Income Inequality Measurements through Tax Data: the case of Greece

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Abstract

The goal of this research was to measure income inequality and the distribution of the tax burden in Greece, by using open tax data released by the Greek Independent Authority of Public Revenues. The findings reveal multiple distortions in the disperse of tax burden among taxpayers' income groups, along with very high income inequality among the population. The calculated Gini coefficient and S80/S20 ratio were found to be considerably higher than any previous measurements performed by international organizations and European statistical authorities through household surveys. The findings indicate an urgent need for an income and tax policy overhaul in the country, while the methodology that was used in the research can be replicated in other countries.

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1 Introduction

During the last three years, the effects of the COVID-19 crisis have placed increased pressure on national fiscal programs. However, governments and international organizations are constantly trying to pursue the long-term goals of sustainability and growth, in a global environment of increased insecurity on the one side, and technological progress on the other. One of the main challenges of growth is related with the existing inequality in the distribution of income, a multifaceted phenomenon with serious health, social, political and economic impacts. While the problem is widely recognised and various proposals have been put in place for its measurement and therapy, we seem to very far from the cure. New technologies that can process and analyse big amounts of data that are related with inequality, can, on the one side, enhance the quality of measurements and, on the other, point the most crucial areas of intervention.

On this context, the current research employs a big data analysis method, in order to measure income inequality and the effects of tax policy for Greece, a European country of long history and an active present. Up to now, measurements of income inequality for the country were based solely on household surveys. Interviewing households may be a practical method to collect income data, however it is based on a small sample of the overall population, and the participants may be unwilling to reveal their true incomes for a number of reasons, especially in the absence of an official verification method between households' answers and declared incomes. Subsequently, income inequality measurements produced by household surveys may diverge significantly from the real figures. A method to double-check their results is to use open data provided by the Greek tax authority, perform measurements for the whole taxed population and record possible differences. This method can be tested with Greek data and replicated in other countries as well.

Following, in Part 2, there is a short literature review about the phenomenon of income inequality, the relationship of income inequality with tax policies and the relative measurements for Greece. The methodology of this research is explained in Part 3. In Part 4 there is a presentation and analysis of the research findings, followed by the conclusions and some policy recommendations in Part 5.

2 Income And Tax Inequality

2.1 Income inequality

Income inequality is one of the major problems that economic science has yet to face. A 2019 Oxfam report mentioned that in the 10 years following the 2008 financial crisis, the number of billionaires in the world nearly doubled, with the fortunes of the world's super-rich reached record-breaking levels. In 2018, the 26 richest people in the world, held as much wealth as half of the global population (the 3.8 billion poorest people) (Lawson et al, 2019; UN, 2020). The effects of the COVID-19 pandemic were also much milder for the super-rich, as they saw their fortunes returning to pre-pandemic levels in just nine months, while recovery for the world's poorest people could take well over a decade (Berkhout et al, 2021). Meanwhile, the World Bank (2020) estimates that the percentage of people living with less than $5.50 a day could increase to 42% of the global population or more, an increase of about 70 million to 180 million people. Oxfam (2020) forecasts are even more ominous, with a 20% drop in income pushing half a billion people below the poverty line of $ 5.50 a day. United Nations university researchers Sumner, Hoy and Ortiz-Juarez (2020) estimated that the impact of COVID-19 on global poverty could represent a reversal of nearly a decade in global progress on poverty reduction, leading in some areas to poverty levels similar to those recorded 30 years ago.

Income inequality seems like a Lernaean Hydra that international organizations, governments, institutions and societies have been unable to tackle, while the recent pandemic has caused the income gap between the super-rich and the very poor to widen. Apart from the obvious economic effects that inequality has on personal and family incomes and the general standard of living, it can also limit access to healthcare, education, water, energy and sanitation (UN, 2020), pose a threat to social and political stability (Carpentier, Kozul-Wright & Passos, 2021) as well as undermine economic and social growth (Berg & Ostry, 2011).

