Tax Capacity and Tax Effort in Turkiye and the European Union Countries: An Empirical Application

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ABSTRACT

An efficient tax system is pivotal for effectively implementing fiscal policy and fostering economic development. The extent to which a tax system realizes its full potential determines its efficacy. Nevertheless, existing literature highlights that various economic, social, demographic, and institutional factors can impose limitations on realizing potential tax capacity, thereby constraining the level of tax effort. In this context, this research's principal objective is to assess tax efforts spanning 1995 to 2021 for 27 European Union member states, 3 European Economic Area nations, and Turkiye. Within this framework, our regression analysis attempts to unveil the influence of critical factors affecting taxable capacity, including sectors with inherent tax challenges, international trade dynamics, the scope of the shadow economy, and the level of financial development. The findings of our study shed light on several noteworthy trends. Northern European countries exhibit a notably higher level of tax effort than the remaining sample countries and Turkiye, which lags behind the sample's average tax effort level. Furthermore, the study postulates that enhancing financial development and curbing the shadow economy can contribute to the expansion of fiscal space by bolstering tax capacity.

Key Words: *Tax Capacity, Tax Effort, Tax Policy, Panel Data Analysis*
JEL Classification: *H20, E62, 023*

Türkiye ve Avrupa Birliği Ülkelerinde Vergi Kapasitesi ve Vergi Gayreti: Ampirik Bir Uygulama

ÖZ

Etkin bir vergi sisteminin özellikle maliye politikasının uygulanabilirliği ve ekonomik kalkınma süreci açısından önemli olduğu düşünülmektedir. En basit anlamıyla, bir vergi sisteminin etkinliği, potansiyelinin ne kadarının gerçekleştirildiğiyle ilgilidir. Bununla birlikte, literatürde ekonomik, sosyal, demografik ve kurumsal faktörlerin potansiyel vergi kapasitesinin gerçekleştirilmesinde bazı kısıtlamalar yaratabileceği ve vergi gayreti düzeyini sınırlayabileceği tartışılmaktadır. Dolayısıyla, bu çalışmanın birincil amacı, 27 Avrupa Birliği, 3 Avrupa Ekonomik Bölgesi üyesi ve Türkiye için 1995-2021 döneminde vergi çabası düzeyini belirlemeye çalışmaktır. Bu bağlamda gerçekleştirilen regresyon tahmini, vergilendirmenin zor olduğu sektörler, uluslararası ticaret, kayıt dışı ekonomi ve finansal gelişme gibi vergileme kapasitesinin temel belirleyicilerinin etkilerini ortaya koymaya çalışmaktadır. Ampirik bulgular vergi gayreti açısından Kuzey Avrupa ülkelerinin örneklemin geri kalanından daha iyi bir performans gösterdiği, Türkiye'nin ise örneklem ortalamasının altında olduğuna işaret etmektedir. Ayrıca finansal gelişmenin iyileştirilmesi ve kayıt dışı ekonomi ile mücadelenin vergi kapasitesini artırarak mali alan oluşumuna katkı sağlayabileceği savunulmaktadır.

Anahtar Kelimeler: *Vergi Kapasitesi; Vergi Çabası, Vergi Politikası, Panel Veri Analizi*
JEL Sınıflandırması: *H20, E62, 023*

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INTRODUCTION

Fiscal policy reflects public choices when considered within the scope of the government's authority to spend and collect revenue. Subsequently, fiscal policy in modern economies serves the main objectives of economic growth, macroeconomic stability, redistribution of income, and efficiency in resource allocation. In any modern economy, fiscal policy's ability to achieve stated goals relates to the adequacy of public revenues (Şen, Bulut-Çevik & Kaya, 2019, p. 104). While preparing the state budget, which is the central pillar of fiscal policy, modern economies first specify public expenditures and then determine the resources to generate public revenue. In modern economies, tax revenues are the primary source of financing public expenditures, with a few exceptions. When excluding countries rich in natural resources, tax revenues provide 50-90% of total public expenditures, although they vary from country to country. Consequently, there is substantial interest in theoretical and empirical perspectives on a country's potential tax capacity and effort.

Tax capacity refers to the highest (potential) tax revenue level a country can collect to the extent that its economic, social, institutional, and demographic structure permits (Garg, Goyal & Pal, 2017, p. 233). In this sense, tax capacity is the highest tax revenue level a country can reach under present conditions; in other words, it is also called the potential tax revenue level (Pessino & Fenochietto, 2010, p. 65). Calculating tax effort determines how much of the real tax income level can utilize the potential tax capacity (Kawadia & Suryawanshi, 2023, p. 2). Tax effort and potential tax capacity level are essential indicators that provide information about fiscal policy sustainability and public revenues' adequacy (Cyan, Martinez-Vazquez, & Vulovic, 2013, p. 4). Estimating the potential tax capacity and measuring the tax effort can also provide practical information about fiscal space that a country can use to achieve its macroeconomic targets. In summary, determining countries' tax efforts provides insight into which countries can boost their tax revenues and which cannot.

The literature uses three empirical methods to determine the potential tax capacity and tax effort level. The first is the representative tax system approach, useful for federal government models. The literature lists several studies based on the representative tax system method, including Bahl (1972), Martinez-Vazquez and Boex (1997), Purohit (2006), Yilmaz, Hoo, Nagowski, Rueben and Tannenwald (2006), Mikesell (2007), and Liesegang and Runkel (2018). Nevertheless, the representative tax system to produce accurate and consistent outcomes demands a precise measurement of tax base and effective tax rates. Moreover, the representative tax system has lost dominance among alternative empirical techniques because it only fits the federal government.

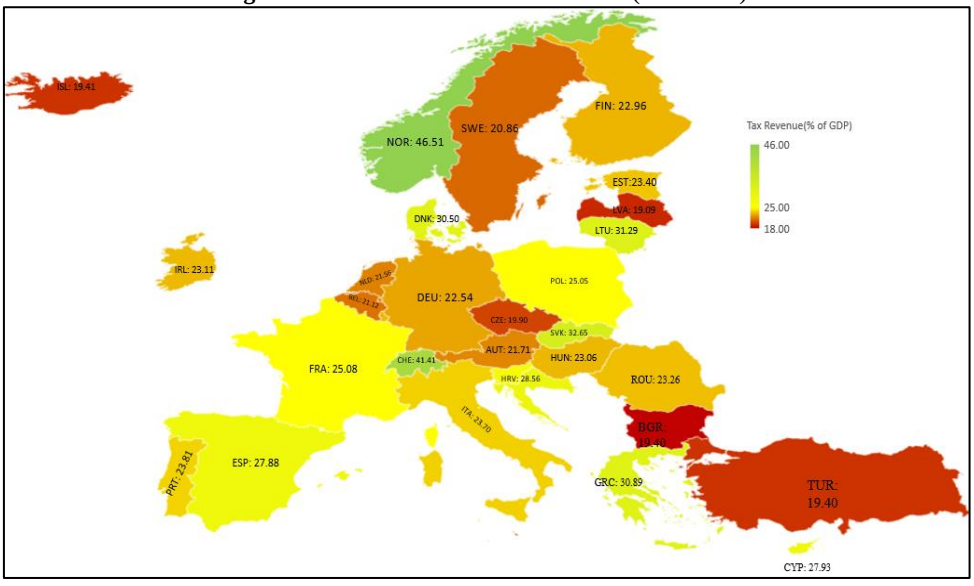
Another empirical approach is the stochastic frontier analysis. To determine the highest-level tax effort can reach under contemporary conditions, researchers prefer using the stochastic frontier function, which functions such as a production possibilities curve. The stochastic frontier analysis is an increasingly preferred technique in the literature as it can produce more detailed information

about the potential tax capacity and tax effort, as well as the efficiency of the tax system compared with other methods (Alfirman, 2003; Cyan et al., 2013; Fenochietto & Pessino, 2013; Vallés Giménez & Zárate Marco, 2017; Kawadia & Suryawanshi, 2023).

