



*Araştırma Makalesi / Research Article*

## Measurement of Tax Gap and Analysis of Tax Gap Components in OECD Countries: Panel Data Method

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### Abstract

Today, tax gap and measurement of tax gap is an important issue. In this study, in order to contribute to the literature, the tax gap of 35 OECD countries for the years 2005-2017 was measured. In the study, GDP, total tax rate and informal economy rates were used. The countries with the lowest tax gap rates are Luxembourg and Switzerland. The countries with the highest tax gap rates are Colombia, Greece and Costa Rica. In addition, the effects of GDP, total tax rate and informal economy rate on the size of the tax gap were examined. The data were tested by applying the panel data analysis method, cross-section dependency, unit root test and fixed effects models. According to the model's results, the informal economy rate increases the tax gap with the increase in the total tax rate and GDP. The tax gap, which exceeds the acceptable level, harms the economies. For this reason, it is very important that the tax gap remains at a controllable level. In this context, it is necessary to make legal arrangements in order to register the informal economy.

**Keywords:** Tax gap, OECD, Gross Domestic Product, Panel Veri Analizi.

## OECD Ülkelerinde Vergi Açığının Ölçümü ve Vergi Açığı Bileşenlerinin Analizi: Panel Veri Yöntemi

### Öz

Günümüzde vergi açığı ve vergi açığının ölçümü önemli bir konudur. Bu çalışmada da literatüre katkı sağlanması amacıyla 35 OECD ülkesinin 2005-2017 yılları vergi açığı ölçülmüştür. Çalışmada GSYH, toplam vergi oranı ve kayıtdışı ekonomi oranlarından yararlanılmıştır. En düşük vergi açığı oranına sahip olan ülkeler Lüksemburg ve İsviçre'dir. En yüksek vergi açığı oranına sahip ülkeler ise Kolombiya, Yunanistan ve Costa Rika'dır. Çalışmada ayrıca GSYH, toplam vergi oranı ve kayıtdışı ekonomi oranının vergi açığının boyutu üzerindeki etkileri incelenmiştir. Veriler panel veri analiz yöntemi ile yatay kesit bağımlılığı, birim kök testi ve sabit etkiler modelleri uygulanarak test edilmiştir. Kayıtdışı ekonomi oranı, toplam vergi oranı ve GSYH' daki artış ile vergi açığını da arttırmaktadır. Kabul edilebilir seviyeyi aşan vergi açığı ekonomilere zarar vermektedir. Bu nedenle vergi açığının kontrol edilebilir düzeyde kalması oldukça önemlidir. Bunun içinde de kayıtdışı ekonominin kayıt altına alınması için yasal düzenlemelerin yapılması gereklidir.

**Anahtar Kelimeler:** Vergi açığı, OECD, Gayrisafi Yurtiçi Hâsıla, Panel Data Analysis.

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## INTRODUCTION

The state has duties that must be fulfilled as a state requirement. To fulfill these duties, it needs financial resources. It obtains this resource largely through tax revenues. The fact that tax revenues are the state's most important source of income has revealed the importance of the effective collection. Although an effective collection of tax revenues is essential for governments, governments sometimes allow tax evasion, tax avoidance and informal activities to support economic growth and development. However, this situation creates the effect of increasing the tax gap. At this stage, the state should be able to control tax evasion, tax avoidance and informal economy activities and ensure that the tax gap remains within acceptable limits. Because the size of the tax gap is seen as a sign that the socioeconomic policy is wrong and needs to be corrected so that business activity can regain its economic and legal character. In addition, the increase in the tax gap indicates an increase in the informal economy. The existence and size of the informal economy prevent the collection of public revenues and create a distorting effect on fair income distribution.

For this reason, knowing the size of the tax gap serves as a system that can take the necessary measures and analyze to protect the financial interests of the state treasury in the public administration process. According to Her Majesty Revenue and Customs (2012), the tax gap can be expressed as the difference between the tax revenues collected by the revenue administrations in a certain period and the amount of tax that should be collected if there is no tax loss or evasion. Although the tax gap has been on the agenda recently, many countries still need to be able to work on this issue due to its difficult and complex measurement. The UK Revenue Administration conducts the most extensive study on this subject, HMRC, which regularly publishes tax gap measurements by general and tax types annually. Keyifli's (2019) study, the tax gap for all OECD countries between 2010-2015, was examined and tried to reveal the methodology used to calculate the tax gap (Keyifli, 2019). There are limited studies on measuring the tax gap in the national literature. Çağdaş et al. (2020) empirically examined the concept of the tax gap in terms of socioeconomic and financial development on a provincial basis in Turkey (Çağdaş, 2020).

In this study, to contribute to the literature, first of all, tax gap measurements were made to determine income losses due to taxes in OECD countries. In the study, an econometric analysis was made that determines the effects of GDP, informal economy, and total tax on the tax gap by using the tax gap measurements we have made as the dependent variable. The study has been prepared in three parts. In the first part, the literature review is given. In the second part, the nominal value of the tax gap and its ratio to GDP was measured in 35 OECD countries using GDP, informal economy, and total tax rates. In the third part, to analyze the effects of the factors used in the tax gap measurement on the gap, panel data analysis and stata 15 were used to analyze the cross-section dependence, unit root test, and fixed-effects models.

### 1. LITERATURE REVIEW

It is possible to come across different definitions of the concept of the tax gap in the literature. Some of the definitions made are as follows: The US Internal Revenue Service (IRS) defined the tax gap as "The difference between the tax that taxpayers must pay and the tax they actually and timely pay" or "The difference between the actual tax liability in any given year and the amount of tax paid on time" (Holgmen, 2013). The tax gap is the tax income that is between

the current tax capacity and the tax effort in an economy in a certain period and that is not collected/uncollectible although the tax has been levied, accrued, and has the opportunity to be collected (Brown & Mazur, 2003; Mazur & Plumbey, 2007; Toder, 2005). Plumbey, while defining the tax gap, divided it into three components: filing errors, under-reporting, and underpayment (Plumbey, 2005). Gemmell and Hasseldine defined the tax gap as the difference between the overdue taxes that taxpayers must pay within a certain period, and the amount of tax contributed to the state budget (Gemmell & Hasseldine, 2012). Giles expressed the tax gap as the hidden economy and hidden income. According to Giles, the value obtained by multiplying the illegal income with the legal tax rate constitutes the tax gap (Giles, 1997a; Giles, 1997b).

There are limited studies on measuring the tax gap in the national literature. Çağdaş et al. (2020) empirically examined the concept of tax gap in terms of socioeconomic and financial development on a provincial basis in Turkey. As a result of the study, they determined that socioeconomic factors are more effective in reducing the tax gap than the level of financial development (Çağdaş et al., 2020). Another study belongs to Keyifli (2019). This study examined the tax gap for all OECD countries between 2010-2015 and tried to reveal the methodology used to calculate the tax gap. In the study, an indirect method was preferred in order to estimate the tax gap, using the results of the informal economy estimated according to the multi-indicator methods, the GDP of the countries and the total tax rates. The estimation results showed that in 2015, a total of 1,373.3 billion dollars for 34 OECD member countries. The important finding is that the size of the tax burdens of the countries is not similar to the informal economy in the country. Although the highest tax burden for 2015 is seen in countries such as France (64.9%) and Italy (64.8%), the countries with the highest informal economy in the relevant year are Mexico (28.07%) and Turkey (27.43%) (Keyifli, 2019).