Perhaps the most important and promising initiative for fighting inequality was its inclusion as the 10th United Nations 2030 Sustainable Development Goal (SDG), which was signed by representatives from 193 countries in New York in 2015. Monitoring of inequality at global, regional and national is made from various international databases, such as the World Bank's PovcalNet database, the World Inequality Lab's Database (WID), UNU-WIDER's World Income Inequality Database (WIID), the OECD's inequality database as well as, in some cases, national accounts. The data sources range between countries and may include and combine household surveys, national accounts, tax records, wealth rankings as well as assumptions. Although there is a significant level of agreement among these datasets, there are various differences in the year coverage, the levels and the trends of inequality, mainly due to the different data collection and harmonization methods used in each case (UN, 2018).

The indicators that can be used for inequality measurement are many, though the Gini coefficient and various ratio analyses have became the most popular. Gini proposed the coefficient in 1912, based on the work of American economist Max Lorenz, who in 1905 depicted total equality as a straight diagonal line on a graph. The difference between this hypothetical equality line and the actual income line is the Gini ratio, and it ranges between 0 (perfect equality) and 1 (perfect inequality). Other popular ratios include the Palma ratio, which is the share of all income received by the 10% people with highest disposable income divided by the share of income received by the 40% people with the lowest disposable income; the 10/10, which is the ratio of the 10% of people with highest income to that of the poorest 10%; and the 20/20, which is the ratio of the average income of the 20% richest to the 20% poorest. Another method for measuring inequality is also the Atkinson index (1975), which includes an inequality aversion parameter and a coefficient of variation that is calculated by dividing the standard deviation of the income distribution by its mean. Eurostat employs the S80/S20 ratio, which is calculated as the ratio of total income received by the 20% of the population with the highest income (the top quintile) to that received by the 20% of the population with the lowest income (the bottom quintile).

2.2 Inequality and Taxation

One of the most important methods for fighting inequality, and perhaps the most promising one, have been tax policies. Tax progressivity refers to the increase of tax rates as the income scale increases, and this implies that the rich get to pay a relatively larger share of their income in taxes. Ideally these tax revenues can be redistributed to the poor with various forms of benefits or services' provision. However, this theory does not always work in practice. Frequently the rich get to pay a low share of their incomes in taxes, through tax evasion, by transferring incomes in low-tax countries, or by enjoying various special tax breaks. Also fair tax reciprocity[2] is frequently not achieved for a number of reasons, especially when citizens in the poor and middle shares of income are obliged to pay high out-of-pocket expenses for health, education, transportation, housing, security and in order to cover various other basic needs.[3] Traub and Young (2020) also mention that tax competition between countries has been one of the main driving forces for the increase in global income inequality. As countries get engaged in tax competition in order to attract more capital, they limit their and other countries' capacity to redistribute income and close the income gap between (mobile) capital holders and (immobile) wage earners.

Torregrosa-Hetland (2020) analysed Spanish micro data and found that tax evasion in the top of the income distribution undermined real tax progressivity and inequality statistics. Similar results were found from Alstadsæter, Johannesen & Zucman (2019) for Skandinavia. Duncan and Peter (2016) used several measures of progressivity over the 1981–2005 period for a large panel of countries and found that progressivity reduces inequality in observed income, but has a significantly smaller impact on actual inequality approximated by consumption-based Ginis. Sologon et al (2021) examined the role of tax benefits between UK and Ireland, and found that differences in tax-benefit rules between the two countries

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[2] Refers to the services that someone receives from the state, as a redistribution mechanism for taxation.
[3] For example, Greece has one of the highest out-of-pocked percentages of health expenditure in Europe (36.43) https://data.worldbank.org/indicator/SH.XPD.OOPC.CH.ZS?locations=GR