In contrast, the regression-based approach is the most preferred empirical method in the literature. The regression-based estimation produces information about the change in tax effort and differences between units and periods, not directly comparing the tax system's efficiency with the stochastic frontier analysis. Researchers intensely prefer the regression-based estimation because it is easy to apply, allows examining large samples, and persists in development (Piancastelli, 2001; Mertens, 2003; Davoodi & Grigorian, 2007; Gupta, 2007; Bird, Martinez-Vazquez & Torgler, 2008; Huang, Lo & She, 2012; Le, Moreno-Dodson & Bayraktar, 2012; Mahdavi & Westerlund, 2018; Ricciuti et al., 2019).

This research aims to estimate the potential tax capacities and tax effort levels of Turkiye and the economies that are members of the European Union and located in the European Union Economic Area. Thus, at this stage, it would be beneficial to investigate some primary indicators of countries' tax systems included in the sample. Figure 1 presents the sample's 27-year (% of GDP) average value of total tax revenues. The cartogram graphic in Figure 1 shows that tax revenues are above 20% in most of the sample.

Figure 1: Total Tax Revenues 1995-2021 (% of GDP)



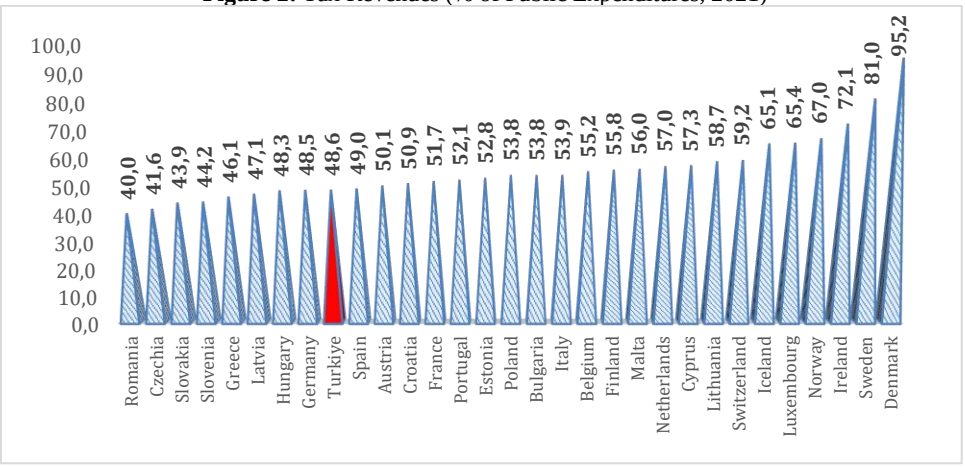
Source: Designed by the authors using Eurostat (2023) and OECD (2023).

In contrast, Northern European countries' tax revenues exceed 30%. A small part of the sample is above the average level. Together, most of the sample is slightly different from average tax revenue. Figure 1 also shows that tax revenues can considerably differ even if countries have similar and harmonized tax systems in nearby geographical areas. Hence, there is no direct evidence for a linear

relationship between economic development, per capita income, and tax revenues. This case supports the idea that demographic, economic, social, and institutional factors are as significant as the tax system regarding tax revenues.

Examining the fiscal purpose of taxation highlights the importance of the share of tax revenues in financing public expenditures. Figure 2 is a column chart showing the percentage of tax revenues used to cover total public expenditures 2021. The chart also highlights that tax revenues in EU transition economies are weak in financing public expenditure in 2021. Therefore, a horizontal differentiation in the ability of tax revenues to cover public expenditures is possible to mention in economies with similar levels of economic development.

Figure 2: Tax Revenues (% of Public Expenditures, 2021)



Source: Designed by the authors using Eurostat (2023) and OECD (2023).

Additionally, the percentage of tax revenues to public expenditures in Northern European countries is above 90%. However, tax revenue and public expenditures reflect public preferences and can show rapid changes according to business cycles. Of course, the actualization of this adjustment in tax revenue is possible if the relevant economy has fiscal space (Nerlich & Reuter, 2015, p. 4). With this dimension, it is crucial to know how much of the potential tax capacity the countries in the sample use. Besides all these, developed countries with natural resources or a foreign trade surplus have the power to finance their public expenditures without the need for high tax revenues.

Especially in the last few years, the main problems that caused fiscal policy to come to the fore again, such as the COVID-19 pandemic and the global inflation wave it caused, the Russia-Ukraine war, and the energy supply crisis, show that the public sector will need more resources to combat these difficulties. For the normalization process in both economic and fiscal policy, we need to take measures against circumstances that affect total economic activity and fiscal balance.

Determining the level of tax effort and potential tax capacity, which we can accept as an indicator of the effectiveness of a tax system, will also provide insight into how countries can improve their real tax revenue levels. We estimated potential tax capacity and effort levels for 27 EU members, 3 EUA member countries, and

Turkiye using panel data methods and following the regression-based estimation method for 1995-2021. In this respect, our study can contribute to the literature with a dataset that allows the examination of many economic, demographic, financial, and social dimensions to determine potential tax capacity.

The following sections of the study are: The second part provides theoretical explanations of tax capacity and tax effort. In the following section, we summarize and discuss the empirical literature. The fourth part focuses on selecting the variables to include in the model, analyzing the basic properties of the dataset, and introducing the predicted model. In the following section, we report our empirical results. In the last stage, we compare the findings with the empirical literature and current conditions and conclude by providing policy recommendations.

I. THEORETICAL EXPLANATIONS OF TAX CAPACITY AND TAX EFFORTS

Examining the design, implementation, and effectiveness of tax systems is crucial in many respects and falls under the purview of political economy for countries at various levels of development. The design of effective tax systems plays a noteworthy role in economic development (Brafu-Insaidoo & Obeng, 2020, p. 1). Therefore, it is essential to determine tax capacity and effort level, uncover tax effort typologies of countries, and discuss policy proposals consistent with these predictions.