Predicting the tax gap is essential in protecting the state treasury's financial interests and establishing a control mechanism in public administration. The tax gap's size indicates that socioeconomic policies are faulty and should be corrected for commercial activity to regain its economic and legal character (Uygun & Gerçek, 2021; Uygun, 2021). Although there is no general rate accepted in the literature, some authors state that the acceptable limit is 5%. Even if the tax gap exceeding the acceptable limit (approximately 5% of GDP) contributes to economic growth, it may create a negative situation in terms of ensuring long-term sustainability (Kuhlen, 2014; Schneider, 2002; Schneider et al., 2010).

Two main research groups designed to investigate the tax gap have been established in the literature. The first is based on control and supervision methods selected from the representative group. Subsequent research is generalized to the entire population. Determining the tax gap has yet to be considered an effective research method since the scope of the audits is limited (O'Doherty, 2014). The second one is called the indirect (macro) method. In this method, there is no physical control over taxpayers. It is based on tax returns and generally easy-to-detect national income-expense gap, tax returns, money flows, business transactions, and other data sources (Gemmell & Hasseldine, 2012). Warren and McManus emphasize that three types of benefits result from measuring the tax gap: first, it allows identifying levels of inappropriate use of resources; second, measuring the tax gap increases the efficiency of resource allocation for revenue administrations; and third, measuring the tax gap becomes a measure of the tax authority's effectiveness in collecting tax revenues (Warren & McManus, 2006). According to Murphy, the tax gap consists of three parts (Murphy, 2019): The first is tax liability. Tax debt is the sum of the debts of the taxpayers who do not knowingly and willingly

pay their debts or pay late. The second is tax avoidance. Tax avoidance is the practice made in a way that minimizes the tax to be paid within the framework of the law. The third is tax evasion. Tax evasion, on the other hand, is the loss of income created by the deduction of income that is not legally accepted or that individuals or institutions do not declare their taxable income deliberately and illegally.

In addition to theoretical explanations, studies on the tax gap measurement have increased significantly in recent years. In his study published in 2015, Raczkowski (2015) examined the tax gap for EU countries for the years 2011-2014 and explained the methodology used to calculate the tax gap (Raczkowski, 2015). The study has been prepared by using the literature dealing with the tax gap in tax evasion and tax avoidance. Using GDP, informal economy, and total tax rates, nominal and proportional measurements of the tax gap were made. It has also been determined that the total tax gap for all 28 EU countries in 2014 was \$1331.6 billion (1.33 trillion \$). Another study, which is a continuation of this study, was conducted by Raczkowski and Mroz in 2018 (Raczkowski & Mroz, 2018). The study covers 35 countries in total for the years 2011-2015. As a result of the study, it has been seen that the level of tax gap has a strong relationship with GDP and varies according to the country. In other words, if the GDP is high, the tax gap as a percentage of GDP is found to be lower in most countries. For example, although the tax gap rate is 4.3% in Japan, 3.8% in the USA, and 3.2% in the United Kingdom, these countries have very high nominal GDP values. Murphy measured the tax gap of EU member states in terms of tax evasion in his study published in 2019 (Murphy, 2019). The study estimated that the tax gap arising from tax evasion for the EU in 2015 would be around 825 billion Euros. In addition, attention was drawn to the difficulty of estimating the corporate tax gap in the EU. However, it was also stated that it could be between 50-190 billion Euros per year with the current data. In addition, the estimates of the VAT gap in Euro millions for the years 2015-2016 are also included in the study. The EU VAT gap average for 2015 was 13.2%, and for 2016 was 12.3%. Center for Social and Economics Research (CASE) has been conducting studies on VAT gap measurements in European Union member states every year since 2013 and continues to publish its study reports. The final report was published in September 2021 (CASE, 2021). In 2019, it was stated that the economic conditions are favorable to increase tax compliance in the European Union member states (EU). It is estimated that the VAT total tax liability (VTTL) increased by 2.9% in 2019, while the VAT income increased by 3.8%, leading to a relative and nominal decrease in the VAT gap (CASE, 2021). In their study on the tax gap measurement in Turkey, Uygun & Gerçek measured both the general and tax gap rates according to tax types for the years 2005-2019. Between 2005 and 2017, Turkey's general tax gap rates were calculated between 10.17% and 13.27%. It has been stated that the high rate of the informal economy is an important factor in the tax gap rate. The tax expenditure rate, tax loss, evasion rate, and the total tax rate calculated by the authors were used to measure the tax gap according to tax types (Gerçek & Uygun, 2021; Gerçek & Uygun, 2022). According to tax types, income tax and corporate tax gap, which are based on declaration and included in the direct tax class, are higher than other taxes (Uygun & Gerçek, 2021; Uygun & Kasa, 2017).

## 2. MEASUREMENT OF TAX GAP IN OECD COUNTRIES

In this section, the measurements of the tax gap for the years 2005-2017 are given. It is possible to reach GDP ratios on the basis of countries and on an annual basis. However, the study data of the World Bank for the measurement of total tax rates covers the years 2005 - 2019. Although many studies have been conducted on the measurement of informal economy rates, the study data of Schneider and others, which are thought to provide the most comprehensive and reliable data on this subject, have been used. Schneider et al. The data on the informal economy rates in the studies of For this reason, the study was prepared to cover the years 2005 - 2017.

Three different data were used for the measurement. The first is the GDP (in billions of dollars nominal, per capita) values obtained from the World Bank database. This is because it is the reserve currency that most countries use in international trade. Other data is the total tax rate obtained as a result of the work carried out by the World Bank on the determination of the tax burdens of countries since 2005. Another data is the informal economy rates (as % of GDP). Informal economy data are taken from Schneider & Medina's study using the MIMIC (Multiple Indicators Multiple Causes) model (Medina & Schneider, 2019; Schneider & Bagaja, 2005; Schneider & Bagaja, 2005). The MIMIC (Multiple Indicator Multiple Causes) model is a time series forecasting model used to measure the informal economy. The MIMIC approach considers the number of observable economic situations that determine the level of informal activities with a set of multiple observable indicators. The MIMIC model approach is based on the statistical theory of latent variables, which includes many cause and indicator variables. The model approach considers such dimensions of the closed economy as "hidden variables", so statistical modeling is used (Medina & Schneider, 2019; Schneider & Bagaja, 2005; Schneider & Bagaja, 2005). GDP, total tax and contribution rate (TTR) informal economy data, and nominal tax gap levels of OECD countries for 2005-2017 are calculated in US dollars. The formula used in the calculation in question is taken from the studies of Raczkowski & Mroz published in 2015 and 2019. The detailed and simple version of the formula is as follows (Raczkowski, 2015; Raczkowski & Mroz, 2018):

$$TG_n = \frac{SE(\%)_n}{100\%} \cdot GDP_n \cdot \frac{TTR(\%)}{GDP_n} = \frac{SE(\%)_r}{100\%} \cdot TTR(100) \quad (1)$$

$$TG_n = TTR\% \cdot SE_n \quad (2)$$

TG<sub>n</sub>: Tax Gap (nominal);

GDP<sub>n</sub>: GDP (nominal, at current prices, per capita);

SE<sub>n</sub>: Shadow Economy (nominal);

TTR: Total Tax and Contribution Rate.

The total tax and contribution rate (TTR), expressed as a percentage of business profit, measures the amount of tax the business pays in its second operating year. The total tax amount is the sum of all the different business tax liabilities borne by the company (World Bank).

The 2005-2017 tax gap nominal values of 35 OECD countries calculated with the above formula and the ratios of tax gap to GDP are also given in table 1. for some years, total tax rate

data for Japan, Mexico, and the USA could not be reached. The tax gap could not be calculated; therefore, they were not included in the analysis.

