Tax Effort in Eurozone Countries After the Outbreak of the Global Economic Crisis

Dimitra Ntertsou, Theophanis Petropoulos, and Konstantinos Liapis

Abstract The purpose of this article is to assess the tax effort undertaken by Eurozone countries, during the decade that followed the outbreak of the financial and economic crisis. Tax effort is measured by relating actual tax collections to some indicator of taxable capacity. Some countries are more favorably placed to levy taxes and can be said to have a greater taxable capacity than others. Regression analysis is used on cross-section data, to quantify the influence of Eurozone countries' specific economic and institutional features on the tax ratio. With the resulting estimates of the coefficients, an average tax ratio is estimated for each country. Then, the tax effort for each country is calculated by the percentage difference of the actual tax ratio and its estimate and countries are ranked accordingly. Our findings confirm previous results that Eurozone countries' tax effort index is around one, suggesting that they adequately use their tax bases to raise tax revenues. However, there are some Eurozone countries which undertake greater tax effort while in some other Eurozone countries there is room for raising more tax revenues. The current article contributes to the existing literature of assessing similarities within the euro-area regarding the tax policy adopted, after the outbreak of the 2008 economic crisis. Most of the literature focuses on comparing tax revenues as a percentage of GDP. However, this tax ratio may give a distorted picture, since economic developments in different countries, especially after the outbreak of the crisis, considerably altered the effectiveness in revenue mobilization. The current article goes beyond this comparison, assesses the tax capacity and the tax effort undertaken in the different Eurozone countries and ranks them accordingly. It contributes to the existing tax effort literature, by introducing in the analysis wealth instead of GDP, as a measure of economic activity and wellbeing.

Keywords Tax revenue · Tax capacity · Tax effort · Eurozone

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1 Introduction

Some countries have a greater ability to raise tax revenue based on their wealth-producing resources. These countries are said to have a greater "tax capacity". But to what extent do countries actually tax, based on their tax potential? The answer is provided if we examine a country's actual tax revenue in relation to an estimate of its tax potential. The ratio between the actual tax revenue and tax capacity is known as tax effort.

Following the global financial crisis in 2008, a number of countries introduced tax measures to raise revenues, reduce the budget deficit and improve the primary balance. The current research focuses on the euro-area and aims to assess tax capacity in Eurozone countries during the period 2008–2018 and the tax effort undertaken in these countries and to rank them accordingly and conclusions on whether countries examined adequately used their tax bases to mitigate the negative effects of the crisis.

The paper is structured as follows; Sect. 1 presents the existing literature on tax effort, Sect. 2 provides a comparative analysis of actual tax revenue as a percentage of GDP in Eurozone countries during the period 2008–2018. Section 3 presents the methodology employed in our research, the data used in our model in order to estimate tax capacity and the sources of these data. Finally, Sect. 4 presents the estimated tax capacity for the countries in our sample and the resulting tax effort index and ranks these countries accordingly.

2 Literature Review

In principle, a country's tax capacity is approached by its Gross Domestic Product (GDP), which is considered to be an indication of the size of its tax base and therefore of its ability to raise tax revenue. Therefore, the total taxes collected as a percentage of GDP could be considered as a first indication of the country's tax effort. This ratio is a reasonable indicator to establish trends or compare revenue performance across countries with similar economic structures and/or income levels.[1] However, GDP alone is not enough to assess a country's tax capacity as there are undoubtedly other factors that decisively affect countries' ability to raise tax revenue. This has led some economists to find alternative ways of measuring tax capacity.

One of the most well-known studies in this field is that of Lotz and Morss (1967), who, using data for 72 countries, calculated their tax capacity by first introducing GDP per capita as an explanatory variable and then adding the degree of openness of the economy (defined by exports as a percentage of GDP). They also found that

[1] Dalamagas et al. (2019).

the trade balance (defined as exports minus imports divided by the Gross National Product) was also a good predictor of tax capacity. Finally, they also found a positive relationship between fiscal decentralization and fiscal capacity. When comparing the estimated tax capacity with the actual tax revenue collected, they concluded that around half of the countries of their sample collected more and half of the countries collected less.

The conclusions of Lotz and Morss have been reproduced. Bahl (1971) estimated tax capacity and tax effort for 49 developing countries. He factored in the regression the structure of the economies examined (proxied by the share of agriculture in GDP and the share of mining exports in total exports) and also included regional dummy variables, leading to different conclusions for different regions. Chelliah et al. (1975) also introduced in their models additional explanatory variables that potentially affect the tax potential of developing countries such as the share of the mining sector in GDP, the share of the agricultural sector in GDP, exports as a percentage of GDP etc. Among other things, they concluded that in countries where tax revenue as a percentage of GDP was above the average of the sample, the tax effort ratio was higher than one and vice versa. Tanzi (1992) for a sample of 83 developing countries concluded that the fluctuation of tax revenues as a percentage of GDP was explained partly by changes in GDP per capita, but for other determinants, such imports, the agricultural sector and external debt were significant explanatory variables. Ghura (1998) examined a sample of 39 sub-Saharan African countries. He extended the models used up to that point, by including as explanatory variables inflation, change in real effective exchange rate, structural reform and a measure of human capital. He also introduced corruption as an explanatory variable, being the first in the relevant literature, to include governance / institutional variables in the analysis. Bird et al. (2004) extended the traditional models for measuring tax potential by introducing as explanatory variables, in addition to supply side variables (GDP per capita, population growth rate, total exports and imports as a percentage of GDP, and non-agricultural contribution) and demand factors (quality of governance, informal economy, inequality, fiscal decentralization), which also prove to have a decisive influence on tax revenue. More recent studies by the World Bank (Le et al. 2008, 2012) extend the empirical study by Bird et al. to cover a larger sample of countries and time period. Their conclusions confirm that institutional factors significantly affect a country's tax capacity. According to these studies, a country with a higher GDP per capita, lower population growth rate, greater economic openness and a smaller contribution of the agricultural sector to GDP formation, is expected to be able to raise more tax resources. A more recent study that used the standard regression approach is that of Yohou and Goujon (2017) who estimated tax capacity and tax effort for 120 developing countries over the period 1990–2012 by taking into account structural economic and human vulnerabilities, proxied in their model by the Economic Vulnerability Index and the Human Assets Index. They found that economic vulnerability is harmful to taxes while human asset enhances taxes.

Pessino and Fenochieto (2013) did not follow the traditional regression method of estimating tax capacity and tax effort and instead employed the stochastic frontier tax analysis for 113 countries during the period 1991–2012 (they extended previous

work conducted in 2010). The estimated tax frontier represents the theoretical maximum amount of tax revenues a country can collect (i.e. tax capacity), taking into account economic and institutional characteristics. The difference between actual tax revenues and stochastic tax frontier includes technical inefficiencies, public choice or policy issues. Pessino and Fenochieto concluded that most European countries with high level of GDP per capita, education, openness, low levels of inflation, corruption and income inequality were near their tax capacity (especially Austria, Begium, Denmark, Finland, France, Italy and Sweden). Langford and Ohlenburg (2016) also estimated tax capacity and tax effort using a stochastic frontier analysis model for 85 non-natural resource-rich countries for the period 1985–2010 and their results were in line with the existing literature. Also, Mawejje and Sebudde (2019) estimated tax capacity and tax effort for 150 countries over the period 1996–2015 by incorporating in their model economic variables (GDP per capita, openness, agriculture share GDP, inflation, grants, income inequality), demographic variables (share of rural population and health expenditure) as well as institutional variables (corruption) and their results are in line with previous estimates.

Cyan et al. (2013) introduced a third approach to estimate tax effort by comparing a country's actual tax revenues to its desired level of taxation (level of public expenditure) for 94 countries over the period 1970–2009.

Boukbech et al. (2018) followed as well a different approach to identify the main determinants of tax revenues for a panel of 29 lower-middle-income countries during the period 2001–2014. They distinguished two different components in tax revenues. The component determined by structural factors on which government has little control in the short-term (tax capacity $= \tau B$), and the component determined by public policy influenced by either direct or indirect government action (tax effort $= e$). Therefore, they first estimated the tax capacity equation and in a second step the tax effort equation using the panel data technique. Regarding tax capacity, they found a positive and significant effect of GDP per capita and of the share of the value added of agriculture on tax revenues, while the openness degree has a positive but not significant effect and the population growth has a negative and not significant effect. Regarding the tax effort, the level of inflation and public expenses have a positive and significant effect, while the official assistance received and the external debt have a negative and significant effect.