Experts have converged on a common definition of tax capacity after developing identical definitions over time. According to Pessino and Fenochietto (2013), tax capacity is the highest level of tax revenue a country can collect. Le et al. (2012) defined tax capacity as the highest tax revenue level empirically estimated based on a country's social, demographic, and institutional characteristics, especially macroeconomic conditions. Apart from the above definitions, Dalton (1954, p. 118-121) divided tax capacity into two on a theoretical scale and introduced the definitions of relative and absolute tax capacity. Dalton (1954, 119), emphasizing the "unpleasant effect," defines absolute tax capacity as the upper limit of tax revenue without creating a distorting effect on economic decisions.

Dalton (1954, p. 121) suggests that the amount identified as relative tax capacity is the amount remaining after subtracting the total production level from the consumption required to sustain society. Empirical literature examines relative tax capacity as it is impossible to measure absolute tax capacity (Dalamagas, Palaios, & Tantos, 2019). In simple terms, relative tax capacity refers to the level of tax revenue generated by effective tax rates estimated using empirical methods for each taxable activity.

Tax effort is the ratio of actual tax revenues to potential tax capacity (Stotsky & Wolde Mariam, 1997; Rosen & Gayer, 2010; Amoh, 2019). In analyzing a country's tax effort, a tax effort index greater than one [E>1] indicates that the tax revenues exceed the estimated taxable capacity and vice versa. In this

context, we can make an efficiency interpretation by calculating how much of the resources subject to the taxable event the tax system can include at a time.

$$T/_{Y_{it}} = f(X_i \ldots . X_n) \quad (1)$$

Identifying the factors determining potential tax capacity forms the basis of tax effort analysis. Equation 1 might present the general structure of theoretical and empirical literature straightforwardly. *T* represents total tax revenues, and *Y* represents gross domestic product (*or gross national product for some special conditions*). In addition, $X_i, \mathrm{i} = 1, \ldots, \mathrm{n}$ represents the independent variables that affect tax capacity.

As introduced under the Khaldun-Laffer curve (Şen et al., 2019), tax revenues have a natural boundary determined by a country's economic, demographic, social, and psychological dynamics. Hence, "tax capacity" can answer questions about how much or how the income will increase in the relevant period. Moreover, tax capacity can also represent an essential part of the fiscal space to obtain from the taxes that the government imposes (Mikesell, 2007, p. 533). However, measuring tax capacity is a complicated process. The tax system is sensitive to many social, political, institutional, demographic, and economic factors. Furthermore, exemptions, derogations, and tax cuts, which are atypical aspects of tax systems, make it challenging to develop a standard measure of tax capacity.

Regarding tax technique, it is possible to obtain tax income from external sources, albeit limited, within the frameworks of the *residency* and *citizenship* principles without causing double taxation. However, within the scope of the race to the bottom, which is a result of the globalization process, countries can willingly give up some of their taxable capacity by lowering or keeping their tax rates low (Bozatlı, 2021, p. 95) to attract international investments (Langford & Ohlenburg, 2016, p. 4). Therefore, we should remember that any approach preferred in the literature, including our study, cannot simultaneously fulfill the entire analytical expectations for tax capacity measurement.

$$\boldsymbol{E_{it}} = \left(\frac{\boldsymbol{T_{it}}}{\boldsymbol{Y_{it}}}\right) / \left(\frac{\boldsymbol{Tp_{it}}}{\boldsymbol{Y_{it}}}\right) \quad (2)$$

The notation *E* in equation 2 represents tax effort, *Tp* represents potential tax capacity, and *i* and *t* represent unit and time, respectively. By simplifying it, we obtain equation 3:

$$\boldsymbol{E_{it}} = \frac{\boldsymbol{T_{it}}}{\boldsymbol{Tp_{it}}} \quad (3)$$

Empirical literature widely accepts that Equation 3 presents the most direct and uncomplicated form for calculating tax effort.

II. EMPIRICAL LITERATURE REVIEW

Critics point out that estimating tax efforts is difficult because of challenges in calculating potential tax capacity and establishing a universally accepted unit of account for all countries. However, these criticisms have been an essential catalyst for the literature to improve new empirical approaches and determine better

potential variables that will provide more sensitive measurements. The main empirical methods developed in this context are representative tax systems, stochastic frontier analysis, and regression-based estimation approaches.

Researchers consider the regression-based estimation method more operational than other empirical methods for measuring potential tax capacity. For this reason, the regression-based estimation method is much more common. However, the regression-based estimation method is also vulnerable to criticism regarding taking tax systems as typical of all countries and precisely measuring potential tax capacity. Tax cuts, exemptions, and derogations are significant constructs in countries' tax systems and are customarily considered atypical. Researchers empirically ignore these constructs, which often lead to divergence from efficiency. On the other hand, the stochastic frontier analysis method can answer the criticism that tax systems are typical because it allows one to make inferences about efficiency. Building flexible tax systems for higher revenue generation is challenging due to a country's institutional factors, political preferences, and demographic and economic limitations despite strict legal sanctions.

Lotz and Morss (1967) conducted the first empirical study to measure tax effort. Lotz and Morss analyzed 72 low- and high-income countries from 1962 to 1965 using a regression-based estimation method. The study divided the countries in the sample into three subgroups expressing high, medium, and low tax efforts. The study reports that a small portion of the sample (12) displayed a high level of tax effort, and no linear relationship exists between economic development and tax effort. Moreover, Turkiye, examined within the study's scope, is in the group of average tax effort. In the following years, Lotz and Morss (1970), Bahl (1971, 1972), Chelliah et al. (1975), and Truong and Gahsh (1979) conducted numerous studies using the regression-based estimation approach. Tanzi (1992) analyzed the macroeconomic effects of taxes by applying a regression-based estimation method, using data for the 1978-1988 period for 77 developing countries. The author, who attaches noteworthy importance to specifying the determinants of tax capacity, states that a positive relationship exists between per capita income, foreign debt, import level, and tax capacity; however, there is a negative relationship between agricultural value added and tax capacity. Piancastelli (2001) also favored a regression-based estimation method for determining tax efforts from 1985 to 1995 for 75 countries with different income levels. Within the scope of this study, the author defined the tax effort index as [E>1.00] high, [1.00> E>0.84] moderate, and [E>0.84] as low tax effort level. Based on the empirical results, the tax effort index for 41 countries is greater than 1; however, for 34 countries, it is lower than 1. Several studies in the literature later followed this classification.

Eltony (2002) examined tax efforts using a regression-based estimation method for 16 Arabian Peninsula countries using the 1994-2000 period data. The findings indicate that the mining sector considered an essential determinant of tax capacity, has negative effects. In addition, per capita income level positively affects potential tax capacity. Eltony (2002) found that despite poor tax collection in

natural resource-rich countries, there was a significant increase in tax effort across the sample. Bird et al. (2008), who also considered the impact of institutional factors on tax effort, applied a regression-based estimation method for 105 countries with different levels of economic development in 1990–1999 and 1998–2000. The principal finding reveals a statistically significant positive relationship between the quality of governance and tax effort. In addition, the real tax revenue in developing countries is below the potential tax capacity, so the tax effort is lower in developing countries than in developed countries.