accounted for over one third of the observed difference in disposable household income inequality. Vergara (2021) examined yearly panel data from 43 countries for the period 1980–2016 and found significant correlation between pre-tax income inequality and economic policy (financial development, trade openness, government expenditure, and income taxation), and an important role for institutions in mediating these correlations. Martorano (2016) examined the relationship between taxation and inequality in developing countries of Latin America, and found that while tax changes promoted equality in the first decade of the 2000s – mainly due to the contribution of direct taxes with respect to indirect taxes - yet, the overall effectiveness of taxation in reducing inequality was limited.
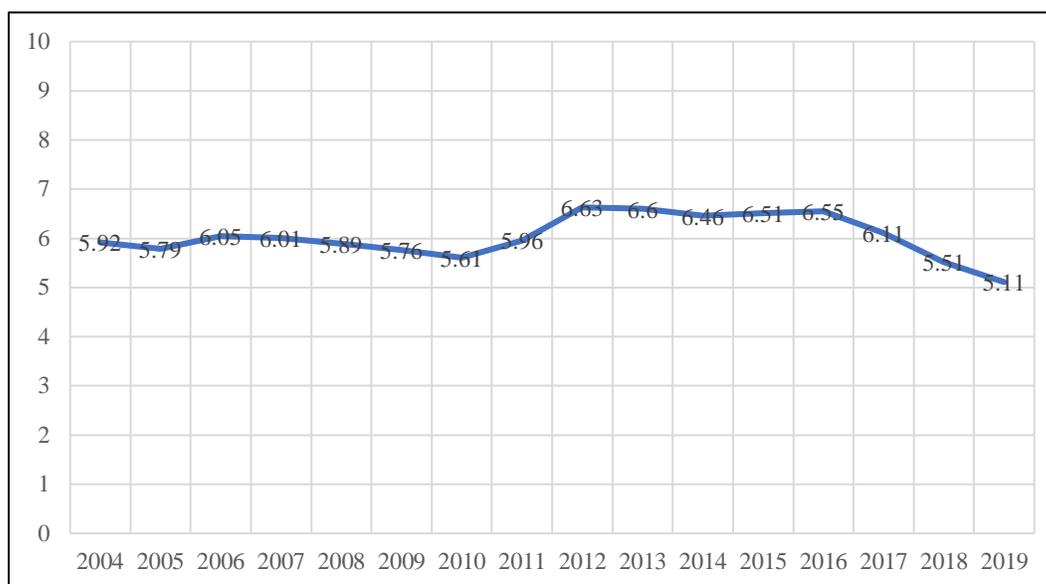
2.3 Greece

The Greek economy is slowly recovering from an intense economic crisis that was fuelled by a combination of internal fiscal and productivity weaknesses and external financial factors. The economy lost a little more than a quarter of its GDP from 2008 to 2019 - from 232 b € to 183 b € (Hellenic Statistical Authority, 2021), the crisis caused mass business closures and thousands of job losses, leaving the country with the highest unemployment rate in the European Union (19% of the workforce) and also the highest one among young people (<25) (Eurostat, 2019). Moreover there have been considerable downturns on social indicators like health, education Eurostat, 2019) and trust to the political system (European Commission, 2018).

Data about income inequality in Greece are available from various databases. **Graph 1** presents the Gini coefficient as it is measured from the World Bank and the OECD. World Bank data are based on primary household survey data obtained from government statistical agencies and World Bank country departments, while OECD data are based on a Household Budget Survey and an EU Survey of Income and Living Conditions, after processing by OECD Secretariat. Between the 2 measurements we can observe slight differences (marked with grey colour), however the overall trend is similar in both cases and depicts a decrease in inequality after 2015. As a measure of comparison, the index in 2018 for Austria was 30.8, in Germany 31.9, in Spain 34.7, in Italy 35.9 and in Portugal 32.1 (Eurostat, 2021).
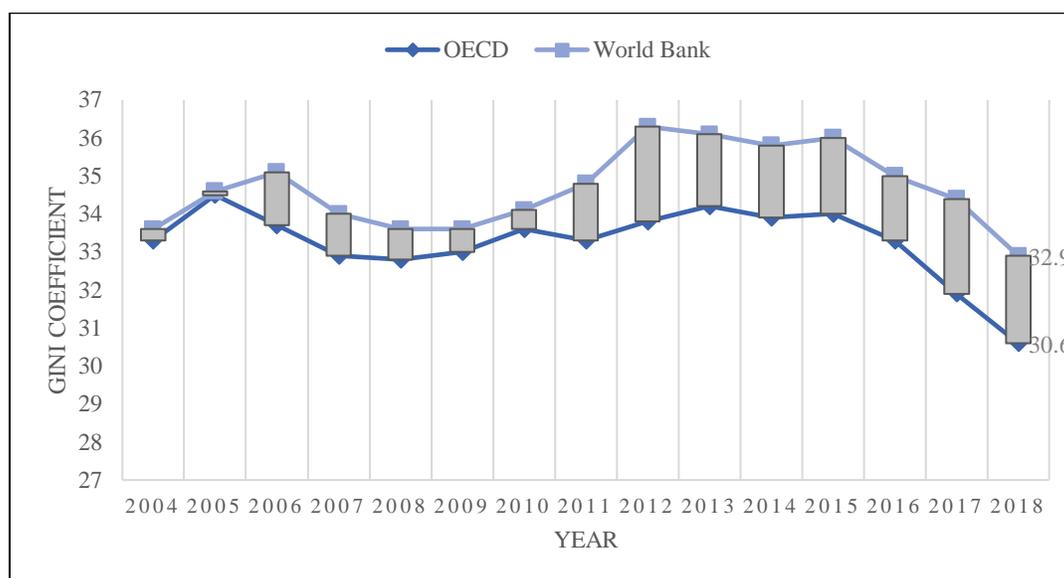
Graph 1: Gini coefficient for Greece, Years 2004-2018 from 2 different databases