The three countries with the lowest tax gap rates are Switzerland (1.47% to 1.84%), Luxembourg (1.58% to 1.86%) and the United Kingdom (2.89% to 3.73%). These countries are the developed European countries at the top of the human development index. In the human development index of 2020, Switzerland ranks second, the United Kingdom 13th and Luxembourg 23rd, and it has the status of a very highly developed country. In addition, according to GDP, Switzerland is one of the wealthiest countries in the world, and the United Kingdom is the fifth largest economy in the world. Luxembourg ranks first in the world in terms of annual per capita income.

The countries with the highest tax gap rates are Colombia (20.33% to 29.22%), Costa Rica (12.36% to 13.64%), Greece (9.20% to 12.88%) and Italy (9.50% to 16.26%). Although Colombia is an oil, natural gas, and coal exporting country, the struggle of armed groups with security forces and the presence of drug gangs are factors that hinder development. Informal economy rates in Colombia are between 25.8% and 30%. Financial imbalances, budget, and current account gaps are the biggest threats to economic stability and growth in Costa Rica. Informal economy rates in Costa Rica are in the 21-22% band. Greece is the least developed economy in the EU. Waste in public expenditures, tax evasion, corruption, borrowing, and budget deficit are structural problems. Italy is one of the most industrialized countries in the world, leading in trade and exports (UN, Human- Development Report, 2020). It was hit hard by the 2007-2008 financial crisis, which exacerbated the country's structural problems. It ranked 2nd in Europe in debt size due to government expenditures made due to political efforts to stimulate growth and significant increases in public debt. Although the tax gap in Italy was around 15-16% in 2005-2006, it has been observed to have a decreasing trend in recent years.

**Table 1: Calculations of The Tax Gap For Some OECD Countries Over 2005-2017**

|             | 2005    |       | 2006    |       | 2007    |       | 2008    |       | 2009    |       |
|-------------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
|             | 1       | 2     | 1       | 2     | 1       | 2     | 1       | 2     | 1       | 2     |
| Austria     | 43.71   | 6.30  | 44.23   | 5.93  | 47.44   | 5.56  | 54.28   | 5.15  | 48.34   | 5.21  |
| Australia   | 13.73   | 4.35  | 12.53   | 3.73  | 12.71   | 3.27  | 14.07   | 3.27  | 16.11   | 4.02  |
| Belgium     | 41.95   | 10.88 | 43.25   | 10.60 | 43.84   | 9.32  | 44.64   | 8.66  | 46.23   | 9.60  |
| Canada      | 70.77   | 6.03  | 71.24   | 5.40  | 75.48   | 5.14  | 78.76   | 5.07  | 76.75   | 5.58  |
| Chile       | 5.10    | 4.15  | 5.98    | 3.87  | 6.54    | 3.77  | 6.72    | 3.74  | 7.14    | 4.14  |
| Colombia    | 42.54   | 29.22 | 44.80   | 27.72 | 56.28   | 27.29 | 57.96   | 23.93 | 60.57   | 26.06 |
| Costa Rica  | 2.70    | 13.48 | 3.02    | 13.30 | 3.55    | 13.19 | 3.95    | 12.84 | 4.23    | 13.77 |
| C.Republic  | 10.08   | 7.35  | 10.77   | 6.89  | 11.79   | 6.20  | 13.67   | 5.77  | 13.28   | 6.40  |
| Denmark     | 10.86   | 4.11  | 10.28   | 3.63  | 11.20   | 3.51  | 10.98   | 3.11  | 11.79   | 3.67  |
| Estonia     | 1.68    | 11.94 | 1.87    | 10.97 | 2.28    | 10.19 | 2.46    | 10.13 | 2.28    | 11.62 |
| Finland     | 11.46   | 5.59  | 11.28   | 5.20  | 12.36   | 4.83  | 13.19   | 4.64  | 13.61   | 5.39  |
| France      | 187.49  | 8.54  | 186.59  | 8.05  | 196.01  | 7.38  | 199.54  | 6.84  | 221.35  | 8.23  |
| Germany     | 147.96  | 5.20  | 141.83  | 4.74  | 149.20  | 4.36  | 160.31  | 4.30  | 164.08  | 4.83  |
| Greece      | 31.45   | 12.69 | 30.44   | 11.14 | 32.55   | 10.22 | 32.60   | 9.20  | 35.14   | 10.65 |
| Hungary     | 13.49   | 11.95 | 13.14   | 11.37 | 15.21   | 10.87 | 16.85   | 10.66 | 15.63   | 11.96 |
| Iceland     | 0.54    | 3.24  | 0.56    | 3.22  | 0.62    | 2.87  | 0.57    | 3.13  | 0.44    | 3.39  |
| İreland     | 6.56    | 3.10  | 6.95    | 3.00  | 7.81    | 2.90  | 8.25    | 3.01  | 7.60    | 3.23  |
| Israel      | 10.93   | 7.67  | 11.26   | 7.31  | 11.78   | 6.58  | 12.37   | 5.72  | 12.04   | 5.80  |
| Italy       | 302.04  | 16.26 | 300.69  | 15.44 | 306.24  | 13.86 | 314.78  | 13.12 | 314.03  | 14.33 |
| Korea Rep.  | 88.08   | 9.42  | 86.94   | 8.26  | 88.93   | 7.58  | 89.11   | 8.51  | 79.57   | 8.43  |
| Latvia      | 1.39    | 8.25  | 1.68    | 7.82  | 2.22    | 7.17  | 2.55    | 7.14  | 2.10    | 7.99  |
| Lithuania   | 3.53    | 13.52 | 3.68    | 12.19 | 4.37    | 11.00 | 4.90    | 10.26 | 4.11    | 10.99 |
| Luxembourg  | -       | -     | 0.79    | 1.86  | 0.82    | 1.62  | 0.88    | 1.58  | 0.95    | 1.84  |
| Netherlands | 31.37   | 4.58  | 30.74   | 4.19  | 31.17   | 3.68  | 30.42   | 3.21  | 31.42   | 3.62  |
| New Zeland  | 4.62    | 4.03  | 4.46    | 4.00  | 5.21    | 3.80  | 5.22    | 3.92  | 4.72    | 3.88  |
| Norway      | 14.98   | 4.85  | 15.34   | 4.44  | 16.97   | 4.23  | 17.68   | 3.83  | 19.49   | 5.05  |
| Poland      | 32.53   | 10.63 | 35.73   | 10.37 | 41.89   | 9.77  | 50.30   | 9.43  | 41.38   | 9.41  |
| Portugal    | 17.27   | 8.76  | 17.91   | 8.58  | 18.54   | 7.72  | 19.17   | 7.31  | 19.69   | 8.08  |
| Slovakia    | 4.68    | 7.45  | 4.85    | 6.85  | 5.43    | 6.28  | 6.00    | 5.97  | 6.16    | 6.92  |
| Slovenia    | 3.25    | 8.98  | 3.38    | 8.55  | 3.54    | 7.37  | 3.54    | 6.39  | 3.84    | 7.63  |
| Spain       | 143.50  | 12.44 | 151.61  | 12.04 | 167.10  | 11.35 | 177.74  | 10.94 | 175.67  | 11.89 |
| Sweden      | 24.19   | 6.17  | 24.49   | 5.79  | 25.37   | 5.16  | 26.46   | 5.11  | 27.06   | 6.20  |
| Switzerland | 7.75    | 1.84  | 7.47    | 1.68  | 7.57    | 1.53  | 8.40    | 1.47  | 9.61    | 1.72  |
| Turkey      | 67.22   | 13.28 | 73.56   | 13.21 | 84.81   | 12.45 | 91.18   | 11.84 | 85.22   | 13.13 |
| UK          | 90.52   | 3.57  | 88.01   | 3.25  | 97.40   | 3.15  | 93.92   | 3.21  | 90.09   | 3.73  |
| OECD        | 3021.21 | 8.04  | 2956.14 | 7.45  | 3011.03 | 6.94  | 3062.90 | 6.66  | 3172.42 | 7.37  |

Not: (1) Bin USD; (2) % of of GDP, at current prices, per capita income: Source: Author elaboration; GDP data: World Bank base: <http://data.worldbank.org/indicator/NY.GDP.MKTP.CD>.; SE data: Leandro Medina, Friedrich Schneider, "Shedding Light on the Shadow Economy: A Global Database and the Interaction with the Official One", Cesifo Working Paper No:7981/1, (December 2019); [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3502028](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3502028). (05.01.2021).; TTR data: World Bank base: <http://data.worldbank.org/indicator/IC.TAX.TOTL.CP>.