Samimi, Zarroki, and Hadizadeh (2009) examined Iran as an example, which empirical literature has rarely studied. The authors used a regression-based estimation method to analyze data from 1990:1-2007:4 and make predictions about the country's potential tax capacity and tax effort. The findings acquired in this context show that Iran's tax effort is relatively high despite its natural resource income, but the volatility of its tax effort is high. Le et al. (2012) examined potential tax capacity and effort using a regression-based estimation method for the period 1994-2009 for 110 developed and developing countries. The authors divided the sample of countries into four sub-groups based on their tax revenue and tax effort levels. These sub-groups were countries with low tax revenue and tax effort, those with high tax revenue and tax effort, countries with low tax revenue but high tax effort, and those with high tax revenue but low tax effort. Within the scope of classification, the authors accepted the point at which the tax effort index is 1 and the tax income level is 18.31% as the origin on the coordinate plane. According to this classification, Turkiye falls into countries with high tax revenues but low tax efforts.

Comparing the results of regression-based estimation and stochastic frontier analysis, Cyan et al. (2013) conducted a study measuring tax efforts for 94 developed and developing countries from 1970 to 2009. The authors proclaimed that most of the sample's tax effort was low. Nevertheless, in some low-middle and low-income countries, estimation results have shown that the tax effort index is greater than 1. Hence, according to the findings, it is impossible to argue that there is a linear relationship between tax effort and economic development. Additionally, Cyan et al. (2013) observed that improving institutional factors can positively impact tax efforts. The comparative results presented by the authors also reveal that the results of the stochastic frontier analysis, following empirical expectations, calculate the tax effort index lower than the results of the regression-based estimation method. Parfenova, Pugachev, and Podviezko (2016), who comparatively examined a regression-based estimation method and multi-criteria decision-making methods studied during 2000-2012, estimated the potential tax capacity for Russia at the sub-regional level. The examination found that tax capacity is lower in Russia's leading or high-income regions and higher for low-income regions than in high-income regions. Moreover, Parfenova et al. (2016) report that the results obtained from both methods had high substitution ability, and the difference between the results was negligible.

Focusing on estimating potential tax capacity and effort for a particular tax type rather than total tax revenues, Andoh (2017) analyzed value-added tax effort for Ghana using the 2000-2014 period data with a regression-based estimation approach. Andoh (2017) has recognized periods when value-added tax revenues exceed potential tax capacity and remain below it. Ghana is an example where tax effort is high [E>1], but the tax revenue level is low. Alternatively, Amoh (2019) examined Ghana's value-added tax capacity and effort using a regression-based estimation procedure from 1979 to 2015. According to the empirical results, tax effort index, which was 0.95 before a radical tax reform in Ghana, decreased to 0.64 after tax reform. Finally, Dalamagas et al. (2019) investigated tax capacity for 30 countries with different economic development levels from 1996 to 2015 by dividing it into two sub-periods (1995-2009; 2010-2015) using the balanced budget, regression-based estimation, and stochastic frontier analysis methods. The authors reported no statistically significant linear relationship between economic development and tax effort. Together with this, Dalamagas et al. (2019) mentioned that the preferred methods may produce similar and consistent results. Dalamagas et al. (2019) stated that the optimal level of total taxation should be equal the difference between GDP and private consumption - the relative tax capacity defined by Dalton (1954) - but this is different in most of the samples.

The widespread use of the stochastic frontier analysis approach has made meaningful and original contributions to the literature. Studies conducted with stochastic frontier analysis allow determining the taxable limit, such as a production possibilities limit and shed light on tax collection levels realized below the limit. Consequently, the tax effort index obtained with the stochastic frontier analysis is [1≥E] because the tax effort index [E=1] means that the potential tax capacity completely used.

Using stochastic frontier analysis, Pessino and Fenochietto (2010) scrutinized tax effort levels for 96 countries from different economic development levels from 1991 to 2016. Tax revenues are below the potential tax capacity in countries with relatively high per capita incomes, such as Hong Kong, Singapore, and South Korea. On the other hand, countries with relatively low per capita income, such as Ghana, Kenya, and Gambia, collect taxes very close to their potential tax capacity. Therefore, Pessino and Fenochietto (2010) declared that tax effort is higher for low-income countries. In addition, countries included in the sample can use their potential tax capacities more effectively by improving the low quality of governance and reducing corruption problems that cause ineffectiveness in the tax system.

Brun and Diakite (2016) studied the non-natural resource tax revenue potential for 114 countries from 1980 to 2014 and the value-added tax potential for 57 countries from 1995 to 2014 with the stochastic frontier analysis. The authors have reported a sharp decline in general tax efforts in low-income countries at the end of the examination period. Additionally, they argue that there is an increasing trend in tax efforts observed in high- and middle-income countries. However, tax effort for low-middle-income countries fluctuates around the trend value;

nevertheless, there is no evident tendency. In contrast, Garg et al. (2017) adopted the stochastic frontier analysis technique to determine potential tax capacity and effort in 1991–2011 for 14 sub-regions of India. Empirical findings show that the average tax effort for the sample is 0.80. Furthermore, when there is an increase in political competition, such as the decentralization of political power between the central and local governments, it tends to affect tax efforts positively. Another distinctive aspect of the study is that the tax effort has exceptionally high volatility, between 0.38 and 0.94, over approximately ten years.

For 15 regions of Spain, Zárate-Marco and Vallés-Giménez (2019) investigated tax capacity and tax effort for the 2002–2012 period using the stochastic frontier analysis approach. According to the findings, the average tax effort level was 0.88. Correspondingly, the lowest and highest tax effort performance states were Extremadura and Catalonia, 0.73 and 0.95, respectively. Therefore, different from the empirical literature findings, tax effort in Spain has a linear relationship with the level of economic development. Also, Brafu-Insaidoo and Obeng (2020) used the stochastic frontier analysis method during 1985–2014 to measure the potential tax capacity, the causes of tax system inefficiency, and the level of tax effort for Ghana. Based on the research findings, Ghana's tax collection was not meeting its full potential. This result also supports the findings of previous studies (Andoh, 2017; Amoh, 2019) that used a regression-based estimation method. Finally, among the findings, an improvement in institutional quality indicators included in the analysis positively influences tax efforts in Ghana.

Chigome and Robinson (2021) preferred a stochastic frontier analysis approach for 2002-2016, in which they investigated potential tax capacity and effort in 13 African countries. The researchers examined tax efforts under two headings - permanent and temporary - where long-term estimator coefficients derive permanent tax effort, and short-term estimator coefficients indicate temporary tax effort. Findings point to a low level of permanent tax effort among Southern African Development Organization (ECOWAS) member countries compared with temporary tax effort. Using a stochastic frontier analysis method, Kawadia and Suryawanshi (2023) investigated the level of tax effort by examining data from 2001 to 2017 in 17 Indian regions. According to the empirical findings, the lowest level of tax effort was 0.77, the highest was 0.99, and average level was 0.89. In addition, an increase in independent variables such as per capita income, agricultural value added, labor, infrastructure development, and credit expansion positively manipulates potential tax capacity. The study has determined that agricultural value-added positively impacts the potential tax capacity, which is consistent with the agriculture-driven economic growth hypothesis and valid for India's low-income regions.