Another measure of inequality of income distribution used by Eurostat is the income quintile share ratio S80/S20. As mentioned, this ratio is calculated by the ratio of total income received by the 20% of the population with the highest income (the top quintile) to that received by the 20% of the population with the lowest income (the bottom quintile).[4] **Graph 2** presents the calculation of the index for Greece. Indicatively it is mentioned that the corresponding index in 2019 for Austria was 4.17, for Germany 4.89, for Spain 5.94, for Italy 6.01 and for Portugal 5.22 (higher index indicates higher inequality) (Eurostat, 2021).

Source: Eurostat

Graph 2: S80/S20 for Greece (Years 2004-2019)

A recent press release by the Hellenic Statistical Authority (22/06/2021)[5] about the Gini coefficient and S80/S20 ratio for the year 2019, provides similar measurements with slight differences. Regarding the impact of tax policies on income inequality, there is a limited amount of studies on the topic. Matsaganis et al (2010) attempted to analyse empirically the implications of tax evasion in terms of inequality, poverty, redistribution and progressivity of the income tax system in Greece, Hungary and Italy. They found that tax evasion was related with higher income inequality and lower tax progressivity. Mitrakos (2014) examined the distributional effects of the fiscal austerity programs that were applied in Greece after 2009, and found that changes to the tax and benefits systems, as well as cuts in public sector wages, led to significant reductions in the disposable income, especially of low-income households. D'Amico, Di Biase & Manca (2013) investigated the impact of the fiscal system on wealth redistribution in Germany, Greece, and Italy and proposed a model that policy makers could use in order to measure the effect of fiscal policies on income inequality. On this context, the present study aimed to use real tax data in order to measure income inequality in Greece and access the effect of tax policies. The exact methodology that was followed is described below.

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[4] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Income_quintile_share_ratio
[5] https://www.statistics.gr/documents/20181/2ab33550-8091-1bb9-d88e-ce004fc57e31

3 Methodology

The data used in the present study come the website of the Hellenic Independent Authority of Public Revenues, the state organization that, under the supervision of the Ministry of Finance, is responsible for tax collection in Greece[6]. The raw data are publicly available is excel form and there is data availability for the years 2011 to 2018. They are divided in two main categories: taxation of legal entities and taxation of natural persons, and this study focused on the latter category. Firstly, the data were extracted, processed, transformed and visualized with Tableau Desktop in order to be easily read and understood. The data visualization is publicly available in Tableau Public and can be found in the following link. Originally the data were grouped in 67 income categories[7]. For the purposes of analysis and visualization, income groups were redivided in 9 larger groups according to the declared income scale, and these were the following:

1. Zero income (0€)
2. Poor income (1€-5.000€)
3. Low income (5.001€-10.000€)
4. Lower middle income (10.001€-20.000€)
5. Middle income (20.001€-50.000€)
6. Upper middle income (50.001€-100.000€)
7. High income (100.001€-200.000€)
8. Very high income (200.001€-900.000€)
9. Highest income (900.000€+)

It is noted that the income that was used for the calculations included all the incomes per taxpayer from a) land property, b) dividends-interest-property rights, c) transfer of capital, d) business activity, e) agricultural activity f) salaried employment and naval incomes. Further processing was executed in Microsoft Excel and SPSS, in order to calculate the S80/S20 ratio, the Gini coefficient and construct the Lorenz curve for the year 2018. As these indicators are typically calculated by the disposable income and not the declared income, the income tax paid by each income group was deducted by the declared income for their calculation. For the exact method of measurement of the S80/S20 ratio, there was contact with the Hellenic Statistical Authority on the 23 of August 2021, and they kindly pointed out the exact method they are using for dividing the data in quintiles and measuring the ratio. It is important to mention, however, that the data were not adjusted for the number of family members that each taxpayer represents, as this kind of information was not available in the platform. Nevertheless, under the assumption that the average family size does not change between income groups, not large variations are expected due to this fact.

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[6] https://www.aade.gr/menoy/statistika-deiktes/eisodima/etisia-statistika-deltia
[7] 0, < 1.000, 1.000 - 2.000, 2.000 - 3.000, 3.000 - 4.000, 4.000 - 5.000, 5.000 - 6.000, 6.000 - 7.000, 7.000 - 8.000, 8.000 - 9.000, 9.000 - 10.000, 10.000 - 11.000, 11.000 - 12.000, 12.000 - 13.000, 13.000 - 14.000, 14.000 - 15.000, 15.000 - 16.000, 16.000 - 17.000, 17.000 - 18.000, 18.000 - 19.000, 19.000 - 20.000, 20.000 - 22.000, 22.000 - 24.000, 24.000 - 26.000, 26.000 - 28.000, 28.000 - 30.000, 30.000 - 33.000, 33.000 - 36.000, 36.000 - 39.000, 39.000 - 42.000, 42.000 - 45.000, 45.000 - 50.000, 50.000 - 55.000, 55.000 - 60.000, 60.000 - 65.000, 65.000 - 70.000, 70.000 - 75.000, 75.000 - 80.000, 80.000 - 85.000, 85.000 - 90.000, 90.000 - 95.000, 95.000 -100.000, 100.000 -110.000, 110.000 - 120.000, 120.000 -130.000, 130.000 -140.000, 140.000 -150.000, 150.000 -160.000, 160.000 -170.000, 170.000 - 180.000, 180.000 -200.000, 200.000 -220.000, 220.000 -250.000, 250.000 -280.000, 280.000 -310.000, 310.000 - 340.000, 340.000 -370.000, 370.000 -400.000, 400.000 -450.000, 450.000 -500.000, 500.000 -550.000, 550.000 - 600.000, 600.000 -650.000, 650.000 -700.000, 700.000 -800.000, 800.000 -900.000, 900.000+.

4 Findings

Before presenting the inequality measures, it worth mentioning some important observations that were made from the visualization, about incomes and taxation in Greece:

- The **total number of personal taxpayers** increased from 5,719,456 in 2011 to 6,469,044 in 2018 (+13%). This indicates a considerable increase in the taxed population during the examined period (total population size: 10.8 million).
- Even though the taxed population increased by 13%, the **total declared income** decreased by -15%, from 89.24 billion euros in 2011 to 75.22 billion euros in 2018.
- The **total tax revenues** decreased by -16%, from 10.32 billion euros in 2011 to 8.57 billion euros in 2018.
- The natural persons that declared **zero incomes** increased by 91.4 thousand or 16% (from 548,418 in 2011 to 639,860 in 2018). However strangely they were taxed with 35 million euros in 2011, down to 14.6 million in 2018. The question of how the zero income population is expected to pay taxes, remains to be answered.
- The **number of the taxpayers** with the **Highest income** (900.000+ euros), increased from 53 in 2011 to 407 in 2018. Their declared income increased from 74 million euros to 964 million, and the tax burden increased from 32 million to 180 m euros.