**Continued Table 1**

|             | 2010    |       | 2011    |       | 2012    |       | 2013    |       |
|-------------|---------|-------|---------|-------|---------|-------|---------|-------|
|             | 1       | 2     | 1       | 2     | 1       | 2     | 1       | 2     |
| Austria     | 60.56   | 5.28  | 66.72   | 4.78  | 71.52   | 4.63  | 73.06   | 4.64  |
| Australia   | 15.28   | 3.90  | 15.11   | 3.51  | 14.99   | 3.66  | 15.63   | 3.63  |
| Belgium     | 46.57   | 9.68  | 48.25   | 9.23  | 48.22   | 9.72  | 50.22   | 9.63  |
| Canada      | 43.41   | 2.68  | 43.43   | 2.42  | 42.63   | 2.33  | 42.26   | 2.29  |
| Chile       | 8.14    | 3.72  | 8.71    | 3.45  | 10.43   | 3.91  | 11.02   | 3.96  |
| Colombia    | 71.10   | 24.82 | 68.08   | 20.33 | 73.56   | 19.83 | 77.68   | 20.33 |
| Costa Rica  | 5.13    | 13.64 | 5.75    | 13.47 | 6.20    | 13.13 | 6.58    | 12.92 |
| C.Republic  | 12.81   | 6.13  | 13.01   | 5.67  | 11.93   | 5.71  | 12.25   | 5.79  |
| Denmark     | 11.51   | 3.58  | 10.61   | 3.08  | 10.67   | 3.26  | 10.47   | 3.05  |
| Estonia     | 2.16    | 11.05 | 2.69    | 11.60 | 3.06    | 13.32 | 2.44    | 9.72  |
| Finland     | 11.28   | 4.53  | 11.41   | 4.14  | 11.64   | 4.51  | 12.02   | 4.43  |
| France      | 212.04  | 8.02  | 215.98  | 7.55  | 218.86  | 8.15  | 227.61  | 8.10  |
| Germany     | 169.20  | 4.98  | 162.21  | 4.33  | 160.28  | 4.54  | 181.44  | 4.86  |
| Greece      | 32.02   | 10.79 | 29.83   | 10.56 | 25.93   | 10.72 | 24.87   | 10.43 |
| Hungary     | 14.88   | 11.28 | 14.46   | 10.20 | 13.02   | 10.14 | 13.26   | 9.79  |
| Iceland     | 0.49    | 3.56  | 0.59    | 3.91  | 0.59    | 4.01  | 0.62    | 3.85  |
| İreland     | 6.92    | 3.12  | 7.30    | 3.06  | 6.93    | 3.07  | 7.22    | 3.03  |
| Israel      | 12.36   | 5.28  | 12.38   | 4.74  | 12.04   | 4.68  | 13.68   | 4.67  |
| Italy       | 300.06  | 14.06 | 292.82  | 12.78 | 282.16  | 13.52 | 280.94  | 13.12 |
| Japan       |         |       |         |       |         |       | 271.61  | 5.21  |
| Korea Rep.  | 83.26   | 7.28  | 98.72   | 7.88  | 100.41  | 7.85  | 105.30  | 7.68  |
| Latvia      | 1.86    | 7.80  | 2.02    | 7.14  | 1.89    | 6.69  | 1.96    | 6.44  |
| Lithuania   | 4.03    | 10.87 | 4.12    | 9.48  | 3.97    | 9.25  | 4.09    | 8.79  |
| Luxembourg  | 0.94    | 1.76  | 1.00    | 1.66  | 1.02    | 1.80  | 1.10    | 1.77  |
| Mexico      |         |       |         |       |         |       | 185.42  | 14.55 |
| Netherlands | 31.35   | 3.70  | 31.86   | 3.52  | 29.93   | 3.57  | 31.17   | 3.56  |
| New Zeland  | 5.59    | 3.82  | 5.96    | 3.54  | 6.23    | 3.54  | 6.50    | 3.41  |
| Norway      | 20.41   | 4.76  | 22.11   | 4.44  | 22.40   | 4.40  | 23.19   | 4.44  |
| Poland      | 41.88   | 8.73  | 42.37   | 8.02  | 40.78   | 8.18  | 41.58   | 7.98  |
| Portugal    | 18.85   | 7.92  | 18.35   | 7.50  | 16.03   | 7.42  | 16.71   | 7.39  |
| Slovakia    | 6.14    | 6.80  | 6.17    | 6.23  | 6.09    | 6.45  | 6.21    | 6.28  |
| Slovenia    | 3.54    | 7.36  | 3.54    | 6.88  | 3.33    | 7.14  | 3.16    | 6.53  |
| Spain       | 167.34  | 11.78 | 114.53  | 7.75  | 106.10  | 8.01  | 162.64  | 12.01 |
| Sweden      | 26.61   | 5.37  | 28.42   | 4.95  | 29.36   | 5.31  | 31.18   | 5.31  |
| Switzerland | 9.73    | 1.61  | 10.64   | 1.47  | 10.78   | 1.56  | 10.88   | 1.53  |
| Turkey      | 94.99   | 12.23 | 87.24   | 10.40 | 92.63   | 10.52 | 97.36   | 10.17 |
| UK          | 92.27   | 3.72  | 95.32   | 3.58  | 91.80   | 3.40  | 91.75   | 3.30  |
| US          |         |       |         |       |         |       | 492.57  | 2.93  |
| OECD        | 3132.16 | 6.93  | 3109.51 | 6.40  | 3178.27 | 6.55  | 3208.59 | 6.52  |