Dalamagas et al. (2019) proposed a utility maximization process to estimate the optimal tax revenue for 30 countries over the period 1996–2015 (and the two subperiods of 1995–2009 and 2010–2015). To our knowledge, it is the first study to examine the impact of the world economic crisis on countries' tax effort. In their analysis, the optimal level of tax revenue is shown to be equal between GDP and consumption. On the basis of this definition, the actual tax burden was below its optimal level for 26 out of the 30 countries studied.

The current paper contributes to the discussion on tax effort by introducing total wealth as a proxy for economic development, in lieu of GDP, which is most commonly used in the literature. Also, by focusing in euro-area countries, it provides useful insight in existing comparative analysis regarding the impact on the global economic crisis in the Eurozone in the field of taxation.

Also, in all the above studies, regardless of the approach used to estimate tax capacity and calculate tax effort, GDP per capita has been used as a proxy of economic development in the countries examined.

The current paper is structured as follows: the first section describes the methodology used, the data selected and the sources of these data. The second section provides the empirical results of countries' tax capacity, i.e. the potential revenue they can raise.

3 Evolution of Actual Tax-to-GDP Revenues, 2008–2018

The current section provides a brief overview of taxation trends in Eurozone countries[2] over the period 2008–2018.

Given that countries' populations and economies differ and to enable cross-country comparisons, total tax revenues are expressed as a percentage of GDP. This is the so called 'tax-to-GDP' ratio.

Data are extracted from the European Commission, Taxation and Customs Union, where total taxes are defined as taxes on production and imports (D.2), current taxes on income and wealth (D.5) and capital taxes (D.91), minus 'Capital transfers (representing taxes assessed but unlikely to be collected)' (D.995) (Table 1).

Tax revenues as a percentage of GDP reached in 2018 24.9% on average in the countries included in our sample, increased by 1 percentage point relative to 2008. Since 2009, after the outbreak of the financial crisis, a trend of annual increases is observed in the Eurozone average.

Of the 17 countries of our sample, the tax-to-GDP ratio in 2018 compared to 2008 rose in 13countries and fell in 4. Between 2008 and 2018, the largest tax-to-GDP ratio increase was seen in Greece (at 7 p.p), followed by France (3.3 p.p). Increases of 2 percentage points or more were seen in Slovakia, Portugal, Netherlands, Luxembourg and Spain.

The largest fall in the tax-to-GDP ratio was in Ireland (−5.9 p.p.), followed by Lithuania (−3.7 p.p).

Even though the total level of tax revenue as a % of GDP has increased in most Eurozone countries, the level of total taxation differs considerably among Member States. In 2018, the tax-to GDP ratio varied between 31,4% in Belgium and 17,4% in Lithuania (Fig. 1).

As it was already mentioned, a country's tax capacity is in principle approached by its Gross Domestic Product (GDP), which is considered to be an indication of the size of its tax base and the tax effort is approached by dividing actual tax collections to GDP. However, GDP alone is not enough to assess a country's tax capacity as there are undoubtedly other factors that decisively affect countries' ability to raise

[2] Due to lack of data for Cyprus and Malta in the empirical analysis, these countries are not included in the Table 2.1. either.

Table 1 Evolution of total tax revenues as a % of GDP, 2008–2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018–2008
Lithuania	21.1	17.7	16.7	16.1	16.2	16.1	16.4	17.4	17.6	17.2	17.4	−3.7
Ireland	24.6	22.9	22.7	22.9	23.5	23.8	24	19.4	19.7	18.7	18.6	−6
Slovakia	17.3	16.4	16	17	16.4	17.6	18.3	18.9	18.8	19.3	19.3	2
Estonia	19.8	22	20.3	19.7	20.4	20.5	21.1	22	22.1	21.4	21.4	1.6
Latvia	20	18.3	19.7	19.6	20.3	20.7	21.3	21.5	22.5	22.7	21.9	1.9
Slovenia	22.9	21.8	22.2	22	22.1	22	22.2	22.2	22.2	21.9	22	−0.9
Spain	20.3	17.7	19.5	19.4	20.7	21.7	22.3	22.5	22.3	22.4	23	2.7
Germany	23.5	23.1	22.1	22.7	23.2	23.3	23.1	23.5	23.8	23.9	24.3	0.8
Netherlands	22.7	22.5	22.6	21.9	21.1	21.4	22.4	23	23.7	24.9	24.8	2.1
Portugal	23.4	21.2	21.8	23.3	23	25.1	25.2	25.4	25	25	25.3	1.9
Austria	27.9	27	27.1	27.3	27.8	28.3	28.3	28.7	27.3	27.3	27.6	−0.3
Greece	21.1	20.6	21.3	23.4	25.2	25.2	25.8	26	27.8	27.6	28.1	7
Italy	28.3	28.4	28.3	28.3	30.1	30.2	30	29.9	29.4	29.1	28.7	0.4
Luxembourg	26.4	26.9	26.8	26.4	27.3	27.3	27	25.5	25.9	26.8	28.8	2.4
France	27	25.9	26.2	27.3	28.1	28.8	28.8	29	29	29.7	30.3	3.3
Finland	29.6	28.6	28.5	29.8	29.8	30.9	30.9	30.9	31	31	30.5	0.9
Belgium	30.2	28.9	29.6	30.2	31	31.6	31.4	30.8	30.6	31.2	31.4	1.2
Average	23.9	22.9	23.0	23.4	23.9	24.4	24.6	24.5	24.6	24.7	24.9	1.0

European Commission, Taxation and Customs Union

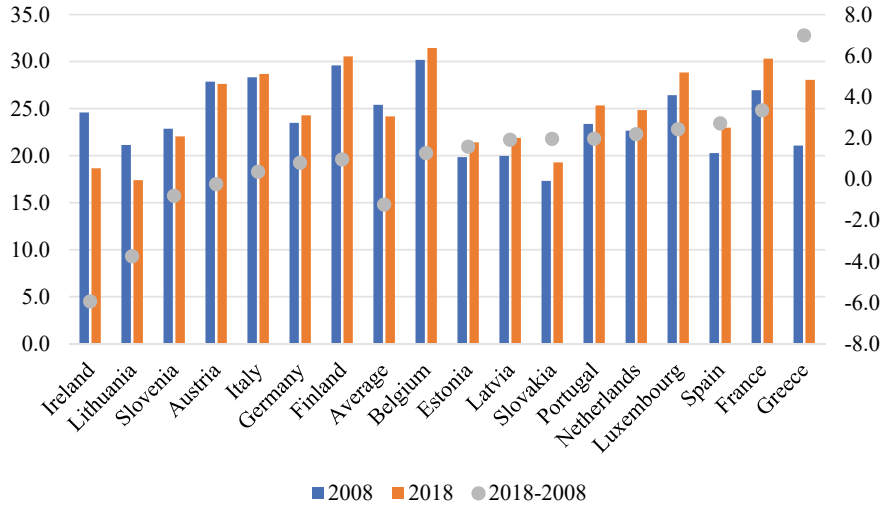

Fig. 1 Tax revenues, 2008–2018 (% of GDP)

tax revenue. Therefore, the paper proceeds with estimating empirically the Eurozone countries' tax capacity.