Some studies in the empirical literature also offer specific examinations of Turkiye's potential tax capacity level and tax effort. Atsan (2017) utilized a regression-based method to estimate Turkiye's potential tax capacity and effort from 1984 to 2012. During a significant part of the examined period for Turkiye, the author claimed that tax collection fell below its potential capacity.

Consequently, the average value of the tax effort was 0.90. In addition, Kızıltan (2018) preferred a spatial panel data approach to determine the local tax effort using the 2007–2014 data with a three-level classification covering 81 provinces in Turkiye. This research is the first in the literature to examine Turkiye at the regional level using spatial panel data analysis. The author reported the total tax effort for the central government as 0.93.

Many examinations in the empirical literature indicate that economic development positively impacts potential tax capacity. However, asserting that tax efforts observe the same effect is impossible. Many examples illustrate that developed regions still need to improve their tax capacity, which reflects public preferences for a lower tax burden. The regions/economies in question have higher non-tax revenue generation opportunities than relatively low-income regions/economies. On the other hand, "when it rains-it pours," low-income regions may occasionally tax beyond their potential tax capacity because of difficulties in meeting their financing needs with external sources, institutional factors, and inefficiencies in tax system design. Finally, there is no consensus in the empirical literature aimed at calculating the potential tax capacity.

III. BUILDING THE MODEL AND PRESENTING THE DATASET

A. Model and Variable Selection

It is a common choice to use the GDP ratio of total tax revenues as a dependent variable in empirical studies (Piancastelli, 2001; Bird et al., 2008; Pessino & Fenochietto, 2010; Le et al., 2012; Dalamagas et al., 2019; Chigome & Robinson, 2021; Kawadia & Suryawanshi, 2023). In contrast, the independent variables preferred in models exhibit a broad spectrum. The per capita GDP variable is at the beginning of the intersection cluster regarding the independent variables preferred for developing and developed countries. All other things being constant (ceteris paribus), increasing per capita income will also increase the taxable base.

Agricultural value-added is a widely preferred model despite the economic, administrative, and political obstacles associated with its taxation. Hence, agricultural value added is an essential variable representing one of the difficult-to-tax sectors. Dalamagas et al. (2019, p. 21) indicate that tax systems extensively apply exemptions, derogations, and subsidies in the agricultural sector. With this formation, the possibility of a negative impact of agricultural added value on potential tax capacity is solid (Davoodi & Grigorian, 2007). Another factor expected to affect tax revenues is population. The empirical literature suggests that researchers can prefer different demographic indicators, such as population growth rate, elderly population dependency ratio, and employment participation rate, to represent the demographic factors. Because this study examines countries with high, middle-upper, and middle-low-income levels, we consider that the population growth rate can better characterize the demographic structure. Amoh (2019) and Garg et al. (2017) expect that the population growth rate will expand the tax base, positively affecting tax revenues, especially for developed countries.

A closed economy hypothesis is unrealistic for up-to-date analysis. For this reason, as another essential determinant of tax revenues, the degree of trade openness, which is the GDP share of a total of imports and exports, is substantially used to represent relations with international markets (Bahl, 1972; Bird et al., 2008; Pessino & Fenochietto, 2010; Chigome & Robinson, 2021). An increase in trade openness may cause a decline in taxes on imports and exports. However, it also increases tax revenues by positively stimulating economic growth (Le et al., 2012, p. 9). With this dimension, the effect on tax capacity is ambiguous, depending on which effect will dominate the degree of trade openness. In addition, the level of development of financial markets and foreign direct investments are among other determinants of tax revenues. The development of financial markets can have a positive impact on tax revenues. Furthermore, FDIs can actively boost total tax revenues, as suggested by Pratomo (2020). Eventually, the shadow economy's size, an inevitable reality for every country's economy, is another expected determinant to have a negative impact on total tax revenues.

$$Tax_{it} = \beta_0 + \beta_1 GDPPERGR_{it} + \beta_2 AVA_{it} + \beta_3 OPEN_{it} + \beta_4 POPGR + \beta_5 FD_{it} + \beta_6 FDİ_{it} + \beta_7 Shadow_{it} + \varepsilon_{it} \quad (4)$$

Equation 4 presents the empirical model encompassing all the variables in our research. Equation 4 will be estimated using panel data analysis techniques between 1995 and 2021 for 27 EU member countries, 3 EEA countries, and Turkiye. In addition to the many advantages that panel data models offer, they also have some sensitivities. Therefore, the presented model may partially replace the results of a study that examined a single country in the context of a specific tax type, aiming to measure potential tax capacity and tax effort. The methodology followed, and the preferred covariates have some sensitivities in measuring the tax capacity of countries in the sample (Le et al., 2008). The first is the systematic errors in measuring independent variables and the limitations of the regression-based estimation approach. However, despite these limitations, the findings obtained will be an essential source of foresight in measuring and increasing the income potential of tax systems (Le et al., 2012). It is important to consider that a regression-based estimation method can produce consistent results compared with other approaches used in the literature (Cyan et al., 2013; Parfenova et al., 2016; Dalamagas et al., 2019).

B. Data Set

We gathered all variables required for the estimation within the research from the Eurostat (2023), OECD (2023), WDI (2023), and IMF (2023) databases, excluding the size of the shadow economy, which obtained from Medina and Schneider (2018) and Schneider (2022). We included all data except the financial development index in the model as a percentage of GDP and a percentage of annual changes. Table 1 provides definitions of variables, explanations, measurement units, and data sources within the scope of equation 4.

Table 1: Explanations of Variables

Variables	Description	Unit	Sources
TAX	Tax Revenue	% of GDP	EUROSTAT; OECD
GDPPER	GDP per capita growth	annual %	WDI
AVA	Agriculture, forestry, and fishing, value added	% of GDP	WDI
OPEN	Import + Export	% of GDP	WDI
POPGR	Population growth	annual %	WDI
FDI	Foreign Direct Investment (inflow)	% of GDP	WDI
FINDEV	Financial Development Index	Index	IMF
SHADOW	Size of Shadow Economy	% of GDP	Medina and Schneider (2018); Schneider (2022)

Table 2 presents the descriptive statistics of the variables used in the model. According to the descriptive statistics, the sample's average tax revenues to GDP ratio was approximately 25% in 1995–2021. The average annual increase in per capita income is 2.3%, and the annual population growth rate is 0.3% on average. The share of the degree of trade openness is also high throughout the sample, which aligns with expectations.

Table 2: Descriptive Statistics

Variables	Num.Obs.	Average	Std. Dv.	Min.	Max.
TAX	837	25.320	5.472	13.50	49.70
GDPPER	837	2.387	3.832	-14.46	23.20
AVA	837	3.044	2.553	0.20	20.48
OPEN	837	109.956	59.462	37.10	388.12
POPGR	837	0.316	0.842	-3.85	3.93
FDI	837	9.306	33.310	-117.42	449.08
FINDEV	837	0.577	0.494	0.00	1.00
SHADOW	835	20.234	7.889	5.50	43.70

The financial development variable offered by the IMF is an index that takes values between 0 and 1, indicating that financial development increases as it converges to 1. The average value of the financial development index is 0.57. In addition, for the variables mentioned earlier, it is worth noting that the average value of foreign direct investments as a percentage of GDP is 9.5%. We determined the standard deviation to be 33.3. Finally, the average value of the size of the shadow economy (% of GDP) was 20% in 1995–2021.