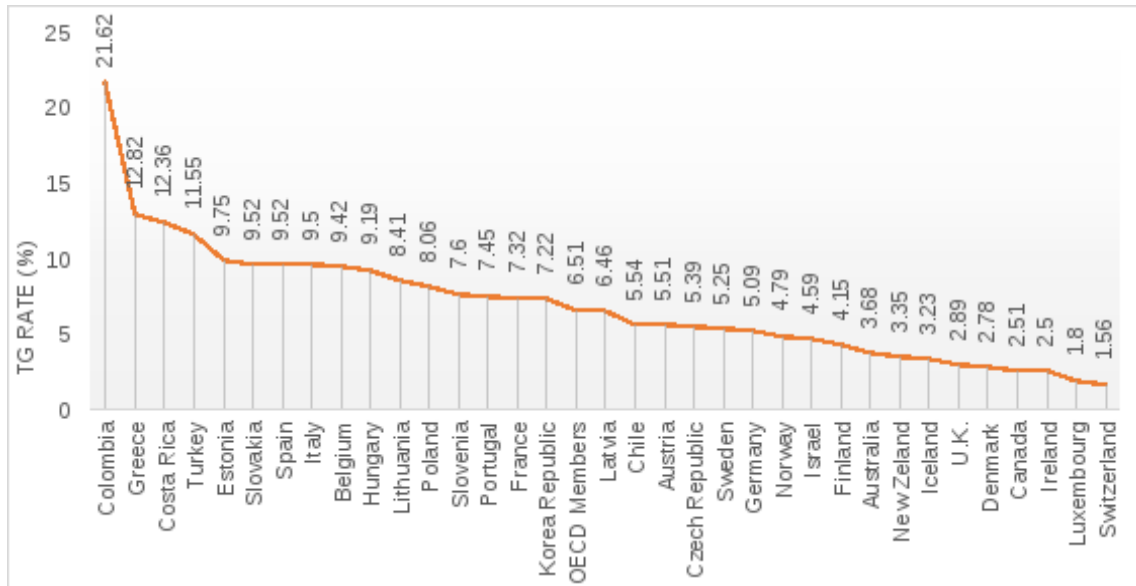


Continued Table 1

|             | 2014    |       | 2015    |       | 2016    |       | 2017    |       |
|-------------|---------|-------|---------|-------|---------|-------|---------|-------|
|             | 1       | 2     | 1       | 2     | 1       | 2     | 1       | 2     |
| Austria     | 65.39   | 4.46  | 67.56   | 5.00  | 67.90   | 5.62  | 73.24   | 5.51  |
| Australia   | 15.08   | 3.41  | 14.41   | 3.77  | 15.10   | 3.82  | 15.31   | 3.68  |
| Belgium     | 49.65   | 9.29  | 46.42   | 10.04 | 47.19   | 9.92  | 47.25   | 9.42  |
| Canada      | 42.29   | 2.34  | 39.74   | 2.55  | 39.47   | 2.58  | 41.36   | 2.51  |
| Chile       | 11.14   | 4.28  | 11.60   | 4.75  | 13.29   | 5.31  | 15.36   | 5.54  |
| Colombia    | 79.17   | 20.77 | 60.69   | 20.68 | 61.25   | 21.66 | 67.43   | 21.62 |
| Costa Rica  | 6.66    | 12.80 | 7.12    | 12.63 | 7.34    | 12.48 | 7.48    | 12.36 |
| C.Republic  | 11.78   | 5.63  | 10.67   | 5.67  | 11.13   | 5.67  | 11.79   | 5.39  |
| Denmark     | 9.95    | 2.82  | 8.68    | 2.87  | 9.24    | 2.95  | 9.25    | 2.78  |
| Estonia     | 2.53    | 9.50  | 2.37    | 10.33 | 2.43    | 10.14 | 2.61    | 9.75  |
| Finland     | 11.67   | 4.25  | 10.22   | 4.36  | 10.45   | 4.34  | 10.58   | 4.15  |
| France      | 231.82  | 8.13  | 193.05  | 7.92  | 193.26  | 7.82  | 189.60  | 7.32  |
| Germany     | 174.37  | 4.49  | 167.06  | 4.98  | 181.43  | 5.23  | 187.24  | 5.09  |
| Greece      | 28.15   | 11.97 | 24.51   | 12.55 | 24.82   | 12.88 | 25.59   | 12.82 |
| Hungary     | 13.34   | 9.48  | 12.53   | 10.03 | 12.19   | 9.49  | 13.13   | 9.19  |
| Iceland     | 0.65    | 3.67  | 0.64    | 3.67  | 0.73    | 3.49  | 0.80    | 3.23  |
| İreland     | 7.40    | 2.86  | 7.20    | 2.47  | 7.53    | 2.52  | 8.35    | 2.50  |
| Israel      | 14.15   | 4.57  | 14.74   | 4.91  | 15.76   | 4.95  | 16.18   | 4.59  |
| Italy       | 277.32  | 12.84 | 248.64  | 13.54 | 239.58  | 12.77 | 185.98  | 9.50  |
| Japan       | 266.02  | 5.43  | 262.11  | 5.90  | 271.04  | 5.42  | 252.42  | 5.12  |
| Korea Rep.  | 110.88  | 7.47  | 112.89  | 7.70  | 112.71  | 7.51  | 117.18  | 7.22  |
| Latvia      | 1.96    | 6.27  | 1.87    | 6.86  | 1.90    | 6.75  | 1.96    | 6.46  |
| Lithuania   | 4.11    | 8.48  | 3.76    | 9.07  | 3.85    | 8.95  | 4.00    | 8.41  |
| Luxembourg  | 1.08    | 1.63  | 1.01    | 1.75  | 1.10    | 1.81  | 1.15    | 1.80  |
| Mexico      | 186.83  | 14.20 | 175.54  | 14.98 | 164.31  | 15.24 | 173.90  | 15.01 |
| Netherlands | 29.88   | 3.35  | 28.24   | 3.69  | 28.80   | 3.68  | 29.79   | 3.58  |
| New Zeland  | 6.58    | 3.27  | 6.11    | 3.43  | 6.54    | 3.46  | 6.92    | 3.35  |
| Norway      | 22.35   | 4.48  | 19.05   | 4.94  | 19.08   | 5.17  | 19.07   | 4.79  |
| Poland      | 42.20   | 7.78  | 38.99   | 8.16  | 38.95   | 8.24  | 42.43   | 8.06  |
| Portugal    | 16.22   | 7.06  | 14.18   | 7.12  | 14.04   | 6.81  | 14.15   | 7.45  |
| Slovakia    | 6.45    | 6.37  | 6.06    | 6.85  | 5.93    | 6.61  | 9.06    | 9.52  |
| Slovenia    | 3.05    | 6.11  | 3.20    | 6.42  | 2.80    | 6.26  | 3.68    | 7.60  |
| Spain       | 165.71  | 12.10 | 149.35  | 10.91 | 127.81  | 10.37 | 124.65  | 9.52  |
| Sweden      | 28.86   | 4.96  | 30.57   | 5.25  | 27.59   | 5.35  | 28.42   | 5.25  |
| Switzerland | 10.79   | 1.47  | 10.92   | 1.62  | 10.82   | 1.56  | 10.96   | 1.56  |
| Turkey      | 97.90   | 10.43 | 105.33  | 11.22 | 102.50  | 11.79 | 99.24   | 11.55 |
| UK          | 89.34   | 2.91  | 86.34   | 2.94  | 80.72   | 3.00  | 76.83   | 2.89  |
| US          | 506.67  | 2.89  | 488.4   | 2.68  | 486.62  | 2.60  | 487.91  | 2.50  |
| OECD        | 3204.63 | 6.38  | 3145.17 | 6.63  | 3212.18 | 6.64  | 3282.74 | 6.51  |

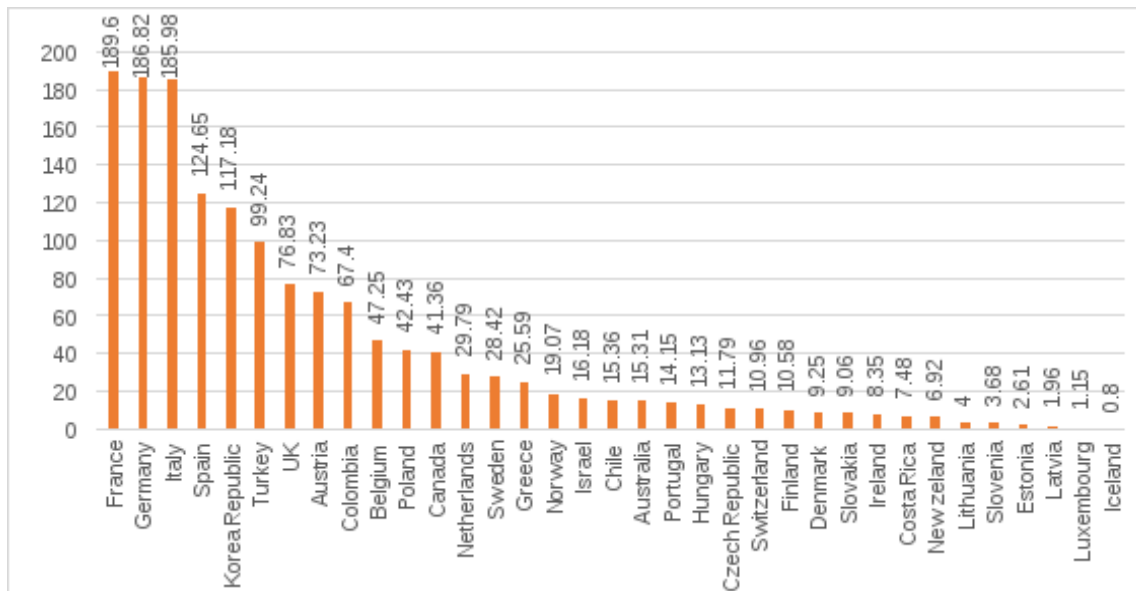
Figure 1 shows the tax gap rates of 35 OECD countries for 2017. The five countries with the highest tax gap rate in 2017 are Colombia, Greece, Costa Rica, Turkey and Estonia. The countries with the lowest tax gaps are Switzerland, Luxembourg, Ireland, Canada and Denmark. In figure 2, the nominal values of the tax gap in 35 OECD countries for 2017 are given. Accordingly, the countries with the highest tax gap are France, Germany, Italy, Spain and South Korea. The lowest tax gap is between Iceland, Luxembourg, Latvia, Estonia and Slovenia.

