protect the environment, prevent and eliminate environmental pollution, market-based mechanisms, economic instruments and incentives such as tax, fee, contribution fee, promotion of renewable energy sources and clean technologies, recycling participation, reduction of plastic bags and plastic packaging use, deposit application, emission fee, pollution charge and assurance for pollution prevention, and carbon trading indicated can be used. Following the legal amendment made in this context, it is seen that the economic instruments, whose functionality is claimed to be used for the

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<sup>147</sup> Ercan, “*Çevre Vergileri*”, p. 215.

<sup>148</sup> Jamali, *op. cit.*, p. 323.

<sup>149</sup> Ekmekci Çalıcıoğlu, Güneş, *op. cit.*, p. 18.

<sup>150</sup> See: Official Gazette dated 11.08.1983 and numbered 18132.

<sup>151</sup> See: Official Gazette dated 10.12.2018 and numbered 30621.

purpose of protecting the environment, preventing, and eliminating environmental pollution in the OECD, EU studies and doctrinal views, are included as a principle in the Environmental Law. In more detail, based on the economic instruments included in the given regulation, and more accurately, based on fiscal instruments, tax, fee, contribution fee, recycling participation fee, deposit application, emission fee, pollution fee come to the fore.

As a matter of fact, it is stated in the doctrine that the scope of environmental fiscal obligations and measures has been expanded with this amendment made in the Environmental Law<sup>152</sup>.

Additional article 11 of the Environmental Law is a new legal amendment. Pursuant to this provision, in which the **recycling participation fee**<sup>153</sup> is regulated, the recycling participation fee in the amount specified in the list will be collected from the sales points for bags and from the marketers/importers for other products from the products placed on the domestic market and included in the list (1) attached to the Environmental Law.

Apart from this, in order to manage the resources efficiently and to prevent environmental pollution caused by plastic bags, in the additional article 13 of the Environmental Law, a bag fee has been regulated for the pouches that are based on the recycling participation fee. In line with the stated purpose, plastic bags will be given to the user or the consumer for a fee at the sales points.

It is envisaged that the recycling participation fee will be collected not only on plastic bags, but also on many products specified in the Law<sup>154</sup>. There is a connection between the recycling participation fee and the plastic bag fee regulated in the Environmental Law.

As a complement to the paid plastic bag regulation, a recycling participation fee has been created and the plastic bag fee includes a recycling

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<sup>152</sup> Ekmekci Çalıcıoğlu, Güneş, **op. cit.** p. 20.

<sup>153</sup> For the work in which it is expressed as *recycling betterment levy* in the doctrine see: Cenker Göker, Çağıl Süt Göker, “Yeni Bir Mali Yükümlülük Olarak Geri Kazanım Katılım Payı”, **Vergi Sorunları Dergisi**, No.: 364, January 2019, pp. 51-55, p. 51; Gülçin Karasu Öztemel, “Benzeri Mali Yükümlülük Kavramının Hukuki Niteliği ve Bu Kapsamda Geri Kazanım Katılım Payının Değerlendirilmesi”, **Vergi Sorunları Dergisi**, No.: 374, November 2019, pp. 88-105, p. 88. For the work in which it is expressed as *contribution of recovery* in the doctrine see: Güneş Yılmaz, Özgür Biyan, “Geri Kazanım Katılım Payının Hukuki Niteliği ve Yabancı Ülke Uygulamalarıyla Karşılaştırılması”, **Vergi Sorunları Dergisi**, No.: 371, August 2019, pp. 101-116, p. 101.

<sup>154</sup> Yılmaz, Biyan, **op. cit.**, p. 102; Karasu Öztemel, **op. cit.**, p. 89.

participation fee<sup>155</sup>. In this context, the recycling participation fee received from the sale of plastic bags is reflected in the plastic bag fee to the final consumers<sup>156</sup>. Therefore, the right to buy plastic bags is obtained by paying the recycling participation fee<sup>157</sup>.

In the current situation, according to the additional article 13 of the Environmental Law, it should be noted that the plastic bag base fee to be applied to the user or the consumer will not be less than 25 cents in order to ensure efficient management of resources and prevent environmental pollution caused by plastic bags. In this context, *the Procedures and Principles Regarding the Pricing of Plastic Bags* have been arranged by the Ministry of Environment and Urbanization<sup>158</sup>. In the Procedures and Principles included, it is stated that the fees for plastic bags will be 25 cents, to be implemented as of 01.01.2019.