IV. EMPIRICAL APPLICATION

To examine the relationship between the data using panel data analysis approaches, one can use the pooled least squares estimator, also known as the classical model, fixed effects, or random effects estimator techniques. These models can produce consistent results without cross-section dependence, heteroscedasticity, or autocorrelation problems. If any of these assumptions are unmet, it becomes necessary to derive robust standard errors to eliminate these deviations.

First, we need to decide which technique is the best fit for estimating the model presented in Equation 4. In this context, we performed Breusch and Pagan (1980) test. Breusch and Pagan (1980) suggest that if the variance of the unit effects is zero within the scope of the panel data model, one should use the pooled least squares method. Otherwise, one should not apply the pooled least squares method.

Based on the result obtained, we rejected the H_0 hypothesis that the variance of unit effects in the model is equal to zero [prob>chibar2=1.00]. Accordingly, one of the remaining fixed or random effect estimators should applied. In this context, we conducted Hausman's (1978) test to determine which model best fits. The H_0 hypothesis of the Hausman (1978) test indicates that the explanatory variables in the unit effect model are uncorrelated.

The result obtained from Hausman's (1978) test [prob>chibar2=0.007] showed that the random effect estimators would not be fit as they could possibly generate unbiased and consistent results. Therefore, we conclude that the panel fixed effect estimator is appropriate for estimation.

Table 3: Panel Fixed Effect Estimator

	Model 1	**Model 2**	**Model 3**	**Model 4**
GDPPER	0.029*	0.320**	0.346*	0.040**
	(1.67)	(1.83)	(2.00)	(2.32)
AVA	-0.077*	-0.069	-0.389	-0.014
	(-1.69)	(-1.53)	(-0.85)	(0.32)
OPEN	-0.005	-0.004	-0.005*	-0.010***
	(-1.62)	(-1.43)	(-1.67)	(-2.92)
POPGR	0.182	0.196	0.149	0.091
	(0.143)	(1.42)	(1.09)	(0.508)
FDI		0.006***	0.005***	0.005***
		(3.20)	(2.79)	(2.62)
FINDEV			0.952***	0.902***
			(3.81)	(3.62)
SHADOW				-0.066***
				(-3.56)
CONS	26.027***	25.845**	25.30***	27.167***
	(59.36)	(58.80)	(55.15)	(39.25)
Groups	31	31	31	31
Obs.	837	837	837	835
R-sq	0.24	0.25	0.30	0.39
Rho	0.924	0.924	0.921	0.919
BP				[1.000]
Baltagi Wu				[1.529]

Note: ***, **, and * expressions represent statistical significance at 1%, 5%, and 10% significance levels, respectively.

Table 3 presents the results of the empirical estimations. First, in Table 3, the coefficient signs of the preferred variables for all models display a stable structure. The effect of per capita income on tax revenues was positive and statistically significant [at a 10% level]. However, the coefficient related to agricultural value added has a statistically significant negative effect only in the first model. On the other hand, the effect of trade openness on tax revenues is negative for all models but is only statistically significant in models 3 and 4. In addition, the effect of FDIs on tax revenues is statistically significant and positive, following empirical expectations. Furthermore, the level of financial development has a substantial and statistically significant positive effect on tax revenues. Finally, the coefficient regarding the effect of the shadow economy on tax revenues is negative and statistically significant.

We performed diagnostic tests for Model 4 and estimated the modified Wald test with the H_0 hypothesis, where we assumed that each unit of variance equals the panel mean. The probability value [prob>chi2 = 1.00] of the estimated

Wald statistics showed no heteroscedasticity in the model, and we obtained consistent results using the fixed-effects model. Additionally, we used the LBI autocorrelation test, and according to the test statistic [1.5267] obtained by Baltagi and Wu (1999), we concluded that there is no first-order autocorrelation problem in the model. We also tested for cross-section dependence using Pesaran (2004) CD test. The test results showed that we could not reject the H_0 hypothesis expressing cross-section independence, indicating the problem of cross-section dependence in the model. Considering that globalization movements are an essential element that increases the interaction between units and leads to cross-section dependence (Aydın & Bozatlı, 2022, p. 54185), we re-estimated the fixed effect estimator for all models using the robust standard error estimator to ensure consistency of the parameters.

Table 4: Panel Fixed Effect Robust Standard Eror Estimator

	Model 1	**Model 2**	**Model 3**	**Model 4**
GDPPER	0.029	0.320**	0.346**	0.400**
	(1.22)	(1.83)	(2.04)	(2.51)
AVA	-0.776	-0.069	-0.389	-0.014
	(-0.55)	(-0.51)	(1.50)	(-0.12)
OPEN	-0.005	-0.004	-0.005*	-0.014***
	(-0.45)	(-0.39)	(-1.67)	(-2.72)
POPGR	0.143	0.196	0.149	0.091
	(0.670)	(0.58)	(0.46)	(0.29)
FDI		0.006***	0.005**	0.005***
		(2.72)	(2.76)	(2.74)
FINDEV			0.952**	0.902***
			(2.76)	(2.62)
SHADOW				-0.066**
				(-1.89)
Cons	26.027***	25.846***	25.301***	27.167***
	(17.83)	(17.35)	(17.29)	(14.03)
Groups	31	31	31	31
Obs.	837	837	837	835
R-sq	0.14	0.25	0.30	0.32
Rho	0.924	0.924	0.921	0.918