Table 1 presents the percentages of each income group in relation to the Number of Taxpayers, the Declared Income and the Tax Obligation. From the table we can notice that the largest percentage of taxpayers is on the Poor group of taxpayers (28,60%), followed by the Lower Middle (24.49%) and the Low (20.40%). These 3 categories, along the Zero income group, add up to a staggering 83,38% of total taxpayers. As far as the Declared income is concerned, the Middle-income category is responsible for 37.2% of the total, followed by the Lower middle group with 30.4%. The largest percentage of tax is paid by the Middle income category (42.5%), followed by the Lower Middle group with (20.83%).

Table 1: Percentages of Taxpayers, Declared incomes and Tax for 2018

Income Category	% of Total Taxpayers	% of Total Declared income	% of Total Tax
Zero income (0€)	9.89	0	0.09
Poor (1€-5,000€)	28.60	4.88	1.92
Low (5,001€-10,000€)	20.40	12.83	2.79
Lower Middle (10,001€-20,000€)	24.49	30.44	20.83
Middle (20,001€-50,000€)	14.76	37.18	42.48
Upper Middle (50,001€-100,000€)	1.52	8.05	17.01
High (100.001€-200.000€)	0.25	2.83	7.52
Very High (200,001€-900,000€)	0.07	2.05	5.18
Highest (900,000€+)	0.01	1.28	2.11

In order to be able to make more comparisons between the various income groups, the author calculated the Average Declared Income, Average Tax and Tax as a percentage of Average Income (**Table 2**). The Average Declared Income was calculated by dividing the Declared income with the number of taxpayers in each group, and the Average Tax was calculated by dividing the Income Tax with the number of taxpayers in each group. From the results it can be noticed that actual tax progressivity is not achieved in the Greek tax system, as there are some important distortions: the Poor income category is taxed higher that the Low income category, and the income tax falls for the Very high (200.001€-900.000€) income lower than the High (100,001€-200,000€) income group. More striking is the fact that for the Highest (900,000€+) income category the income tax is only 18.7% of declared income, which is lower that the Upper Middle (50,001€-100,000€), High (100,001€-200,000€) and Very High (200,001€-900,000€) income categories.

Table 2: Average Declared Income, Average Tax and Tax as Percentage of Income

| Income Category	Average Declared Income	Average Income Tax	Tax as a percentage of income
Zero income (0€)	-	23	-
Poor (1€-5,000€)	1,986	89	4.47
Low (5,001€-10,000€)	73,10	181	2.47
Lower Middle (10,001€-20,000€)	14,454	1,127	7.79
Middle (20,001€-50,000€)	29,291	3,812	13.01
Upper Middle (50,001€-100,000€)	64,859	14,783	22.79
High (100.001€-200.000€)	131,477	39,767	30.20
Very High (200,001€-900,000€)	333,786	96,165	28.81
Highest (900,000€+)	2,369,709	444,033	18.73

The measurements of income inequality were performed by calculating the Gini coefficient and the S80/S20 ratio. The Gini measurements were performed by processing the actual tax data, as they are published from the Hellenic Independent Authority of Public Revenues, so the calculations are much more accurate in comparison to the World Bank and OECD measurements, which are based on household surveys. The results have shown a Gini coefficient for Greece of over 50 for all the examined years, a value much higher than all previous measurements. Keeping in mind that a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality, the value of 54.86 (2018) indicates very large income inequality for the Greek population (**Table 3 and Graph 3**). **Graph 4** depicts the Lorenz curve for Greece for the year 2018, as it was constructed based on actual tax data.