Subsequently, in the *Notification on Recycling Participation Amounts to be Obtained in accordance with the Environment Law No. 2872 (2022/I<sup>159</sup>)* prepared by the Ministry of Environment, Urbanization and Climate Change, it was decided that the plastic bag fees would be 25 cents, effective from 01.01.2022.

In the light of these explanations, it is beneficial to make an evaluation in terms of the will of the legislator in Turkey. Because only in this way, it is possible to make a determination within the definitions with the classification developed by the OECD and the EU. In this context, in this study, the nature of the fiscal liabilities within the scope of environmental taxation in Turkey will be tried to be revealed independently of the theoretical and legal regulations of the Turkish Tax Law. *Organizational interpretation<sup>160</sup>* will be used in determining the qualifications for fiscal liability in the study.

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<sup>155</sup> Erdem Ercan, “Bir Maliye Politikası Aracı Olarak Poşet Ücreti”, *Vergi Sorunları Dergisi*, No.: 382, July 2020, pp. 99-109, p. 100, 102.

<sup>156</sup> Ekmekçi Çalıcıoğlu, Güneş, *op. cit.* p. 36.

<sup>157</sup> Yılmaz, Biyan, *op. cit.*, p. 114.

<sup>158</sup> **See:** Çevre ve Şehircilik Bakanlığı, Çevre Yönetimi Genel Müdürlüğü, **Plastik Poşetlerin Ücretlendirilmesine İlişkin Usul ve Esaslar**, <https://webdosya.csb.gov.tr/db/cygm/icerikler/plasposetue20181227-20181227091110.pdf>, 11.11.2022.

<sup>159</sup> **See:** Official Gazette dated 31.12.2021 and numbered 31706.

<sup>160</sup> It is stated in the doctrine that it is now seen that international organizations attribute comments to the tax results of economic transactions, and in this context, one of the types of interpretation in terms of the source that makes interpretation in tax law is the *interpretation of international organizations*. **See:** Yeliz Neslihan Akel, “Vergi Hukukunda Yorum Yapan Kaynak Perspektifinde Değişim ve Agresif Vergi Planlaması Üzerine Bir Değerlendirme”, *Vergi Sorunları Dergisi*, No.: 337, October 2016, pp. 91-109, p. 93, 96.

First of all, when the justification in the *Draft Motor Vehicles Tax Law*<sup>161</sup> is examined, it is stated that an independent liability has established itself in modern taxation and is developing as a fiscal issue due to the increasing importance of motor land vehicles in economic and social life. In this respect, the fiscal purpose of direct tax was prioritized in the introduction of the motor vehicle tax. However, later, the Motor Vehicles Tax Law was amended with the *Law No. 5035 on Amending Certain Laws*<sup>162</sup>. In the rationale for this change, it is stated that with the cylinder volume being taken as the main criterion in taxation, the motor vehicle tax has gained the qualification of being an environmental tax on the one hand<sup>163</sup>. Therefore, in the Turkish Tax System, the motor vehicle tax has taken on an environmentalist content over time.

However, it should be noted separately that in the Turkish Tax System, the motor vehicle tax is classified as one of the wealth taxes<sup>164</sup>.

When the rationale in the *Draft Special Consumption Tax Law*<sup>165</sup> is examined, it is stated that the special consumption taxes, which are included in the scope of consumption taxes and started to occupy an important place in

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<sup>161</sup> First name in the text of the Motor Vehicles Tax Law is the *Motor Land Vehicles Tax Law*. **See:** Türkiye Büyük Millet Meclisi, **Motorlu Kara Taşıtları Vergisi Kanunu**, [https://www5.tbmm.gov.tr/tutanaklar/KANUNLAR\\_KARARLAR/kanuntbmmc046/kanuntbmmc046/kanuntbmmc04600197.pdf](https://www5.tbmm.gov.tr/tutanaklar/KANUNLAR_KARARLAR/kanuntbmmc046/kanuntbmmc046/kanuntbmmc04600197.pdf), 11.08.2022. Later, after the amendment made with the *Law No. 2348 on Amending the Motor Land Vehicles Tax Law No. 197*, it took its current name. **See:** Official Gazette dated 28.11.1980 and numbered 17174. As a matter of fact, in the justification of the Law No. 197 on Amending the Motor Vehicles Tax Law, the material burden of the use of motor vehicles on the economy and especially on the public sector has been emphasized and it has been stated that the revenues of the motor land vehicles tax have the lowest collection rate among the taxes. **See:** Türkiye Büyük Millet Meclisi, **197 Sayılı Motorlu Kara Taşıtları Vergisi Kanununda Değişiklik Yapılmasına Dair Kanun Tasarısı (1/50)**, [https://www5.tbmm.gov.tr/tutanaklar/TUTANAK/MGK\\_/d01/c001/mgk\\_01001020ss0067.pdf](https://www5.tbmm.gov.tr/tutanaklar/TUTANAK/MGK_/d01/c001/mgk_01001020ss0067.pdf), 11.08.2022. In this respect, it is clearly understood that the main purpose of the motor vehicle tax is fiscal.