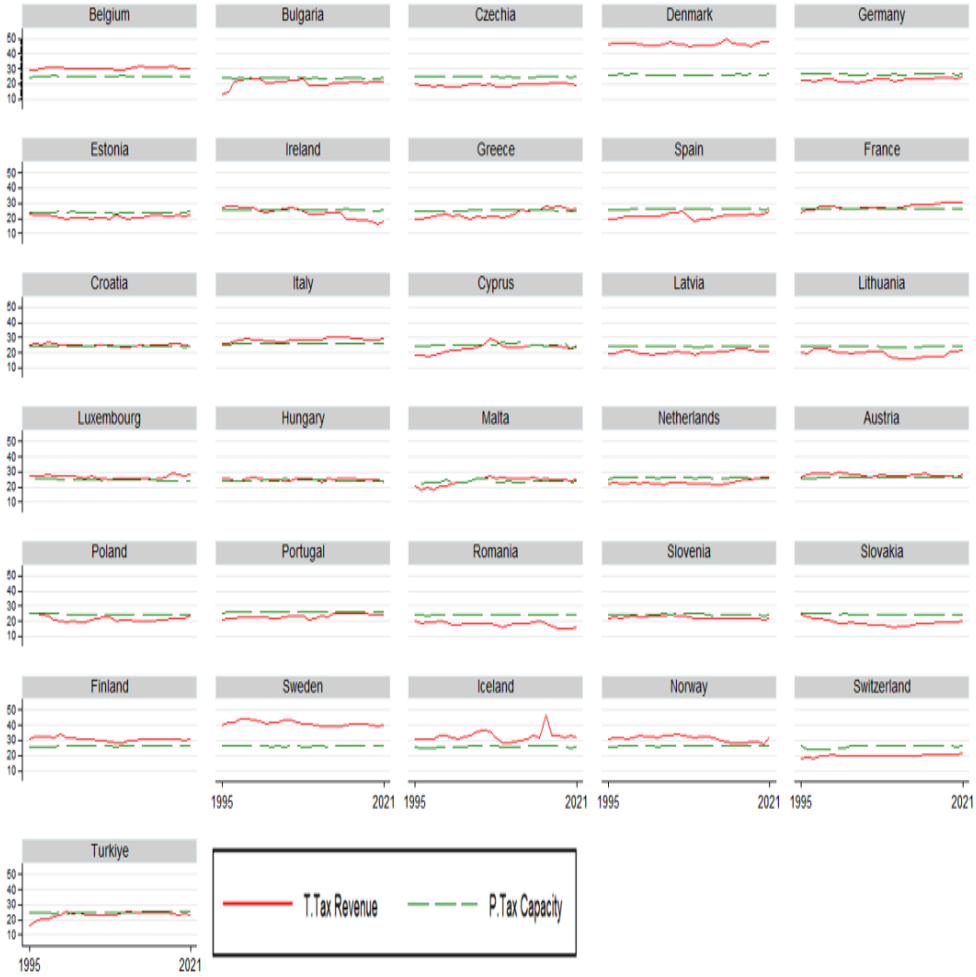
Note: ***, **, and * expressions represent statistical significance at 1%, 5%, and 10% significance levels, respectively.

We present the results in Table 4, which show that an increase in per capita income has a positive and statistically significant effect on tax revenues. Both theoretical and empirical expectations (Tanzi, 1992; Stotsky & Woldemariam, 1997; Eltony, 2002; Gupta, 2007; Ndiaye & Korsu, 2014; Garg et al., 2017; Dalamagas et al., 2019; Brafu-Insaidoo et al., 2020; Kawadi & Suryawanshi, 2023) support the compatibility of increases in per capita income and tax revenues. We found that agricultural value added has a negative effect on tax revenues, which also agrees with expectations (Le et al., 2008; Pessino & Fenochietto, 2010; Le et al., 2012) but is statistically insignificant. We observed that increased trade openness negatively affects tax revenues (Piancastelli, 2001; Piancastelli & Thirlwall, 2021). This situation is consistent with the low customs tariff rates that countries keep as a requirement for membership in the EEA Customs Union and the World Trade Organization. Additionally, we can evaluate this phenomenon due to shifting production factors and centers to areas with lower taxes due to increased

external openness (Gupta, 2007; Bird et al., 2014). Moreover, we found that the level of financial development positively affects tax revenues with statistical significance. Finally, we observed a statistically significant negative relationship between shadow economy size and tax revenues.

Figure 3 displays the relationship between potential tax capacity and tax revenues based on regression estimates as a time path graph. In Figure 3, which represents the relationship for each country from 1995 to 2021, the red line represents the total tax revenue level (% of GDP); the green dashed line represents the estimated potential tax capacity (% of GDP).

Figure 3: The Relationship Between Tax Capacity and Tax Revenues



We can calculate the tax effort index based on real tax revenue and potential tax capacity. If the real tax revenue in terms of tax effort is higher than the potential tax capacity, the calculated tax effort index will be greater than 1. Conversely, if the real tax revenue is lower than the potential tax capacity, the calculated tax effort index will be less than 1. We present the calculated tax effort

indexes of the countries in Table 5. We can calculate the tax effort index for each year separately using a regression-based estimation method. However, it is useless to report all of them and is not rational either. Although the tax effort index for a single year can be misleading in terms of generalization, the long-term average values can also represent the permanent tax effort index (Chigome & Robinson, 2021). Thus, Table 5 reports the averages for three periods of tax effort. These are 1995-2008, respectively; periods are 2009-2021 and 1995-2021, which covers the entire sample. According to the results obtained in Table 5, tax effort in the sample is higher in the 2009-2021 period compared to the 1995-2008 period. On the other hand, the top 5 Northern European countries with the highest tax effort performance in all three periods are Denmark, Sweden, Iceland, Norway, and Finland, also known as social welfare states.

In these countries, the level of per capita income and level of development of financial markets are high; the size of the shadow economy is relatively low compared to other countries in the sample, and it plays a vital role in the high tax effort. In addition, these countries can finance more than 85% of their total public expenditures with tax revenues, as shown in Figure 2. Piancastelli (2001) classified a tax effort index below 0.84 as low tax capacity.

Table 5: Tax Effort Index

	Countries	**Tax Effort Index**		
		1995-2008	**2009-2021**	**1995-2021**
1	**Denmark**	1,768	1,773	1,771
2	**Sweden**	1,613	1,520	1,612
3	**Iceland**	1,264	1,247	1,312
4	**Norway**	1,232	1,132	1,230
5	**Finland**	1,202	1,144	1,205
6	**Belgium**	1,194	1,208	1,201
7	**Italy**	1,079	1,121	1,099
8	**Luxembourg**	1,073	1,085	1,079
9	**Austria**	1,066	1,041	1,054
10	**Spain**	0,832	0,827	1,045
11	**France**	1,006	1,086	1,045
12	**Croatia**	1,040	1,020	1,030
13	**Hungary**	1,023	1,030	1,027
14	**Malta**	0,937	1,067	1,000
15	**Türkiye**	**0,901**	**0,955**	**0,957**
16	**Slovenia**	0,936	0,902	0,944
17	**Poland**	0,884	0,853	0,940
18	**Portugal**	0,871	0,929	0,935
19	**Ireland**	1,023	0,812	0,921
20	**Cyprus**	0,874	0,959	0,915
21	**Netherlands**	0,865	0,906	0,885
22	**Estonia**	0,872	0,890	0,880
23	**Bulgaria**	0,881	0,864	0,873
24	**Germany**	0,846	0,887	0,866
25	**Latvia**	0,816	0,862	0,838
26	**Greece**	0,833	0,999	0,829
27	**Switzerland**	0,767	0,766	0,812
28	**Slovakia**	0,801	0,745	0,807
29	**Lithuania**	0,861	0,745	0,805
30	**Czechia**	0,758	0,801	0,779
31	**Romania**	0,770	0,707	0,775

Within this framework, the level of tax effort is low for Latvia, Greece, Switzerland, Slovakia, Lithuania, Czechia, and Romania. The average tax effort value of 1.015, with a standard deviation of 0.09, distributes the remainder of the sample around it. According to the classification, a significant sample has a moderate tax effort level performance. Turkiye is in the 15th rank regarding tax effort within the scope of the 1995-2021 period, which considers the overall sample, but still has a tax collection below its potential tax capacity. Previous empirical estimates (Atsan, 2017; Kızıltan, 2018) found the tax effort index for Turkiye to be over 0.90, which is consistent with our results.