Table 3: Gini Coefficient for Greece 2011-2018 based on tax data
(Disposable income after tax)

Year	Gini calculated by tax data	World Bank Gini	Difference
2011	48,23	34,85	13,38
2012	51,35	36,25	15,10
2013	53,70	36,13	17,57
2014	55,50	35,81	19,69
2015	55,62	36	19,62
2016	55,21	34,96	20,25
2017	54,76	34,35	20,41
2018	54,86	32,89	21,97
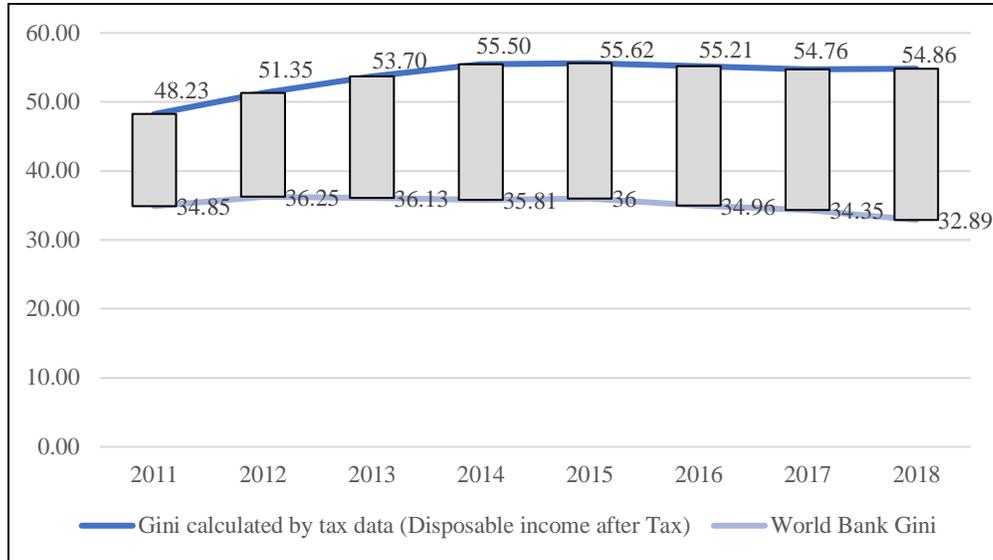
**Graph 3: Differences in Gini Coefficient calculations for Greece**
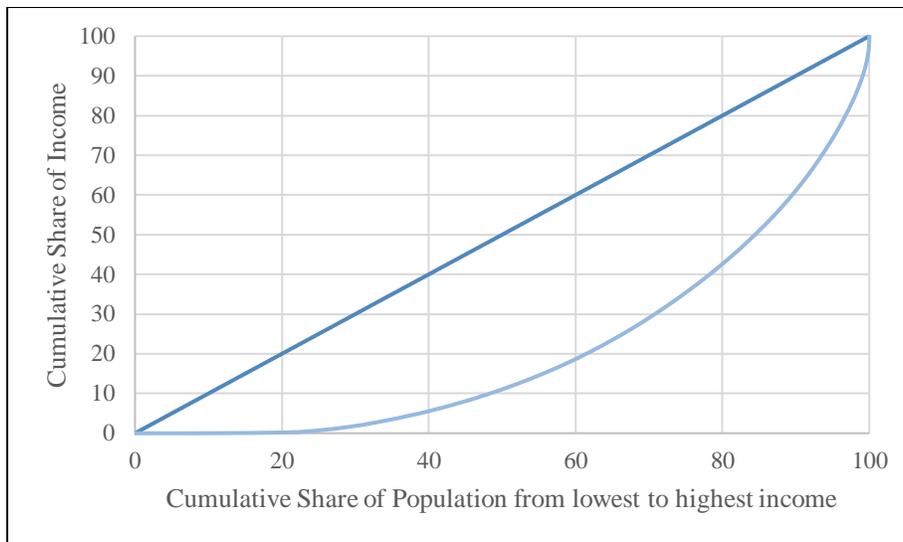
Graph 4: Lorenz Curve for Greece for the year 2018

The second measure of income inequality employed was the S80/S20. The calculations were executed by verifying the method used by Eurostat and applying it on the actual tax data. The results show vast differences in the value of the ratio from the values calculated by Eurostat and the Hellenic Statistical Authority (**Table 4**). While the value of the ratio is between 60 and 70 during 2011 and 2013, it climbs up to 94 in 2018. This is interpreted as follows: the quintile of the Greek population with the highest 20% income share in 2018 has 94 times the income of the quintile of the Greek population with the lowest 20% of the income. The differences in the measurements are presented graphically in **Graph 5**.