<sup>162</sup> **See:** Official Gazette dated 02.01.2004 and numbered 25334-Repetitive.

<sup>163</sup> **See:** Türkiye Büyük Millet Meclisi, **Bazı Kanunlarda Değişiklik Yapılması Hakkında Kanun Tasarısı ve Plan ve Bütçe Komisyonu Raporu (1/720)**, <https://www5.tbmm.gov.tr/tutanaklar/TUTANAK/TBMM/d22/c036/tbmm22036037ss0316.pdf>, 19.09.2022, ("**5035 Sayılı Kanun Tasarısı**").

<sup>164</sup> **See:** Akif Erginay, **Vergi Hukuku: İlkeler-Vergi Tekniği, Türk Vergi Sistemi**, 14th Edition, Ankara, Savaş, 1990, p. 238, 248; Aksoy, "**Vergi Hukuku**", p. 331-352; Kaneti, **op. cit.**, p. 364, 383; Doğan Şenyüz & Mehmet Yüce & Adnan Gerçek, **Türk Vergi Sistemi**, 17th Edition, Bursa, Ekin, 2020, p. 385; Erdoğan Öner, **Türk Vergi Sistemi**, 10th Edition, Ankara, Seçkin, 2020, p. 313; Nurettin Bilici, **Türk Vergi Sistemi**, 44th Edition, Ankara, Savaş, 2020, p. 188; S. Ateş Oktar, **Türk Vergi Sistemi**, 2nd Edition, İstanbul, Türkmen, 2018, p. 367.

<sup>165</sup> **See:** Türkiye Büyük Millet Meclisi, **Özel Tüketim Vergisi Kanun Tasarısı ve Plan ve Bütçe Komisyonu Raporu (1/988)**, <https://www5.tbmm.gov.tr/tutanaklar/TUTANAK/TBMM/d21/c096/tbmm21096106ss0870.pdf>, 15.08.2022.

the total tax revenues, affect the consumption patterns of consumers as well as collecting income. In addition, it was stated that while special consumption taxes provide fiscal purposes, these taxes can affect consumer preferences in a wide range of areas such as energy savings, transportation and environment.

Therefore, unlike the Motor Vehicles Tax Law, there is also a focus that directs the will of the consumer in the justification of the Special Consumption Tax Law. In this sense, apart from the fiscal purpose of the tax, especially the environmental issue is also included. Although this is the case, even in the justification, the priority is the fiscal purpose of the special consumption tax. The main purpose of the tax is not the solution of a concrete environmental problem. As a matter of fact, in a special consumption tax applied to motor vehicles, oil, natural gas and fuels, it is clear that the alternatives that the consumer can develop alone are quite limited. Again, it should be noted that before being included in the scope of the Special Consumption Tax Law, the fuel consumption tax was regulated by *the abolished Fuel Consumption Tax Law No. 3074*<sup>166</sup>. When the justification given in *the Draft Fuel Consumption Tax Law*<sup>167</sup> is examined, it is clearly stated that the purpose of the Law is to create an additional source of finance. However, it can be stated that the special consumption tax applied on the basis of vehicles, petroleum, natural gas and fuels maintains a balance between these targets and externalities, with priority being given to the economic policy targets.

Finally, when it is desired to make an evaluation on the environment and cleaning tax included in the study, it is seen that the environment and cleaning tax was established with an amendment made in 2003 in *the Law on Amending the Law on Municipal Revenues No. 3914*<sup>168</sup>.

In the justification of the relevant legal amendment, it is stated that the financing needs of the municipalities have increased and they are experiencing extraordinary fiscal difficulties.