4 Methodology and Data

The current research follows the standard regression method for predicting Eurozone countries' potential revenues for the period 2008–2018, i.e. for estimating their tax capacity. The basic model can be expressed as follows:

$$Y_{it} = f(X_{it})$$

where

Y_{it} is tax revenue as a percentage of GDP

X_{it} are factors that have a decisive influence on the size of the tax base and consequently affect countries' potential tax revenue collection

t = years covered (from 2008 to 2018)

i = countries covered (from 1 to 17).[3]

Following existing literature, the underlying hypothesis of this specification is that the tax revenue capacity of a country is determined by both economic factors and institutional characteristics. Therefore, the following empirical specification is estimated:

[3] Cyprus and Malta are not included in our sample no data on national wealth per capita were available at the time of the research.

$$\text{Tax/GDP}_{it} = a_o + a_1 \text{WEALTHPC}_{it} + \text{a2SERV}_{it} + a_3 \text{IND}_{it} + a_4 \text{AGR}_{it} + a_5 \text{CORRUPT}_{it} + e_1$$

where

WEALTHPC: wealth per capita (constant 2018 US$)
SERV: services value added, measured as a fraction of GDP
IND: industry and construction value added, measured as a fraction of GDP
AGR: agricultural value added, measured as a fraction of GDP
CORRUPT: Corruption Index
e: the stochastic term

National wealth is a new (albeit historically older) indicator which has gained attraction and is used as a proxy for the level of development of a country by going beyond economic output. While GPD, which is the traditional means of determining a country's economic vitality, measures the monetary value of the goods and services a country produces on a yearly basis, national wealth considers a country's assets. Specifically, national wealth accounts for produced capital (resources made by humans like buildings, machines and technology), natural capital (renewable and non-renewable assets like forests, fisheries, minerals, fossil fuels and agricultural land), human capital (skills and experience of the labor force) and net foreign assets (the sum of a nation's foreign assets minus its foreign liabilities).[4] Needless to say that the measure of national wealth does not substitute the GDP measure. These two measures are linked and when considered alongside each other provide useful understanding of an economy's sustainability. In our analysis, national wealth per capita is measured in constant 2018 USD and data is extracted from the World Bank Wealth Accounts dataset. One would expect the sign of the coefficient on national wealth per capita in the regression to be positive.

The economy's composition also affects the tax revenue level that a country can potentially raise. Certain sectors of the economy have been traditionally hard to tax, such as services and agriculture. Services are often provided informally and therefore are hard to capture by tax administrations. Similarly, agriculture activities can easily escape formal economy and also for equity or political economy issues, they are often taxed at lower rates and are even exempted (Cyan et al. 2013). As a result, the largest the share of these two sectors in an GDP, the more difficult would be for a country to raise tax revenues and thus one would expect a negative relationship in the regression. Data on services value added[5] as a fraction of GDP and agricultural value added as a fraction of GDP (including forestry and fishing) are extracted from the World Development indicators, World Bank database.

[4] World Bank (2021). © World Bank. https://openknowledge.worldbank.org/handle/10986/36400 License: CC BY 3.0 IGO.

[5] Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.

Industry is another important sector of the economy. Data on industry value added as a fraction of GDP are similarly extracted from the World Development indicators, World Bank database. The effect though on potential tax revenues is ambiguous, as this indicator also includes construction section, which in many countries has a high percentage of output produced informally.

Following Ghura (1998), recent tax effort studies included institutional variables in the analysis. The current research uses corruption as a proxy for governance quality, as measured by the Corruption Perception Index, which is published annually by the non-governmental Transparency International. The Corruption Perception Index ranks countries and territories around the world based on how corrupt their public sectors are perceived to be and the results are given on a scale of 0–100 where 0 is highly corrupt and 100 is very clean. In this paper, following the methodology used by Tanzi and Davoodi (1997), the index is multiplied by minus one, so that higher values of the index imply higher corruption. It is expected that the coefficient on CPI will be negative, as corruption discourages taxpayers compliance and discourages investment, leading thus to lower tax revenues.

Finally, data on tax revenues are extracted from the European Commission, Taxation and Customs Union, where total taxes are defined as taxes on production and imports (D.2), current taxes on income and wealth (D.5) and capital taxes (D.91) minus 'Capital transfers (representing taxes assessed but unlikely to be collected)' (D.995).

Dividing actual tax revenue as a percentage of GDP by the tax capacity (fitted tax revenues) estimated in each country results in the tax effort that each country makes. When the result is greater than one, it is concluded that the country adequately uses its tax base to increase its tax revenues and vice versa. When the result is lower than one, it is concluded that there is room either to increase taxes or the efficiency of collecting them.

Since our sample consists of a combination of cross section data and time series, where the same unit cross section is measured at different times, the methodology applied to estimate our model is Generalized Least Squares in Eviews, with country fixed effects. This method controls for time-invariant unobserved individual characteristics that can be correlated with the observed independent variables. This is different from a simple Ordinary Least Square Model in the intercept term. By introducing Dummy variables (Cross-section Fixed Effects) a different intercept is calculated for each individual country. As a result, the estimation of an unknown constant effect in the model is enabled, which is unmeasured by the data.

Also, the Generalized Least Squares method with a cross section weighting in the sample is considered appropriate to fix heteroskedasticity, as subpopulation differences attributed to the wealth standard of each country are eliminated.

As a result the model is changed to:

$$\text{Tax/GDP}_{it} = a_{\text{o}} + a_1\text{WEALTHPC}_{it} + \text{a2SERV}_{it} + a_3\text{IND}_{it} + a_4\text{AGR}_{it} + a_5\text{CORRUPT}_{it} + \text{CSFE}_j + e_1$$

where

CSFE = the Cross Section Fixed Effect per Country, which is actually a dummy variable for each country that differentiates the constant variable against the average constant variable of our sample. In other words, the fixed effects assume that differences between individual countries (cross section) can be accommodated from different intercepts.

It is expected that our estimations are auto-correlated. To correct for auto-correlation, an auto-regression scheme of low order AR(1) is introduced. As a result, the model is transformed to:

$$\text{Tax/GDP}_{it} = a_{\text{o}} + a_1\text{WEALTHPC}_{it} + \text{a2SERV}_{it} + a_3\text{IND}_{it} + a_4\text{AGR}_{it} + a_5\text{CORRUPT}_{it} + \text{CSFE}_j + \text{AR}(1) + e_1.$$

5 Empirical Results

5.1 Estimation of Tax Capacity

The results obtained from the estimation of the above equation, using the fixed effects model with cross-section weighting are presented in the following Table 2.

The adjusted R-squared is high, indicating that approximately 99% of actual tax revenues is explained by the model. The coefficient on wealth per capita has the expected positive sign and is statistically significant at 0.001 level. This means that the wealth per capita has a positive and significant relation with tax revenues from corporate tax. The coefficients for services value added and agricultural value added have both the expected negative signs and are statistically significant at 0.001 level. This confirms that they are both hard-to-tax sectors and an increase in their share in GDP, will affect negatively tax revenues. Similarly, the coefficient with the industry value added (construction included) has a negative sign and is also significant at 0.001 level. The coefficient on corruption is also negative and significant at 0.001 level, confirming that when the public sector of a country is perceived to be corrupted, then tax revenues are negatively affected. Finally, the constant term is significant,

Table 2 Determinants of tax capacity

Dependent variable: tax revenues as a % of GDP		
C	128.4133 (8.646)	***
Wealth per capita	0.0000182 0.000	***
Services value added % of GDP	−1.2848 (0.098)	***
Industry (incl. construction) value added % of GDP	−1.3774 (0.095)	***
Agriculture value added % of GDP	−0.7725 (0.178)	***
Corruption	−0.5596 (1.154)	***
AR(1)	0.5668 (0.051)	***
Method	Generalized panel least squares	
Observations	170	
Cross-sections included	17	
R-squared	0.989	
R-squared adjusted	0.987	
F-Statistic	602.99	
Country fixed effects	Yes	
Year fixed effects	No	

*** means statistically significant at the 0.001 level

suggesting that there is an unmeasured common effect, not explained by the data that has a positive overall effect on tax revenues.

It should be noted that several studies (Ghura 1998; Bird et al. 2004; Le et al. 2012; Cyan et al. 2013; Langford and Ohlenburg 2016; Yohou and Goujon 2017) use a demographic variable in their empirical estimation, which is either the growth rate of population between 15 and 64 years old or the age dependency rate, or population density or human capital index. The current paper attempted to introduce as an additional explanatory variable the age dependency ratio and the ratio of population over 65 years old, but the results were not significant. Also, in lieu of these demographic variables the unemployment rate and the employment rate were tested as additional explanatory variables, but again the results were not significant.

The following Table 3 presents the time invariant fixed effects for each country in our sample.

Tax capacity (predicted tax to GDP ratio) is calculated for each country, using the estimated coefficients in Table 2 and the country fixed effects.