**Figure 1: The Level of the Tax Gap (% of GDP) in the OECD Countries in 2017**



Source: Author elaboration

**Figure 2: The Level of the Tax Gap (nominal value) in the OECD Countries in 2017**

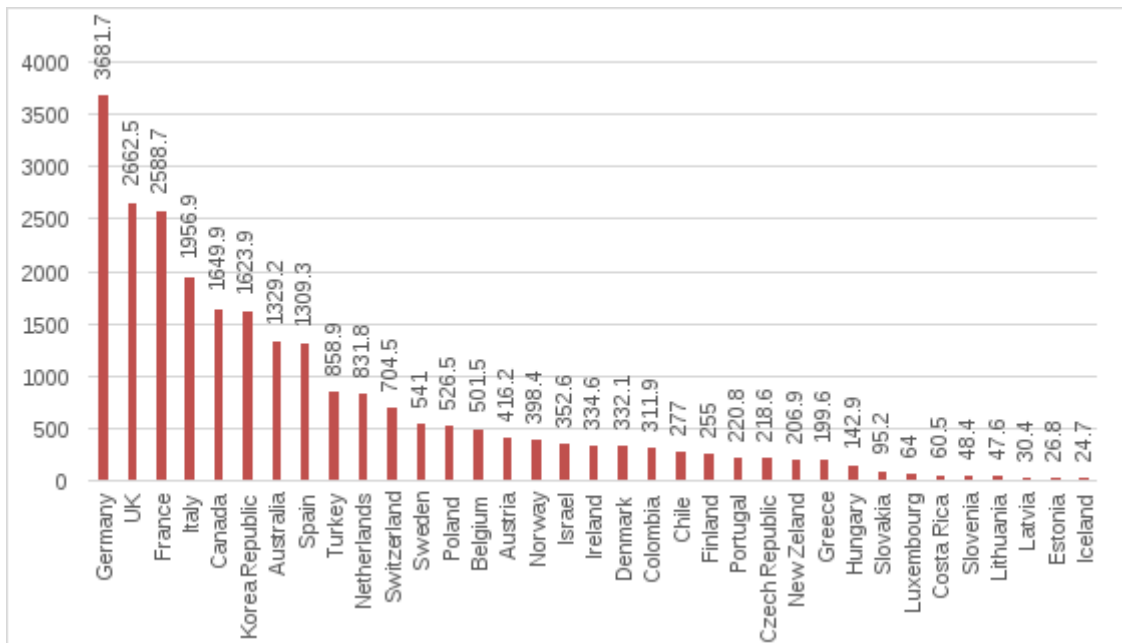


Source: Author elaboration

In Figure 3, the 2017 GDP values of OECD countries are given. The country with the highest GDP in 2017 was Germany (3681.7 thousand USD). For 2017, the nominal value of the Germany tax gap was 186.82 thousand USD, and the tax gap rate (22nd place) was 5.09%. The second country in terms of GDP (2662.5 thousand USD) was the United Kingdom. The nominal value of the UK tax gap is \$76.83 thousand, and the tax gap rate (30th place) is 2.89%. Germany and the United Kingdom, which are in the first two places in terms of GDP, are developed European countries. Germany ranks 3rd in the OECD countries in terms of GDP, while the United Kingdom ranks 5th. Canada ranked 8th in GDP (1649.2 thousand USD). The nominal value of Canada's tax gap in 2017 was USD 41.36 thousand, and the tax gap rate was (32nd) 2.51%. Although Germany, the United Kingdom, and Canada rank first in terms of GDP, their tax gap rates are low. This situation indicates the development level of countries with a strong economy and development in terms of tax morale and financial law order. In 2017, the informal economy rate was 10.4% in Germany, 9.4% in the United Kingdom and 12% in Canada.

The third country in terms of GDP is France (2588.7 thousand USD). The nominal value of the French tax gap was calculated as 189.6 thousand USD, and the tax gap rate (15th place) was calculated as 7.32%. Italy (1956.9 thousand USD) took fourth place. The nominal value of Italy's tax gap is 185.98 thousand USD, and the tax gap rate (at 8th place) is 9.50%. Although countries such as France and Italy are developed, unlike Germany, the United Kingdom, and Canada, they rank high in terms of GDP, and their tax gap rates are above the OECD average. The high rate of tax gap shows that there are problems in the economic situation of the country and the financial and legal order. The informal economy rates also feel this. Informal economy rates are around 11-12% in Italy and 19-20% in France. It is known that there are economic and financial problems in France and Italy.

**Figure 3: GDP in the OECD Countries in 2017**



Source: Author elaboration

### 3. ECONOMETRIC ANALYSIS

#### 3.1. Data

In the study, 35 OECD member countries were discussed. The study used GDP (in thousand USD nominal values), total tax and contribution rates (TTR) obtained from the World Bank database. Informal economy rates are compiled from Schneider's studies. Since the data on the total tax rates for some years for Japan, Mexico, and the USA could not be reached, the tax gap could not be calculated. Therefore, it was not included in the analysis. The countries included in the study and the variables used in measuring the tax gap are given in the table below.

**Table 2: Countries and Variables Considered in the Study**

| Countries Included in the Study   |                    |                                      |             |             |          |              |
|-----------------------------------|--------------------|--------------------------------------|-------------|-------------|----------|--------------|
| Austria                           | Colombia           | Finland                              | Ireland     | Latvia      | Norway   | Spain        |
| Australia                         | Costa Rica         | France                               | Israel      | Lithuania   | Poland   | Sweden       |
| Belgium                           | C.Republic         | Germany                              | Italy       | Luxembourg  | Portugal | Switzerland  |
| Canada                            | Denmark            | Greece                               | Iceland     | Netherlands | Slovakia | Turkey       |
| Chile                             | Estonia            | Hungary                              | Korea Rep.  | New Zeland  | Slovenia | Uni. Kingdom |
| Variables Considered in the Study |                    |                                      |             |             |          |              |
| GDP: Gross domestic product       | SE: Shadow Economy | TTR: Total tax and contribution rate | TG: Tax gap |             |          |              |

The econometric model used in the study is as follows:

$$(TG_{i,t}) = \mu_i + \delta_t + \beta_1(SE_{i,t}) + \beta_2(TTR_{i,t}) + \beta_3(GDP_{i,t}) + \varepsilon_{i,t} \dots \dots \dots \quad (3)$$

Here, the number of observations is:  $n=N \times T$  (number of groups x temporal observations)  $\forall_i \in (1, N)$  and  $\forall_t \in (1, T)$ .  $\mu_i$  and  $\delta_t$  captures unobserved country- and time-specific effects, respectively, and  $\varepsilon_{i,t}$  is the error term and i.i.d. invalid mean and variance are assumed to be equal to  $\sigma^2$ .