In addition, it has been stated that there is a need to collect a fee from the residents of the town for the environmental cleaning services undertaken, and thus, the participation of the people in the environmental cleaning together with the fiscal means is needed. Again, in the justification, it was

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<sup>166</sup> See: Official Gazette dated 20.11.1984 and numbered 18581.

<sup>167</sup> See: Türkiye Büyük Millet Meclisi, **Akaryakıt Tüketim Vergisi Kanunu Tasarısı ve Plan ve Bütçe Komisyonu Raporu (1/612)**, <https://www5.tbmm.gov.tr/tutanaklar/TUTANAK/TBMM/d17/c008/tbmm17008022ss0141.pdf>, 16.08.2022.

<sup>168</sup> See: Official Gazette dated 24.07.1993 and numbered 21647.

stated that an environmental cleaning tax was introduced for those who benefits from solid waste collection and sewerage services as an immediate and short-term solution to the fiscal problems of the municipalities<sup>169</sup>. In this context, taxpayers have been appointed even in buildings that are empty for solid wastes, and buildings are divided into groups and degrees in the calculation of taxes to be paid. It is envisaged that the waste water subject to environmental cleaning tax will be collected together with the water consumption price according to the building group and grades and not exceeding the water consumption price<sup>170</sup>. In this context, for the first time, the contribution of individuals to environmental cleaning was included as a legal justification in taxation. However, it is thought that the fiscal purpose of the tax is dominant in the environmental cleaning tax. The regulation on environmental cleaning tax has been amended with the Law No. 5035 on Amending Certain Laws. Within the scope of these changes, the system of calculating the environmental cleaning tax of the houses on the basis of the amount of water consumption has been started<sup>171</sup>. It has been brought as a rule that taxes for workplaces and buildings used in other ways are collected according to building grades and groups. At this point, it is thought that due to the direct connection with the amount of water consumption in the calculation of the environmental cleaning tax, the environmental purpose is getting closer. However, it is believed that the fiscal purpose of the environmental cleaning tax is still dominant due to the main purpose of its introduction and the taxes on workplaces and other buildings used in other ways continue to be calculated according to the building group and grade.

When we want to make an evaluation regarding the plastic bag fee regulated in the Environmental Law, we have reached a different conclusion from the fiscal liabilities mentioned above.

In the general rationale of Law No. 7153 On the Amendment of the Environment Law and Some Laws, it is stated that regulations regarding the

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<sup>169</sup> See: Türkiye Büyük Millet Meclisi, **Belediye Gelirleri Kanununda Değişiklik Yapılması Hakkında Kanun Tasarısı ve Plan ve Bütçe Komisyonu Raporu (1/555)**, <https://www5.tbmm.gov.tr/tutanaklar/TUTANAK/TBMM/d19/c038/tbmm19038124ss0354.pdf>, 11.10.2022.

<sup>170</sup> In this sense, *the tariff* basis has been made effective for workplaces and other buildings in the calculation of environmental cleaning tax. See: Fazıl Aydın, “2006 Yılı Çevre Temizlik Vergisi Uygulaması”, **Vergi Sorunları Dergisi**, No.: 209, February 2006, pp. 14-18, p. 15; Mehmet Tosuner, Abdullah Tekbaş, “Atık Su Bedeli ve Sıvı Atık Çevre Temizlik Vergisinin Gelişimi Ve Niteliği Üzerine Bir İnceleme”, **Vergi Sorunları Dergisi**, No.: 189, June 2004, pp. 33-45, p. 44.

<sup>171</sup> See: Türkiye Büyük Millet Meclisi, “**5035 Sayılı Kanun Tasarısı**”.

efficient use of resources should be made to reduce the use of plastic bags and plastic packaging, which are almost impossible to recycle and cause environmental pollution.

In addition, in the justification of the special article regarding the plastic bag fee, it is stated that to reduce the use of plastic bags, which are almost impossible to recycle and cause serious visual and environmental pollution, plastic shopping bags will be given to the consumer for a fee and the amount of use per person will be reduced. Afterwards, it was stated that the sale of plastic bags was aimed at efficient use of resources and gaining income for the economy<sup>172</sup>.

Therefore, at the level of legal justification, a legal regulation has been introduced in the Turkish Tax System in which the environmental purpose of a fiscal liability takes place at the primary level.

In other words, the will of the legislator regarding environmental pollution has been put forward in the justification of the changes regarding the recycling participation fee and the plastic bag fee, and a fiscal purpose has been stated in the shadow of this purpose.