Table 3 Country fixed effects

Country	Country fixed effects
Austria	0.18419
Belgium	4.29654
Estonia	−2.66305
Finland	−2.24263
France	2.32495
Germany	−3.48789
Greece	4.02274
Ireland	1.38374
Italy	8.02871
Latvia	−1.26939
Lithuania	−1.44919
Luxembourg	−5.21347
Netherlands	−5.56810
Portugal	1.12528
Slovak Republic	1.09135
Slovenia	−2.42032
Spain	1.85655

5.2 *Estimation of Tax Effort Indexes*

The following Fig. 2 illustrates the actual tax to GDP ratio and tax capacity on average across Eurozone countries included in our sample, over the period 2008–2018.

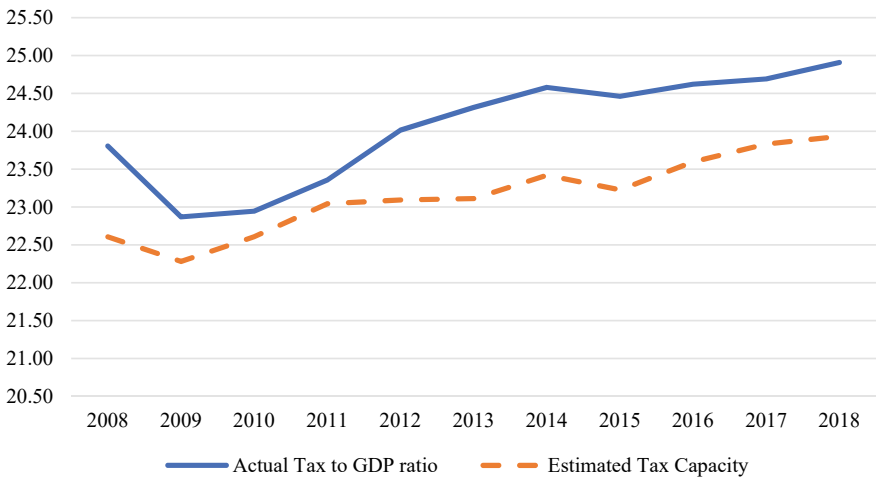

Fig. 2 Average actual tax to GDP ratio and tax capacity euro area, over 2008–2018

Table 4 Average actual tax to GDP ratio, tax capacity and tax effort by country, 2008–2018

Country	Actual tax to GDP ratio	Tax capacity	Tax effort
Lithuania	17.27	14.77	1.17
Slovak Republic	17.76	16.04	1.11
Slovenia	22.12	20.25	1.09
Estonia	21.10	19.51	1.08
Germany	23.32	21.64	1.08
Latvia	20.83	19.62	1.06
Finland	30.15	28.49	1.06
Austria	27.69	26.21	1.06
Ireland	21.93	20.84	1.05
Spain	21.07	20.45	1.03
Italia	29.15	28.40	1.03
Belgium	30.64	30.12	1.02
Netherlands	22.81	22.53	1.01
France	28.20	28.05	1.01
Portugal	23,96	23.86	1.00
Luxembourg	25.85	27.04	0.96
Greece	24.72	25.88	0.96

During the 10 year period since the outbreak of the global economic crisis, in the Eurozone area, on average, tax capacity is well below the actual tax to GDP ratio. The gap between the two series was large in 2008, it became smaller in the years that followed and up to 2013. The gap is the largest in 2015 and since then euro-area countries on average receive tax revenues closely above their tax capacity.

To compare countries' effectiveness in revenue mobilization, the index of tax effort is calculated by dividing the actual tax to GDP ratio by the estimated tax to GDP ratio (taxable capacity). The following Table 4 presents the actual and predicted tax revenue as a percentage of GDP (i.e. tax capacity) as well as the tax effort for each country included in our sample, on average over the period 2008–2018.

Countries in the Table 4 are ranked according to Tax Effort data, from the highest to the lowest value of tax effort. Lithuania has the highest tax effort index, while Luxembourg and Greece have the lowest tax effort index. The results confirm previous findings that most developed countries are located around the value of 1. With the exception of Luxembourg and Greece, all other countries adequately use their tax base to increase tax revenues.

Table 5 Ranking of countries according to tax effort–tax collection

Low tax effort–Low tax collection No countries	**High tax effort–Low tax collection** Slovak Republic, Lithuania, Latvia, Estonia, Slovenia, Spain, Ireland, Netherlands
Low tax effort–High tax collection Luxembourg, Greece	**High tax effort–High tax collection** Germany, Italy, Belgium, France, Austria, Portugal, Finland

Le et al. (2012) classify countries into different groups based on their tax efforts and actual tax collections. Countries with a tax effort index <1 are included in the low tax effort group, while countries with a tax effort index higher than 1 are included in the high tax effort group. Similarly countries with actual tax to GDP ratio less than the median of the sample are regarded as low-collection countries while countries with actual tax to GDP ratio higher than the median are regarded as high-collection countries. In our results, the median value of the actual to GDP ratio equals 23.32.

As a result Slovak Republic, Lithuania, Latvia, Estonia, Slovenia, Spain, Ireland, Netherlands are regarded as low-collection countries (Table 5).

For high tax effort, high tax collection countries, where all of them are older EU members, there is little scope for increasing revenue collection without generating disproportionately high economic costs, therefore tax policy in these countries should be oriented towards rationalizing the tax mix and reducing excessive high tax rates, so as to avoid possible distortions.

High tax effort, low tax collection countries, are the newer members of the EU, which have all implemented (at least for some years) flat tax systems, together with Spain, Ireland and Netherlands. These countries adequately use their tax base to raise tax revenues, but they need to improve collection of revenues.

Finally, Luxembourg and Greece seem to have high revenue potential but the combination of high level of collection and low tax effort might reflect their choice of the level of taxation. According to Le et al. (2008), countries belonging in this group need to consider restructuring their tax mix since they typically impose high factor income taxes, specifically on labor.

Average values give us the general picture of tax efforts across countries. A detailed analysis of countries overtime can provide a clearer understanding of the trends in taxes (Table 6).

Countries are ranked according to 2018 values (from smallest to largest) while the last column reports the difference between the 2018 and the 2008 values. The biggest increase in the tax effort index is reported in Ireland (+0.22), followed by Greece (+0.19) and Portugal (+0.09).

Table 6 Tax effort index, annual, 2008–2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018–2008
Latvia	1.19	1.11	1.09	1.10	1.08	1.06	1.04	1.04	1.04	1.04	0.96	−0.23
Italy	1.01	1.02	1.01	1.00	1.06	1.07	1.06	1.05	1.02	1.00	0.98	−0.03
Greece	0.81	0.86	0.84	0.90	1.00	1.02	1.01	1.01	1.03	1.01	1.00	0.19
France	1.00	0.98	0.97	0.98	1.01	1.03	1.03	1.02	1.01	1.01	1.01	0.02
Belgium	1.02	0.98	1.00	1.01	1.03	1.04	1.04	1.03	1.00	1.01	1.02	0.00
Spain	1.05	1.03	0.99	0.99	1.04	1.06	1.06	1.04	1.02	1.02	1.03	−0.02
Netherlands	1.02	1.02	1.03	1.00	0.97	0.97	1.01	1.01	1.01	1.05	1.04	0.02
Estonia	1.18	1.13	1.09	1.08	1.08	1.09	1.07	1.07	1.06	1.03	1.04	−0.14
Austria	1.09	1.04	1.04	1.04	1.06	1.08	1.09	1.09	1.03	1.03	1.04	−0.05
Portugal	0.96	0.95	0.93	0.97	0.97	1.08	1.05	1.05	1.02	1.03	1.04	0.09
Finland	1.16	1.08	1.05	1.03	1.01	1.04	1.05	1.06	1.05	1.08	1.05	−0.12
Luxembourg	0.93	0.97	0.98	0.93	0.92	0.92	0.90	0.95	0.98	0.98	1.05	0.12
Slovenia	1.16	1.10	1.09	1.09	1.09	1.08	1.09	1.08	1.08	1.08	1.08	−0.07
Germany	1.15	1.08	1.07	1.05	1.06	1.06	1.06	1.07	1.09	1.08	1.09	−0.05
Lithuania	1.50	1.27	1.17	1.15	1.14	1.15	1.13	1.12	1.12	1.06	1.09	−0.40
Slovakia	1.10	1.06	1.09	1.10	1.12	1.11	1.13	1.15	1.13	1.10	1.10	0.00
Ireland	0.94	0.94	0.98	0.98	1.05	1.12	1.12	1.22	1.17	1.05	1.16	0.22
Average	1.07	1.04	1.02	1.02	1.04	1.06	1.06	1.06	1.05	1.04	1.05	−0.03

