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Estimating an Optimal Income Tax for the Euro Area

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Abstract

Diese Masterarbeit untersucht die Anwendung von Prinzipien der optimalen Einkommensteuer in EU-Ländern, um die normativen Ziele der Verringerung von Ungleichheit, der Ausrichtung an gesellschaftlichen Präferenzen und der Verbesserung des sozialen Wohlergehens zu erreichen. Durch den Einsatz eines theoretischen Rahmens und Kalibrierungsmethoden, gestützt auf empirische Beweise, zielt die Studie darauf ab, ein klareres Maß für die optimale Einkommensteuer bereitzustellen, das trotz gesellschaftlicher Veränderungen in der gesamten EU anwendbar ist. Unter Verwendung der von Piketty and Saez (2013) entwickelten optimalen linearen Steuerformel und hochwertiger Mikrodaten aus der Haushaltsfinanz- und Verbrauchererhebung (HFCS) konzentriert sich die Forschung darauf, die Elastizität des zu versteuernden Einkommens (ETI) zu erfassen und Wohlfahrtsgewichte zu bestimmen. Aufgrund von Datenbeschränkungen wurde die ETI ausschließlich für Deutschland geschätzt; die vorhandene Literatur unterstützt jedoch die Verallgemeinerbarkeit dieser Ergebnisse auf die gesamte EU. Die Kalibrierungsmethode der Studie spiegelt horizontale Gerechtigkeit und das Prinzip des gleichen Opfers wider, während sie durch eine Durchschnittsmethode gesellschaftliche Präferenzen einbezieht. Die Ergebnisse deuten darauf hin, dass die berechnete optimale Einkommensteuer eng mit den tatsächlichen Einkommensteuersätzen übereinstimmt, was darauf hinweist, dass die EU-Länder progressive Besteuerungsprinzipien im Allgemeinen effektiv umsetzen. Diese Forschung unterstreicht die Bedeutung des Verständnisses der ETI und ihrer Auswirkungen auf das Arbeitsangebot sowie die Notwendigkeit einer umfassenden Analyse, wie die optimale Einkommensteuer Individuen auf verschiedenen Einkommensniveaus beeinflusst. Die Dissertation legt die Grundlage für zukünftige Studien, um breitere Ziele der Steuerreform zu erkunden, wie die potenzielle Rolle der Erbschaftssteuer bei der Erreichung sozialer Wohlfahrtsziele.

Abstract

This thesis investigates the application of optimal income taxation principles across a sample of EU countries, addressing the normative goals of mitigating inequality, aligning with societal preferences, and enhancing social welfare. By employing a theoretical framework and calibration methodologies, supported by empirical evidence, the study aims to provide a clearer measure of optimal income tax applicable across the EU, despite societal changes. Utilizing the optimal linear tax formula developed by Piketty and Saez (2013) and high-quality microdata from the Household Finance and Consumption Survey (HFCS), the research focuses on capturing the elasticity of taxable income (ETI) and determining social welfare weights. Due to data limitations, the ETI was estimated solely for Germany; however, existing literature supports the generalizability of these results across the EU. The study's calibration method reflects horizontal equity and the principle of equal sacrifice while incorporating societal preferences through an averaging method. The findings suggest that the optimal income tax calculated aligns closely with actual income tax rates, indicating that EU countries generally implement progressive taxation principles effectively. This research highlights the importance of understanding the ETI and its impact on labor supply, as well as the need for a comprehensive analysis of how optimal income tax affects individuals at various income levels. The thesis sets the foundation for future studies to explore broader tax reform objectives, such as the potential role of inheritance taxation in achieving social welfare goals.

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Contents

1 Introduction

Theories of taxation have evolved from understanding the purpose taxes should serve to formulating models that guide policymakers toward optimal tax structures. For instance, Edgeworth (1897) outlined tax principles such as equity, efficiency, diminishing marginal returns of income, and the importance of understanding elasticities to establish optimal taxation. These concepts have evolved further to relate to our dynamic societies, striving to find a universal measure that captures optimality.

This thesis aims to implement theoretical frameworks with calibration methodologies, supported by empirical evidence, to identify a clearer measure of optimal income tax at the EU level, one that remains applicable regardless of societal changes. The focus is specifically on income taxation, as it is the tax that most affects the majority of people and remains at the center of policy debates. Many European countries frequently alter their income tax schemes, highlighting the uncertainty and inefficiency among policymakers on this issue.

Understanding optimal income taxation enables countries to adapt to unforeseen economic circumstances while mitigating long-term implications of increasing inequality. Given that taxation is deeply intertwined with democratic principles, it requires a thorough and comprehensive examination.

The normative relevance of the research question in this paper is crucial. Therefore, this paper will clearly define what characterizes optimal income taxation, building on the foundational principles discussed by Edgeworth (1897). The thesis aims to unravel the complexities of evolving tax systems, assessing whether current income tax structures effectively serve their intended purposes of enhancing social welfare, mitigating inequality, and aligning with societal preferences, all while evaluating the ramifications of such reforms on the average citizen. Equity and progressive taxation are key pillars in this interpretation of optimal taxation. For instance, horizontal equity receives particular emphasis, with specific criteria and assumptions established, taking into account the conclusions discussed by various literature like Auerbach (2002).