The tax gap rate was accepted as the dependent variable in the study. The informal economy rate, the nominal GDP value and the total tax rate were accepted as independent variables. The effects of the informal economy rate, the nominal value of GDP and the total tax rates on the tax gap are analyzed. As a result of the analysis, there is expected to be a positive relationship between the tax gap and the informal economy, GDP and the total tax rate.

#### 3.2. Estimation Results

Before the analysis results of the study were announced, the data of 35 OECD countries were reported by performing the necessary tests within the scope of panel data analysis. First, descriptive statistics about the variables are included. In the second stage, whether there is a cross-sectional dependence between units was tested. In the third stage, the panel unit root test, which is suitable for the cross-section dependence test results, was selected, and the stationarity of the series was tested. Since there is no cross-section dependency according to the unit root test results, a cointegration test was not needed. Due to the stationary level of the

variables, the results were obtained using the Driscoll-Kraay Fix Effect model as static panel data analysis. Stata 15 package program was used in all analyzes.

Descriptive statistics for the data of OECD countries for the years 2005-2017 are shown in Table 3 below. The table shows the total number of observations, mean, standard deviation, and minimum and maximum values of the series in the sample.

**Table 3: Descriptive Statistics**

| Variable | Observation | Mean     | Standard Dev. | Minimum | Maximum |
|----------|-------------|----------|---------------|---------|---------|
| TG       | 468         | 7.11776  | 4.330494      | 1.4688  | 29.2179 |
| SE       | 468         | 15.77408 | 6.066517      | 5.1     | 33.7    |
| TTR      | 468         | 43.23526 | 13.43455      | 19.8    | 87.2    |
| GDP      | 468         | 2.35235  | 3.500213      | -14.8   | 25.2    |

Neglecting cross-sectional dependence in panel data analysis can cause significant problems with the estimators' efficiency and the results' reliability (Phillips & Sul, 2003). The presence of cross-section dependence means a correlation exists between the residuals obtained for each unit that makes up the model. (Tatoğlu, 2017). Additionally, in cross-section dependency tests, the significance of the correlation between the residues is tested, and the correlation is not expected to be zero (Güriş, 2015).

When the literature is examined, it is seen that many tests, such as Breusch and Pagan's (1980) LM test, Pesaran's (2004) CDLM test, Baltagi et.al., (2019) Bias Corrected LM test, and Pesaran's (2004) CD test have been developed to test cross-section dependency. Which of the listed tests will be applied varies according to the time and cross-section size of the panel. Cross-section dependence is tested using Breusch and Pagan's (1980) LM test for panels with a time dimension more significant than the cross-section dimension and the Pesaran LM test for panels with a time dimension smaller than the cross-section dimension. In addition, the CDLM test was developed by Pesaran (2004), valid in both cases in terms of time and cross-section size and gave results with a mean of zero (Pesaran, 2004a).

Although the group mean is zero in the CDLM test developed by Pesaran in 2004, the mean of each cross-section in the panel is different from zero. Therefore, deviations may occur in the calculated results. Pesaran, Ullah, and Yamagata (2008) corrected this deviation in the results by adding the variance and mean to the test statistics (Mercan, 2014). This test deviation has been recorded in the literature as the corrected LM test, the CDLMadj test.

The mathematical equation of the CDLM and CDLMadj tests is shown below.

$$CDLM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^N \rho_{ij}^2 \frac{X^2 N(N-1)}{2} \tag{4}$$

After adding the variance and mean to the CDLM test, CDLMadj test statistics were created (Pesaran et al., 2018).

$$CDLM_{adj} = \left(\frac{2}{N(N-1)}\right)^{1/2} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \rho_{ij}^2 \frac{(T-K-1)\rho_{ij} - \mu_{Tij}}{\mu_{Tij}} N(0,1) \tag{5}$$

The Ho and H1 hypotheses of the test are as follows:

Ho: No cross-section dependency

H1: There is a cross-section dependency

If the probability value of the test is less than 0.05, the H0 hypothesis is rejected, and it is concluded that there is a cross-sectional dependence between the units. At this stage, whether there is a cross-sectional dependence between units will be tested. Table 4 shows the results of the cross-section dependency test using the Stata 15 Package Program in the data set consisting of 35 countries and 13 years of data in the panel. Table 4 shows the results of the LMCD test recommended by Pesaran (2004) and the LMCDadj (Bias adjusted LM test) by Pesaran (2008).

**Table 4: Cross Section Dependency Test Results**

|                          | Statistics | P-value |
|--------------------------|------------|---------|
| <b>LM</b>                | 1114       | 0.0000  |
| <b>LM<sub>adj</sub>#</b> | 15.33      | 0.0000  |
| <b>LM CD#</b>            | 11.17      | 0.0000  |

# : Double-sided test; H0 Hypothesis; There is no cross-section dependency;  
H1 Hypothesis; There is a horizontal section dependency.

As seen in the table above, the H0 hypothesis, which was established as there is no cross-sectional dependence on both test results, is rejected. Considering all the explanations made about the tests, the test result referenced in our study should be the Pesaran (2008) LMAdj test statistic, that is, the results in which the deviations were corrected by adding the variance and mean. Although the results of the other test are the same, the results of the LMCD test statistic may need to be more reliable in terms of time and the cross-section size of the sample. Cross-section dependency testing helps us decide whether to use first or second-generation unit root tests. As a result, it would be appropriate to conduct second-generation unit root tests to determine the series' stationarity due to cross-section dependence.

Another test that should be applied in panel data analysis is the stationarity of the series. If the mean, variance and autocovariance of a series are constant over time, they are expressed as stationary series (Tatoğlu, 2017). Non-stationary series have a common trend. Thus, although there is no significant relationship between the series, R2 values are high due to the trend effect. The main reason for this is the common trend among the variables.

Many tests were developed to test the stationarity of the series in panel data analysis. Which of these tests will be selected depends on the cross-sectional dependence test results. For this reason, firstly, the cross-section dependency test was performed. According to the results of the cross-sectional dependence test, the H0 hypothesis was rejected, and it was concluded that there was a cross-section dependence.

As a result, the presence of cross-section dependence requires second-generation panel unit root tests. In this context, the second generation Extended Cross Section Lm, Pesaran and

Shin (CIPS; Cross-Sectionally Im-Pesaran Shin) unit root test and Maddala and Wu (1999) unit root test were applied. The results were obtained by Maddala and Wu's (1999) test was found to be stationary at the I(0) level.

Maddala and Wu (1999) derived the test based on the combination of the p-values of the unit root test statistics calculated for each cross-section using Fisher (1932). An advantage of the Fisher-type test is that it can be adapted to any unit root test. According to Maddala and Wu (1999), performing time series analysis without performing unit root tests leads to biased and inconsistent estimations (Maddala et.al, 1999). Panel unit root tests give stronger results than unit root tests for time series belonging to a single mass since they consider cross-section and time series features. If there is a unit root, the problem of spurious regression arises. Maddala and Wu's (1999) test results are given in Table 5.