Table 7 Average values over the period 2008–2018, by variable and country

Country	Tax_ Rev	Wealth_per_ capita	Serv_value_ added	Ind_value_ added	Agr_value_ added	CPI
Austria	27.69	60371403714.59	62.33	25.61	1.23	7.54
Belgium	30.64	55495754957.14	68.60	20.06	0.68	7.45
Estonia	21.10	22486624866.94	59.72	24.65	2.90	6.78
Finland	30.15	60540905409.57	59.70	24.67	2.32	8.93
France	28.20	53524035240.56	70.30	17.82	1.54	6.98
Germany	23.32	62112721127.29	62.21	26.91	0.81	7.98
Greece	24.72	20618706187.21	70.06	14.60	3.36	4.14
Ireland	21.93	45379253792.75	61.19	29.27	0.98	7.48
Italy	29.15	37128971289.79	66.41	21.57	1.94	4.46
Latvia	20.83	20543305433.77	64.99	19.90	3.45	5.15
Lithuania	17.27	15314953149.78	59.95	26.88	3.29	5.44
Luxembourg	25.85	85456154561.37	78.90	11.15	0.26	8.24
Netherlands	22.81	64322943229.68	69.01	19,15	1.70	8.51
Portugal	23.96	25119351193.32	65.94	19.42	2.01	5.90
Slovak Republic	17.76	18040780407.09	57.91	30.12	2.15	4.75
Slovenia	22.12	31219112191.90	57.10	27.83	1.98	6.12
Spain	21.07	32057020570.12	67.36	21.62	2.56	6.04

The economic crisis largely affected all three countries, and they had to undertake restrictive fiscal consolidation measures. The largest decrease in the tax effort index is reported in the three Baltic countries, Lithuania (−0.4), Latvia (−0.23) and Estonia (−0.14) and Finland (−0.12).

In 2018, the highest tax effort index is reported in Ireland, followed by Slovakia. The lowest tax effort index is reported in Latvia and Italy, which are the only two countries where actual tax collections are below the estimated tax capacity. It is observed that Greece, despite having one of the largest increases in their tax effort index since 2008, still has the third lowest tax effort index in 2018, among the countries included in our sample.

In the Annex, Table 7 provides the average values over the period 2008–2018, by variable and country. Also, in the Annex, Figs. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19 illustrate graphically the evolution of the Actual Tax Collections, the Predicted Tax Revenues and the Tax Effort Index for each country included in our sample.