Table 4: S80/S20 for Greece (2011-2018)

Year	S80/S20 (based on Tax Data)	Eurostat S80/S20 (based on Household Survey)	Difference
2011	63,05	5,96	57,09
2012	62,99	6,63	56,36
2013	69,01	6,6	62,41
2014	95,19	6,46	88,73
2015	107,80	6,51	101,29
2016	91,05	6,55	84,50
2017	89,14	6,11	83,03
2018	94,19	5,51	88,68
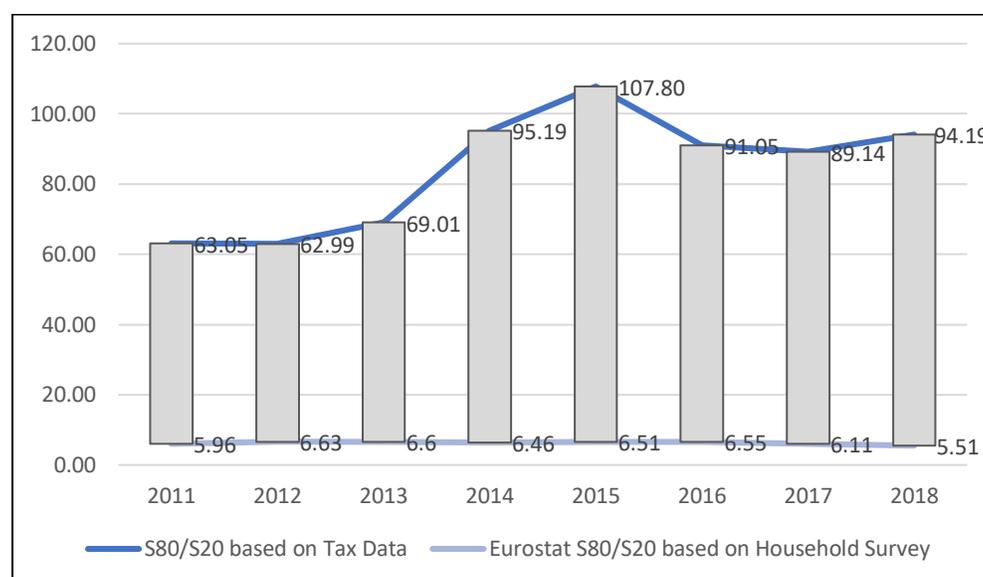
Graph 5: S80/S20 difference in measurements between tax data and household surveys

5   Conclusions And Further Research

With this study the researcher aimed to measure income inequality and the effects of tax policy in Greece, based on actual tax data rather than on household surveys, which is the typical practice by statistical authorities and various international organizations that measure inequality. The findings of the research were striking, as they reveal severe distortions in the disperse of tax burden among taxpayers' income groups, along with very high income inequality among the population. In terms of the distribution of the tax burden, the researchers found that on average the Poor income category is taxed higher that the Low income category, and the income tax falls for the Very high income group lower than the High income group. More striking is the fact that for the Highest income category (900,000€+), the income tax is only 18.7% of declared income, a percentage which is lower than the Upper Middle, High and Very High income groups.

As far as income inequality is concerned, the results have shown a Gini coefficient for Greece of over 50 for all the examined years, a value much higher than all previous measurements. The S80/S20 ratio ranged

from 63 to 105, which constitutes a shocking measurement about the income gap between the poor and the rich in the country. The findings of the current research point out a number of important policy recommendations: a) the need to redesign the methods that are applied for measuring inequality, b) the need to use more accurate data and the power of data analytics in the design of tax and social policies, and c) the need to improvise effective economic and social measures that will reduce the income gap that exists among various income groups of the population d) the achievement of Goal 10 of the UN Sustainable Development Goals (SDG 10) requires brave new policies and economic interventions. Needless to mention that the same methodology should be applied in all other countries that need accurate statistics about inequality and the effects of tax policy.

Data Availability Statement: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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