**Table 5: Maddala and Wu (1999) Panel Unit Root Test (MW)**

|            | Lag | With Trend |         | Without Trend |         |
|------------|-----|------------|---------|---------------|---------|
|            |     | chi-sq     | p-value | chi-sq        | p-value |
| <b>TG</b>  | 1   | 286.466    | 0.000   | 219.576       | 0.000   |
| <b>SE</b>  | 1   | 342.861    | 0.000   | 288.420       | 0.000   |
| <b>TTR</b> | 1   | 87.986     | 0.097   | 106.939       | 0.005   |
| <b>GDP</b> | 1   | 143.418    | 0.000   | 224.245       | 0.000   |

It is concluded that the series is stationary at the I(0) level. Since the variables are stationary, there is no need to look at autocorrelation. Since the study was stationary at the I(0) level and the second generation unit root test was performed, the cointegration test was not considered necessary. Since the variables are also stationary, the Driscoll - Kraay Fixed Effect method was used.

Models in which the coefficients are assumed to change according to units or time are called "fixed effect models". The general formulation of the model assumes that differences between units can be captured in differences in the constant term. It is assumed that each error term is associated with explanatory variables in fixed effect models. In addition, the constant term is allowed to change between sections, and unobserved heterogeneity or unitary effects are considered (Hill et al., 2011). The fixed effects model assumes that the coefficients vary according to cross-sections or cross-sections and time (Pazarlıoğlu & Gürler, 2007).

Among the panel data models, the classical model, random effects model and fixed effects model predictions were made, and it was seen that the most suitable model was the fixed effects model. Since the assumptions of the panel data regression model were not provided, the coefficients were obtained using the Driscoll-Kraay estimator, one of the resistant estimators. Driscoll and Kraay (1998) obtained a consistent covariance matrix by performing simple transformations under cross-section dependence in panel data orthogonality conditions. In this case, they proposed an approach based on robust standard errors. The Driscoll and Kraay method, which can give effective results in different time and unit dimensions, can be applied even in the presence of varying variance and autocorrelation problems (Driscoll & Kraay, 1998; Tatoğlu, 2012). The results using the Driscoll/Kraay Fix Effect are in table 6.

**Table 6: Driscoll /Kraay Fix Effect Results**

| TG                 | Coefficient Estimation | Standard Error      | T      | P >  t                  | 95% Confidence Interval |           |
|--------------------|------------------------|---------------------|--------|-------------------------|-------------------------|-----------|
| SE                 | .5162408               | .0235169            | 21.95  | 0.000                   | .4650018                | .5674798  |
| TTR                | .1683792               | .0053208            | 31.65  | 0.000                   | .1567862                | .1799722  |
| GDP                | .0121835               | .0023101            | 5.27   | 0.000                   | .0071503                | .0172168  |
| _cons              | -8.334043              | .3226664            | -25.83 | 0.000                   | -9.037072               | -7.631013 |
| Gözlem sayısı: 486 |                        | F (3, 12) = 1028.24 |        | R <sup>2</sup> = 0.9022 |                         |           |
| Grup Sayısı: 36    |                        | Prob > F=0.0000     |        | Maksimum Lag: 1         |                         |           |

Note: All hypothesis testing was based on a significance level of 0.05 (5%).

Table 6 shows the resistant estimation results of the model in which the tax gap rate is used as the dependent variable. When the factors determining the tax gap are examined, it is statistically positive and significant according to the model results. Each unit increase in the informal economy rate increases the tax gap by 0.5162%. Each unit increase in the total tax rate increases the tax gap by 0.1683%. Each unit increase in GDP increases the tax gap by 0.1218%.

#### 4. DISCUSSION AND CONCLUSION

States must first know the size of the tax gap in the country in order to fully reach their tax capacity and determine policies to prevent tax gaps. For this reason, measuring the tax gap and comparing it with other countries is important for the taxation policies to be followed. In this study, tax gap measurements of OECD countries were made by taking the informal economy rate, total tax rate and nominal GDP values per capita for 2005-2017. In the said years, the average tax gap rate of OECD countries varied between 6.38% and 8.04%. Tax gap in developed countries such as Austria, Australia, Canada, Chile, Czech Republic, Denmark, Finland, Germany, Ireland, Iceland, Israel, Luxembourg, Netherlands, New Zealand, Norway, Slovakia, Sweden, Switzerland and the United Kingdom, which have an important place in the world economy. It was observed that it remained below the OECD average. The three countries with the lowest tax gap rates were Luxembourg, Canada and Ireland (See figure 1). These countries have developed economies and rank first in terms of per capita income.

Countries with tax gap rates above the OECD average are Belgium, Colombia, Costa Rica, Estonia, France, Greece, Hungary, Italy, South Korea, Latvia, Lithuania, Luxembourg, Poland, Portugal, Slovenia, Spain and Turkey. The countries with the highest tax gap rates (See figure 1) were Colombia, Costa Rica and Greece. It is known that there are economic imbalances in all three countries. Colombia is one of the most important politically and economically significant countries in South America and is a country that exports oil, natural gas and coal. However, the struggle of armed groups with the security forces and the fact that drug gangs are on the agenda are factors that hinder its development. It is understood from the high rates of the informal economy that this situation negatively affects the financial law order in the country. Although Costa Rica has made great progress in socioeconomic, health and education areas, the country's biggest threat to economic stability and growth is financial imbalances and the resulting budget and current account deficit. Greece has essential problems such as waste in public expenditures,



tax evasion, corruption and budget deficit. As a matter of fact, these adverse economic conditions have an impact on the increase in the tax gap.

The country with the highest GDP in 2017 was Germany (3681.7 thousand USD). For 2017, the nominal value of the German tax gap was 186.82 thousand USD, and the tax gap rate (22nd place) was 5.09%. The second country in terms of GDP (2662.5 thousand USD) was the United Kingdom. The nominal value of the UK tax gap is \$76.83 thousand, and the tax gap rate (30th place) is 2.86% (See figure 1-2-3). Germany and the United Kingdom, which rank first in terms of GDP, are developed European countries. Germany is in third place in terms of GDP in the world, and the United Kingdom is in fifth place. Although they rank first in terms of GDP, their tax gap rates are low. This situation indicates the development level of countries with a strong economy and development in terms of tax morale and financial law order. In these countries, on the one hand, the governments collect the tax revenues they need effectively; on the other hand, the tax morale and tax compliance level of the taxpayers are high.

On the other hand, although France and Italy have high GDP values, the tax gap rate in these countries is also high. This indicates that the country's financial law order has yet to be fully established, and economic stability has yet to be achieved. In addition, the tax morale and tax compliance level of the people in these countries are also low. As a result, it is known that these countries' informal economy rates and budget deficits are high.

The tax gap measurements made in the study were considered dependent variables, the informal economy rate, total tax rate and GDP nominal values were considered independent variables, and the effects of the independent variables on the tax gap were tested by applying a horizontal cross-section. Dependency, unit root test and static panel data were used in the panel data analysis method. The results of the model were found to be positive and significant. Each unit increase in the informal economy rate increases the tax gap by 0.5162%, each unit increase in the total tax rate increases the tax gap by 0.1683%, and each unit increase in GDP increases the tax gap by 0.1218%. It has been observed that all three of our variables have an increasing effect on the tax gap.

However, when the effects are examined, preventing the informal economy in terms of reducing the tax deficit is much more effective than increasing the tax rates or GDP. The measurement results of the tax gap in OECD countries confirm that the tax gap is high in some developed countries, such as Italy and France, due to the high level of informal economy and low tax compliance. On the other hand, countries with low informal economies and high tax compliance are much more successful in reducing the tax gap. Therefore, the most important policies to be followed to reduce the tax gap instead of increasing tax rates should be measures to prevent the informal economy.

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## AUTHOR STATEMENT

### Statement of Research and Publication Ethics

This study has been prepared in accordance with scientific research and publication ethics.

### Author Contributions

The authors contributed equally to the study.

### Conflict of Interest

There is no conflict of interest for the authors or third parties arising from the study.

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