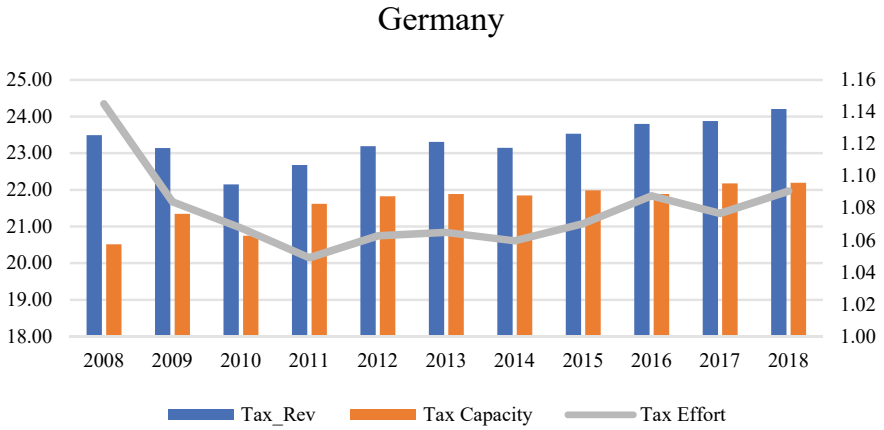

Fig. 3 Germany—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

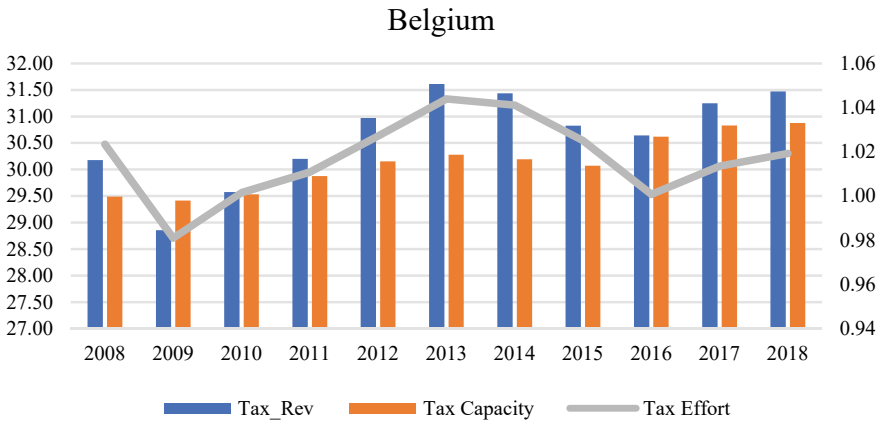

Fig. 4 Belgium—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

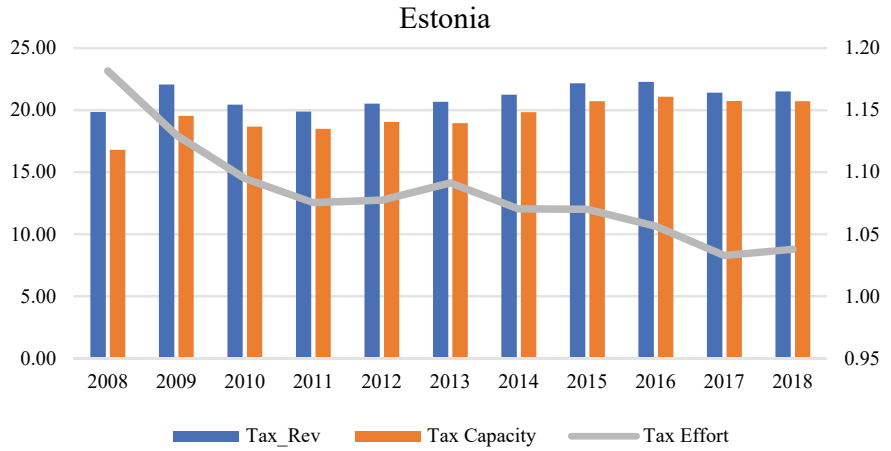

Fig. 5 Estonia—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

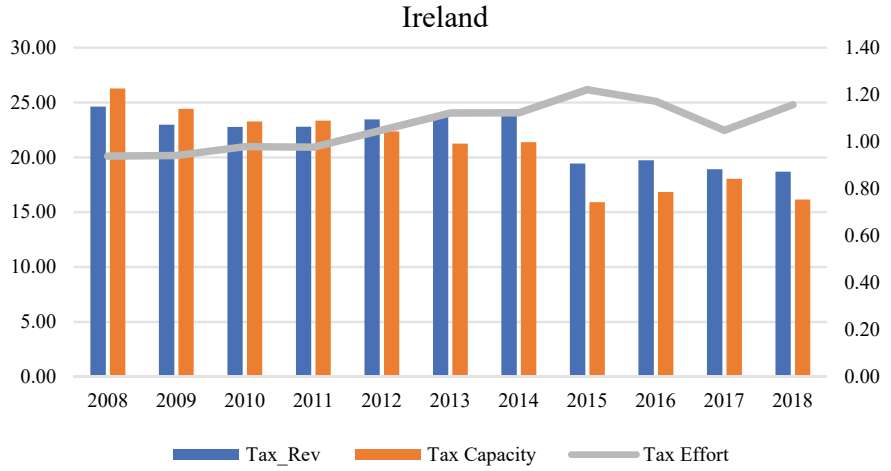

Fig. 6 Ireland—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

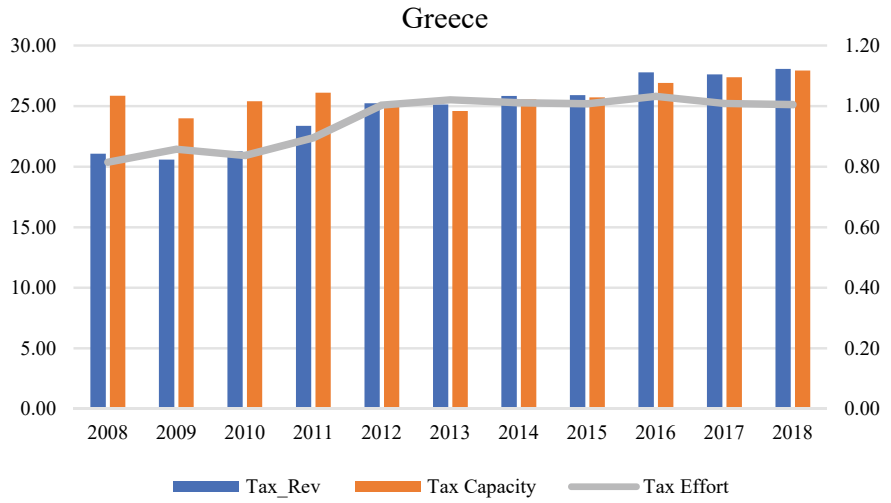

Fig. 7 Greece—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

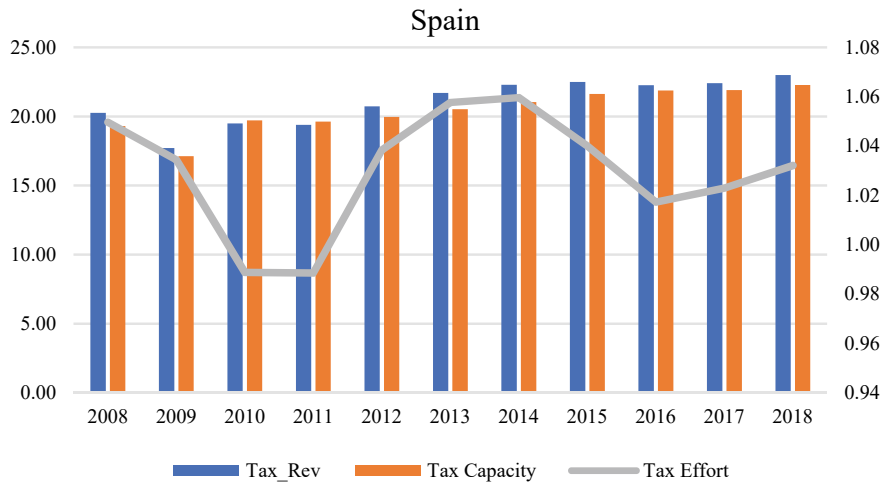

Fig. 8 Spain—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

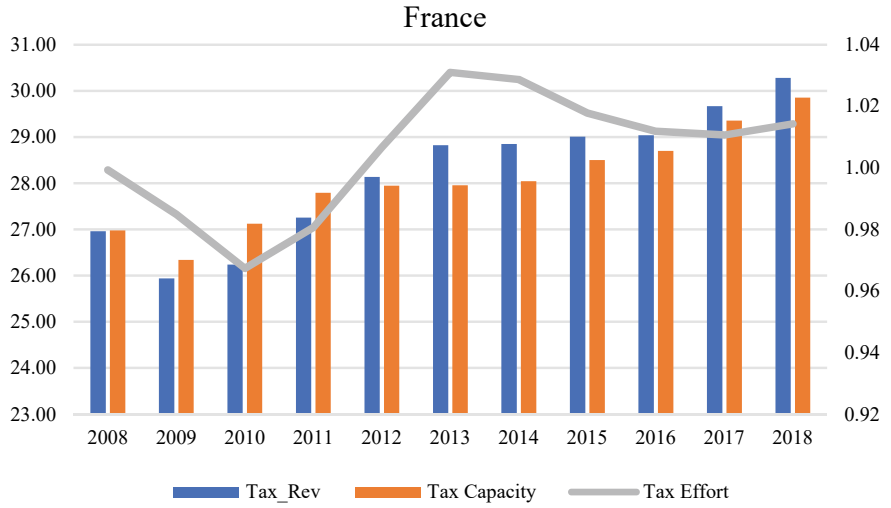

Fig. 9 France—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

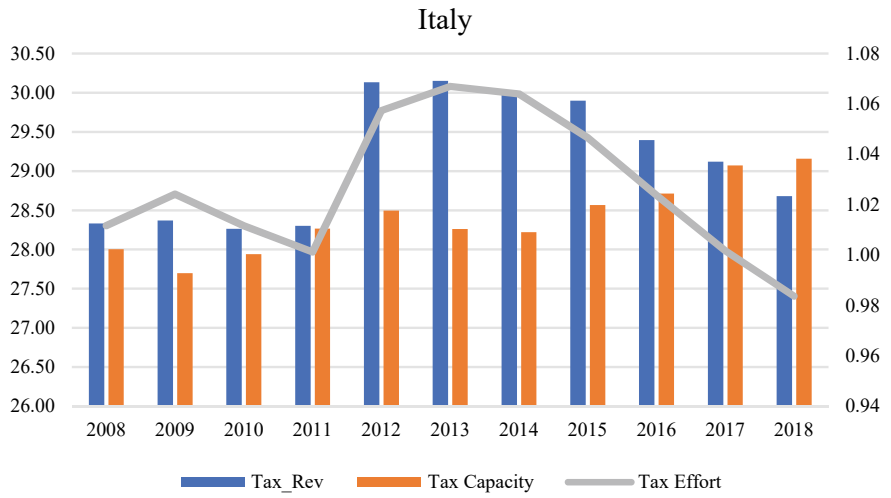

Fig. 10 Italy—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

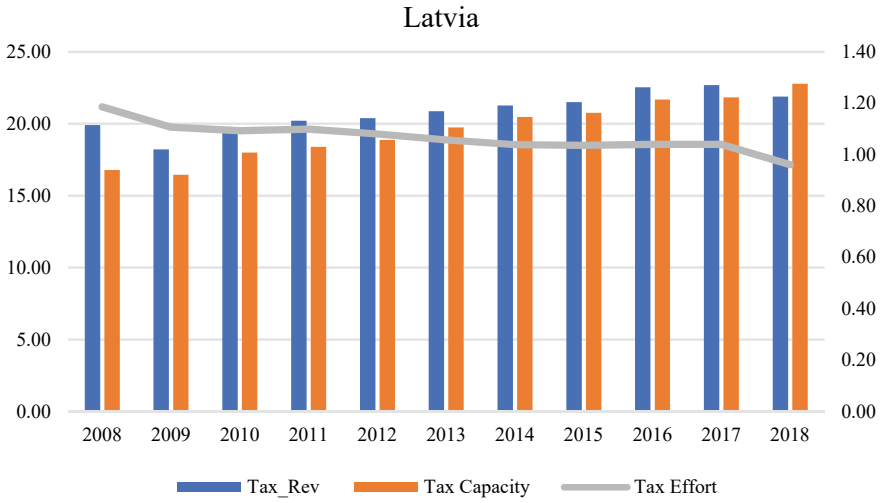

Fig. 11 Latvia—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

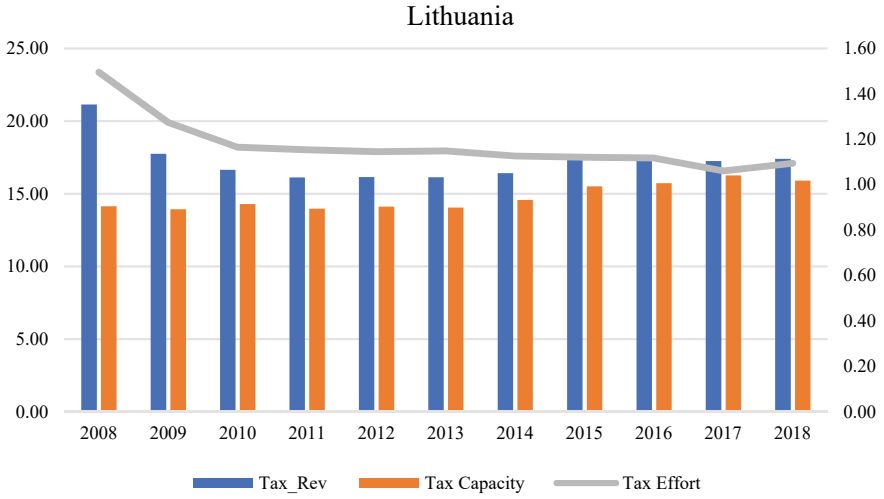

Fig. 12 Lithuania—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

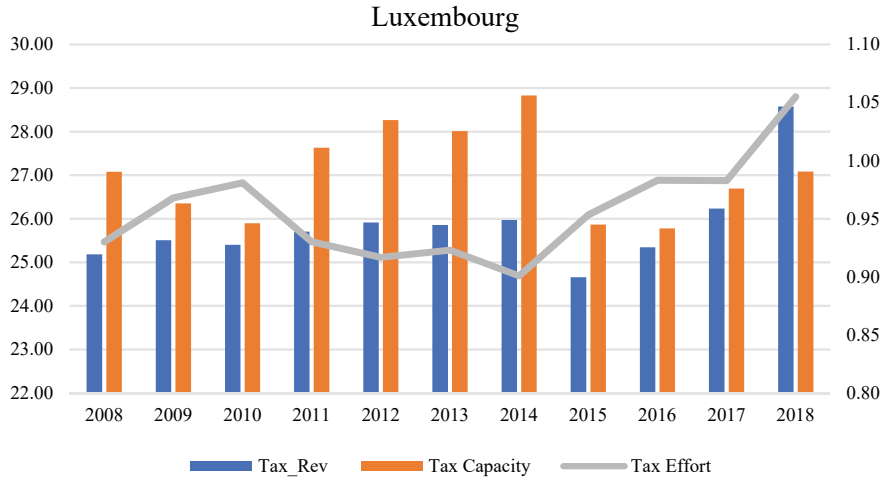

Fig. 13 Luxembourg—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

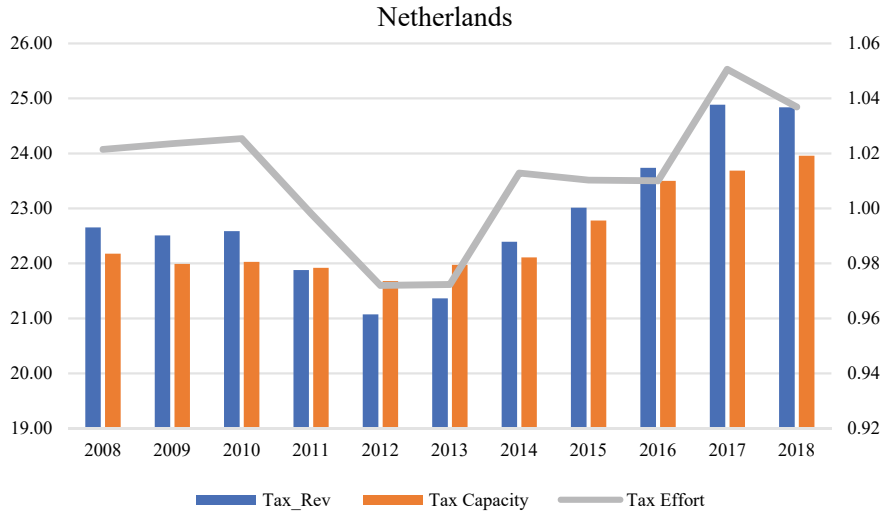

Fig. 14 Netherlands—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

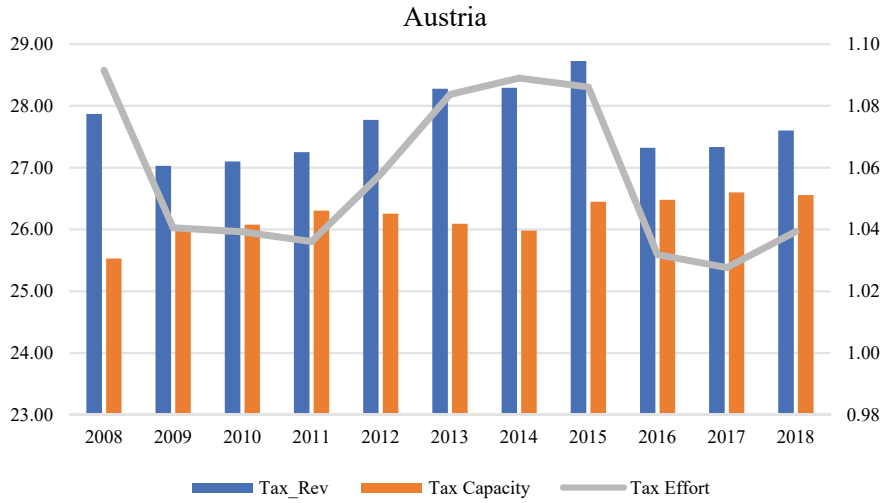

Fig. 15 Austria—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

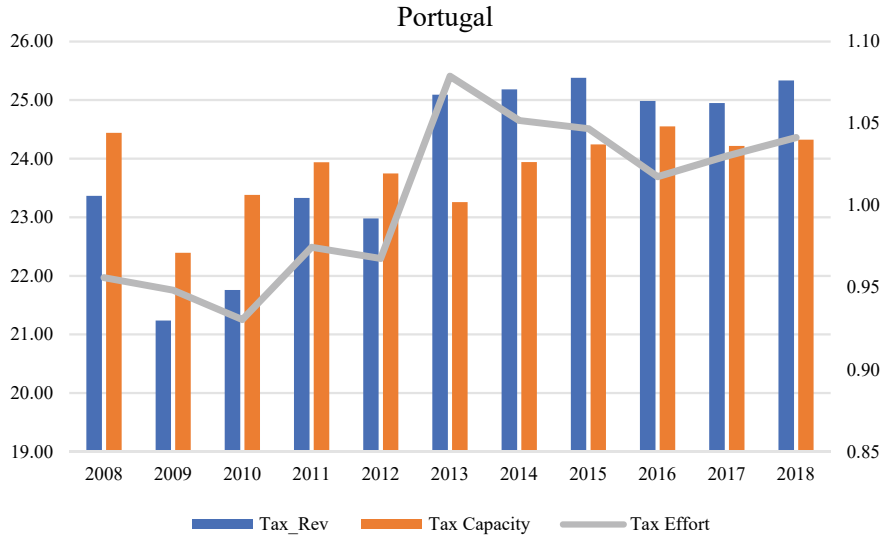

Fig. 16 Portugal—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

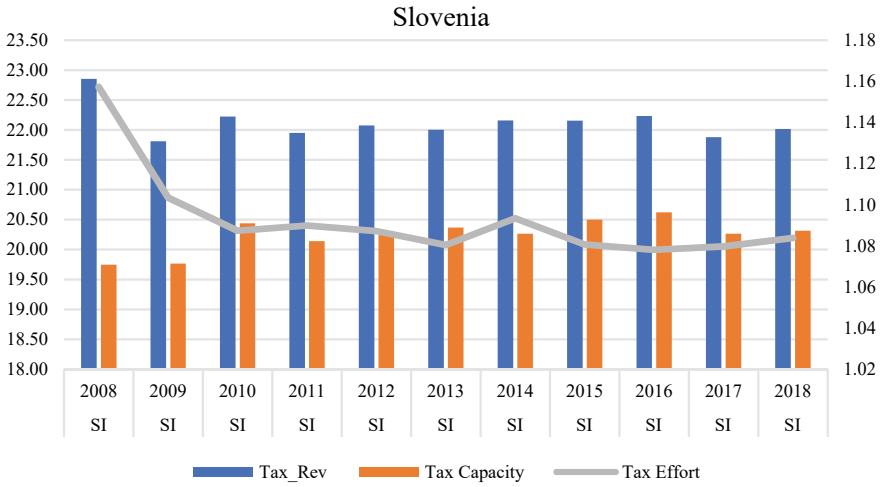

Fig. 17 Slovenia—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

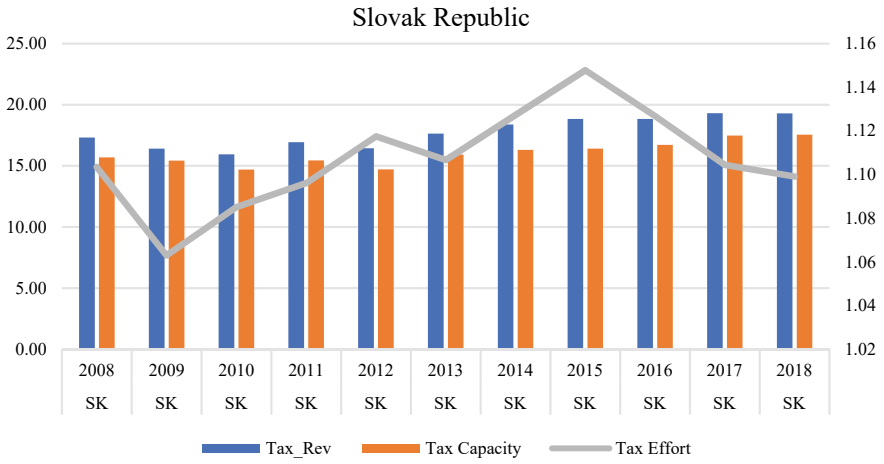

Fig. 18 Slovak Republic—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

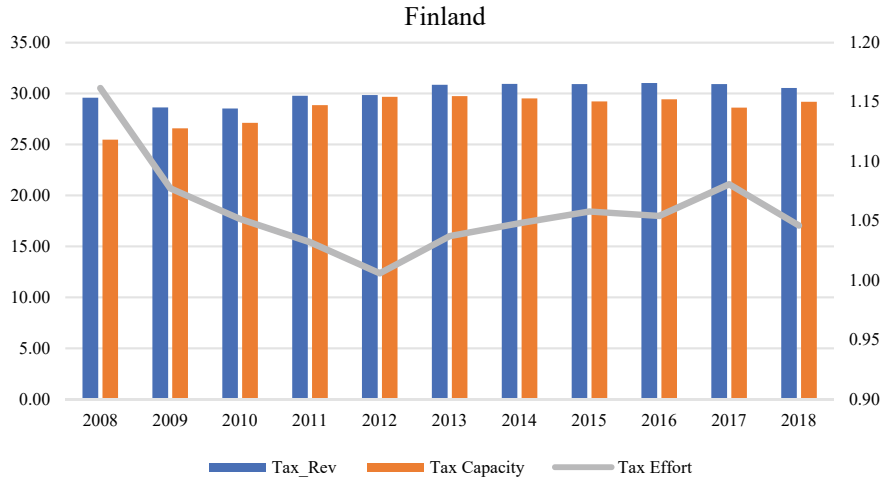

Fig. 19 Finland—Evolution of actual tax collections, predicted tax revenues and tax effort index (2008–2018)

6 Conclusion

The calculation of the tax effort index which relates a country's actual tax revenues as a percentage of GDP with some estimation of its tax capacity, gives a more complete comparative measure which takes into consideration the countries' economic and institutional characteristics.