It is helpful to infer by comparing the tax effort index obtained at the last stage with the total tax revenues (% of GDP) compiled from Eurostat (2023) and OECD (2023) databases. Within this framework, we created a distribution table, similar to a coordinate system, placing the tax effort index on the horizontal axis and the GDP ratio of tax revenues on the vertical axis. The average tax effort index value for 1995-2021 is 1.015 throughout the sample.

Table 6: Grouping by Tax Effort and Tax Collection Levels

	Low Tax Effort [E<1.015]		**High Tax Effort [E>1.015]**	
	IV. Area		**I. Area**	
Low Tax Collection [T/Y<25.318]	Bulgaria Czechia Estonia Germany Hungary Ireland	Latvia Malta Netherlands Poland Romania Turkiye	Austria Belgium Finland Iceland	Italy Luxembourg Sweden
High Tax Collection [T/Y>25.318]	**III. Area**		**II. Area**	
	Cyprus Greece Lithuania	Slovakia Slovenia Switzerland	Croatia Denmark France	Norway Spain

Countries with a higher tax effort index than the average tax effort index in Table 6 [E>1,015] I. and II. in the numbered regions, Countries with a lower tax effort index than the average tax effort index [1,015> E] located in areas no. III. and IV. On the other hand, the sample-wide average tax collection level is 25,318. Countries with higher tax income than the average tax income [*T/Y>25,318*] II. and III. countries with lower tax income than the average tax income level while located in the regions numbered [*25,318> T/Y*] located in areas no I. and IV.

Consider that we perform grouping according to the mean values of the sample. Therefore, a country with a high tax effort does not necessarily have high direct tax revenues. A country with a relatively low potential tax capacity may have a high tax effort index but a low tax income level. Similarly, a low tax effort index does not necessarily mean inadequate tax revenue because, for an economy with high potential tax capacity, the tax effort index may be low. However, the tax income level may still be very satisfactory.

CONCLUSION AND DISCUSSION

For a country, taxes are indispensable in terms of both their historical basis and the financing source they provide. In addition, taxes are one of the main tools comprising the income dimension of fiscal policy, which is an essential component

of economic policy. Although tax revenues vary according to the countries that finance public expenditures, they can provide resources between 50% and 90%. In this respect, knowing the potential capacities and the actual structure of tax revenues is necessary. For this reason, academic literature has been conducting studies on determining potential tax capacity for a long time. Simply defined, the maximum amount of tax available if a country's social, political, demographic, institutional, and economic factors allow is the potential tax capacity (Cyan et al., 2013; Garg et al., 2017; Chigome & Robinson, 2021; Kawadia & Suryawanshi, 2023). Pessino and Fenscietto (2010) defined tax effort as the usage level of this potential tax capacity. However, taxation reflects public preferences to a great extent and the intention of tax authorities to collect tax. With this dimension, tax effort for a country can be low because of its technical inefficiencies or governance failures.

The literature has developed many empirical techniques to identify potential tax capacity and effort. The most widely used methods are representative tax system, stochastic frontier analysis, and regression-based estimation. However, other studies have used spatial panel data estimation models (Kızıltan, 2018), balanced budget models (Cyan et al., 2013), and utility maximization methods (Dalamagas et al., 2019). Lotz and Morss (1967) first performed a regression-based estimation, which has remained the focus of serious attention to date (see others: Lotz & Morss, 1970; Bahl, 1971, 1972; Chelliah et al., 1975; Truong & Gahsh, 1979; Tanzi, 1992; Piancastelli, 2001; Eltony, 2002; Bird et al., 2008; Le et al., 2008; Samimi et al., 2009; Le et al., 2012; Andoh, 2017; Amoh, 2019).

Given the risks posed by the COVID-19 pandemic, the global inflation wave it caused, the Russian-Ukrainian war, and the energy supply crisis, fiscal policies with Keynesian characteristics have become more relevant again. This has led to an important research question of how much financing countries can generate using their tax revenues. Within this framework, our research examined the potential tax capacity and effort level using a regression-based estimation method for 27 European Union and 3 European Economic Area member countries and Turkiye using data from 1995 to 2021. The obtained findings overlap with the results previously revealed in the empirical literature and meet the expectations. Within the results obtained, we divided the countries into four groups using a method similar to the grouping performed by Lee et al. (2012). We classify countries with a taxable income lower (higher) than the average tax income level of 25.3% as having low (high) tax collection. In addition, we defined countries with a sample average tax effort level below (above) 1.015 as countries with low (high) tax effort. According to this classification, a significant part of the sample has low tax effort and income levels compared with average values. On the other hand, countries with high tax collection and high tax effort appear to have the lowest membership. We also observed that the tax effort index values in the 1995-2008 period were higher across the sample than those in the 2009-2021 period. This situation supports the view that the tax effort has decreased gradually over the last few years.

As mentioned earlier, discussing the taxable capacities of countries and tax system's performance has many theoretical and empirical challenges. One of the empirical limitations is the problem of identifying common determinants of tax capacity for many countries (Piancastelli, 2001; Bird et al., 2008; Pessino & Fenochietto, 2010; Le et al., 2012; Dalamagas et al., 2019; Chigome & Robinson, 2021; Kawadia et al. Suryawanshi, 2023). Furthermore, there are some systematic errors in measuring these determinants and limitations of a regression-based estimation method. Finally, as a theoretical problem, tax cuts, exemptions, and derogations, which are atypical elements of tax systems, constitute another limitation in the measurement of taxable capacity.

However, despite such sensitivity, measuring a country's potential tax capacity level and determining the level of tax effort provide essential information regarding countries' fiscal space or opportunities to create additional financing resources. It can also provide policymakers with a picture of the current state of the tax system, providing insight into what tools they should use to improve potential tax capacity or what policies they should implement to increase tax efforts. From the public economics perspective, this analysis reveals how tax systems differ in effectiveness and efficiency.

Regarding this particular issue, it is necessary to maintain and increase the per capita income level to increase the potential tax capacity. Moreover, improving the total tax capacity by encouraging FDI inflow to internalize the negative effect of trade openness seems possible. In addition, to increase the development of financial markets, which is a powerful determinant, deregulation processes in financial markets and strengthening the transaction volume and governance skills of financial institutions are essential for increasing tax capacity and tax effort.

Implementing measures to reduce the informal economy, which we can define as the main problem of the tax system and the operation of audit and penalty mechanisms, will directly affect tax revenues. Policies aimed at reducing the size of the informal economy will positively impact potential tax capacity and, therefore, tax efforts. To analyze critical institutional factors in the tax system, such as institutional quality, governance skills, degree of political fragmentation, and democracy, researchers can draw on the critical findings on tax efforts presented in this study. Lastly, we consider that researchers can add exciting results to the literature in future studies using spatial panel data analysis techniques that provide more detailed information about tax system by providing micro-scale perspective.

Statement of Research and Publication Ethics

In all article processes, the principles of research and publication ethics of the Journal of Management and Economics were acted upon.

Authors' Contribution Rates

The authors contributed equally to the study.

Statement of Interest

The author has no conflict of interest with any person or organization.

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