In the doctrine, it is stated that among the taxes, which are one of the tools used in the fight against environmental pollution, those related to the use of plastic bags have an important place<sup>173</sup>. Because the plastic bag tax is a tax that is put into practice in order to realize the objectives found in environmental taxes<sup>174</sup>. In this context, it is claimed that charging a fee for plastic bags may have a reducing effect on the use of heavily used plastic bags<sup>175</sup>.

It is seen that the plastic bag fee complies with the definition of environmental tax in OECD<sup>176</sup> and EU<sup>177</sup> studies. The first of the elements in the definition of environmental tax is that the tax base has a proven negative impact on the environment. As a matter of fact, a fiscal liability has been established for plastic bags that *have objectively proven their damage to the environment*, since recycling is almost impossible. Another element in the

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<sup>172</sup> See: Türkiye Büyük Millet Meclisi, **Kocaeli Milletvekili İlyas Şeker ve 6 Milletvekilinin Çevre Kanunu ve Bazı Kanunlarda Değişiklik Yapılmasına Dair Kanun Teklifi (2/1285) ve Çevre Komisyonu Raporu**, <https://www5.tbmm.gov.tr/sirasayi/donem27/yil01/ss15.pdf>, 10.08.2022.

<sup>173</sup> Yılmaz, Biyan, **op. cit.**, p. 101.

<sup>174</sup> Erkan Kılıçer, "Plastik Poşet Vergisi ve Örnek Ülke Uygulamaları," **Vergi Sorunları Dergisi**, No.: 357, June 2018, pp. 55-64, p. 56.

<sup>175</sup> Göker, Süt Göker, **op. cit.**, p. 52.

<sup>176</sup> See: OECD, "**Environmental Fiscal Reform**".

<sup>177</sup> See: European Commission, "**Environmental Taxes**".

definition of environmental tax is that the tax base of the tax base is a physical unit. The fact that the plastic bag fee is charged per piece indicates that *a physical unit constitutes the base*.

Although there is no expression as a tax in its name, the plastic bag fee is thought to be a tax that can be evaluated as ***an environmental tax*** in the Turkish Tax System in the context of OECD and EU studies, since it serves to internalize negative externalities.

## CONCLUSION

The environment is an indispensable and only exhaustible issue, and it is one of the areas most affected by negative externalities. For this reason, a future that requires much more effort awaits us in pursuit of a sustainable environment. As one of these efforts, it is thought that tax classification has gained a new dimension. As a matter of fact, apart from the classification made on the basis of traditional income, wealth and expenditure in tax systems, a new category has emerged under the name of environmental taxes. In this sense, the principle of collecting tax according to fiscal power within the framework of fiscal purpose, which is the classical purpose of tax, is no longer applicable alone. Within the scope of these efforts, it is thought that the instrumental role of taxes will not change, but environmental taxes will be more dominant in country practices rather than environmentally related taxes.

At this point, the need for a definition has emerged for the taxes that have an “environmental” quality by the OECD and the EU. These definitions are also different from the classical tax definition. With this different tax definition, it becomes easier to determine at what level countries apply to fiscal liabilities on sustainable environment.

Among the environmental taxes and environmentally related taxes conceptualized by the OECD and the EU, it seems that the most focused on today is environmentally related taxes. As a matter of fact, the environment and taxes ensure that the activities carried out by the mentioned organizations are more comprehensive.

Environmental taxes are more ancient fiscal liabilities compared to environmentally related taxes. Environmental taxes, on the other hand, are taxes with a relatively new history and it is predicted that their number will increase day by day.

Although environmentally related taxes have existed for a long time in Turkey, these taxes have a fiscal purpose as a priority. However, 2019 is considered to be a milestone in terms of environmental taxation in Turkey.

Because the plastic bag fee envisaged in the Environmental Law falls within the scope of the environmental tax definition made in the OECD and EU studies. Because the plastic bag fee has a base applied per piece as a physical amount. At the same time, this base is made up of plastic bags that have been objectively proven to harm the environment. In this sense, both the polluter pays, and the user pays principles have been activated by reflecting the plastic bag fee to the consumers.

In addition, the will of the legislator, manifested as the prevention of environmental pollution, stands out in the justification for introducing the plastic bag fee, and the fiscal purpose remains in the background in the bag fee. In this sense, an environmental tax was established with the plastic bag fee for the first time in the Turkish Tax System, which was regulated outside of a fiscal law and whose primary purpose was to protect the environment.

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