The current paper focused on estimating tax effort index for Eurozone countries in the period that followed the outbreak of the global economic and financial crisis (2008–2018), so as to assess whether there were strong divergences among the euro-area countries. Compared to previous studies, the paper uses wealth per capita as a proxy for economic development, in order to estimate tax capacity.

As in previous studies, and since all countries in our sample are classified as high income-developed countries, the tax effort index is around one, with the majority of Eurozone countries' actual tax revenues exceeding their estimated tax capacity. This proves that Eurozone countries, during the period where the effects of the crisis were pronounced, were able to utilize adequately their tax bases in order to raise revenues. Undoubtedly, differences were recorded among the countries in our sample. For example, Greece, Ireland and Portugal, all severely hit by the crisis, undertook a major effort during the period examined recording. Their tax effort index was below 1, in 2008, which meant that there was room for increasing efficiency in their tax systems.

It should be stressed that the results need to be interpreted with caution, since there is not adequate a priori justification for the use of the selected explanatory variables and also, since the corruption index variable is an estimate, based on people's perceptions.

Further research could be directed towards confirming the results obtained in this paper, by using an alternative methodology, following Cyan et al. (2013). Also, the evolution of countries tax effort index could be examined in conjunction with the tax policy reforms introduced in these countries over the period 2008–2018.

7 Annex

See Table 7, Figs. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19.

Graphical Illustration of Actual Tax Collections, Predicted Tax Revenues and Tax Effort Index for Each Country Separately

References

Bahl R (1971) A regression approach to tax effort and tax ratio analysis. International Monetary Fund, Staff Paper, 18:570–612

Bird RM, Martinez-Vazquez J, Torgler B (2004) Societal institutions and tax efforts in developing countries. Working Paper 04-06. Andrew young School of Policy Studies, Georgia State University, Georgia, Atlanta

Bouckech R, Bousselhamia A, Elhadj E (2018) Determinants of tax revenues: evidence from a sample of Lower Middle Income countries, MPRA Paper No. 90268

Chelliah RJ, Baas HJ, Kelly RM (1975) Tax ratios and tax effort in developing countries. IMF Staff Papers

Cyan M, Martinez-Vasquez J, Vulovic V (2013) Measuring tax effort: Does the estimation approach matter and should effort be linked to expenditure goals? ICEPP Working Papers 39

Dalamagas B, Palaios P, Tantos S (2019) A new approach to measuring tax effort. Economies 7(3):77. https://doi.org/10.3390/economies7030077

Ghura D (1998) Tax revenue in sub-Saharan Africa: effects of economic policies and corruption. IMF Working Paper, WP/98/135. International Monetary Fund, Washington, DC, USA

Langford B, Ohlenburg T (2016) Tax revenue potential and effort—an empirical investigation. Working Paper International Growth Centre, Version: 31 January 2016

Le TM, Moreno-Dodson B, Rojchaichaninthorn J (2008) Expanding taxable capacity and reaching revenue potential: cross-country analysis. World Bank Policy Research Working Paper. No: 4559, March 2008

Le TM, Moreno-Dodson B, Bayraktar N (2012) Tax capacity and tax effort, extended cross–country analysis from 1994 to 2009. World Bank Policy Research Working Paper. No: 6252

Lotz JR, Morss ER (1967) Measuring "Tax Effort" in developing countries. IMF Staff Papers, pp 478–499

Mawejje J, Sebudde RK (2019) Tax revenue potential and effort: Worldwide estimates using a new dataset. Economic Analysis and Policy 63(C): 119–129

Pessino C, Fenochietto R (2010) Determining countries' tax effort". Hacienda Pública Española, Revista de Economía Pública 195:61–68

Pessino C, Fenochietto R (2013) Understanding countries' tax effort". IMF Working Paper 13/244. International Monetary Fund, Washington

Tanzi V (1992) Structural factors and tax revenue in developing countries: a decade of evidence. In: Goldin I, Winters LA (eds) Open economies: structural adjustment and agriculture. Cambridge University Press, Cambridge, pp 267–281
Tanzi V, Davoodi H (1997) Corruption, public investment, and growth. IMF, Washington, DC
World Bank (2021) The Changing Wealth of Nations 2021: Managing assets for the future. World Bank, Washington, DC
Yohou DH, Goujon M (2017) Reassessing tax effort in developing countries: a proposal of a vulnerability—adjusted tax effort index. Fondation pour les etudes et recherches sur le developpement international. Working Paper 186, Development Indicators

Databases

https://ec.europa.eu/taxation_customs/taxation-1/economic-analysis-taxation/data-taxation_el
https://databank.worldbank.org/source/wealth-accounts
https://data.worldbank.org/indicator