After defining the characteristics of optimal income taxation, the paper addresses the research question by examining the extent to which major European countries conform to optimality in their income tax systems. While political discourse often focuses on tax redistribution, this thesis evaluates the justification of the tax burden on the general population before considering redistribution. By applying the optimal linear tax formula alongside high-quality micro-data from across Europe, readers can gain valuable insights into the rationale behind their income tax burden from the perspective of tax implementation.

To achieve this, the thesis employs the optimal linear tax formula developed by Piketty and Saez (2013) and combines it with EU micro-data from the Household Finance and Consumption Survey (HFCS) to evaluate the optimal income tax for the average citizen in various EU countries. The main model of Piketty and Saez (2013) is utilized due to its linearity, which simplifies the problem, while also incorporating methodologies from Burns and Ziliak (2015) to capture specific parameters that address non-linearities. Despite some reliance on arbitrary figures, Piketty and Saez (2013)'s formula demonstrates empirical consistency.

Burns and Ziliak (2015) serves as the primary reference for replicating the method of grouping instrumental variables estimator to determine the elasticity of income tax, a key parameter in Piketty and Saez (2013). This method is particularly chosen for its inspiration from Gruber and Saez (2002), enhancing precision by grouping the instrumental variable at the cohort level.

The second variable of interest is the aggregate normalized social welfare weights. This variable is crucial because it accounts for horizontal equity, consistent with achieving vertical equity. To find this parameter, I utilize Saez and Stantcheva (2016) to understand what cannot be captured by the standard welfarist approach and the important criteria used by policymakers. This understanding allows for the modeling and empirical replication of Saez and Stantcheva (2016) to determine the generalized social welfare weights for individual countries, which are then included in the general model used in this paper from Piketty and Saez (2013).

The thesis navigates data limitations, acknowledging that the HFCS does not provide explicit tax information. Therefore, the paper extrapolates individual tax rates for specific purposes, mainly elasticity of income taxation. OECD (2023) is combined with HFCS data to extrapolate individual income tax rates. For accuracy, given the limited data combinations at the country level, Germany is chosen as a representative country for the EU in terms of the elasticity of taxable income.

Although some may argue that Germany is not representative of the EU, the results of this thesis will demonstrate that the elasticity of taxable income is consistent with empirical evidence at the EU level, confirming Piketty and Saez (2013) while utilizing the novel method from Burns and Ziliak (2015).

When determining generalized social welfare weights, the thesis calibrates these weights using available HFCS variables that reflect standard practices not captured by the standard welfarist approach. Although final results may not be considered entirely accurate due to undefined accuracy extents, they provide a clear assessment of how well major EU countries' policymakers perform in setting new income tax structures.

The following section of this thesis is dedicated to data and its manipulation, addressing the limitations of HFCS and OECD (2023). The third section details the estimation strategy, identifying differences from the basic models offered by Burns and Ziliak (2015) and Saez and Stantcheva (2016), and adapting these models to fit the available microdata. The final sections present the results, discuss their implications, and relate them to the research question and existing literature. Lastly, a conclusion summarizes the main findings of the thesis and potential future research directions in the field of income taxation and broader taxation issues.

2 Data

The data section provides a comprehensive overview of the primary data sources used to evaluate the research question. This study primarily relies on the Household Finance and Consumption Survey (HFCS) for detailed analysis. Additionally, the OECD tax database is employed to obtain crucial country-level tax data not covered in the HFCS.

The HFCS provides both household-level and individual-level data, facilitating the investigation of research questions across varying scopes. This study specifically necessitates individual-level data due to the focus on income taxation. Additionally, the HFCS encompasses data from fifteen countries, including the largest economies in the EU, and incorporates panel data observations. This panel data structure is particularly advantageous for conducting specific experiments that require longitudinal analysis.

Consistency in utilizing the HFCS is crucial due to the extensive range of variables it offers, as well as its use of replicate weights and imputations to ensure accuracy and representativeness across EU countries for various years from 2010 to 2022. Furthermore, the HFCS is curated by the national banks of the respective EU countries and subsequently reviewed and edited by the European Central Bank, resulting in a financial survey that is highly standardized and accurate at the European level.

The published HFCS comprises four waves, with each wave taking approximately five years to produce, edit, review, and transmit to the ECB for publication. The ECB distinguishes between core and non-core variables within the HFCS. Core variables are essential and must be provided with the highest accuracy by national banks. In contrast, non-core variables are either experimental or less critical for the survey's completion by a specific national bank. The HFCS employs flag variables to indicate whether specific observations have been manually edited or deleted, thus helping to track the original responses given by participants and any subsequent modifications for accuracy.

The survey provides household-specific weights that sum to the total population of a given country. For example, if the survey results include a disproportionate number of respondents over sixty-five compared to those aged eighteen to twenty-five, the weights for the younger respondents are adjusted to accurately represent the country's true population. These adjustments are not limited to age but extend to other characteristics to enhance representativeness. The household weights (variable: HW0010) facilitate the calculation of point estimates.

Additionally, the HFCS includes one thousand replicate weights that, when incorporated into the methodology, align with the intent of HW0010 but offer enhanced accuracy. For instance, in regression analysis, using HW0010 provides a single, accurate estimate. However, employing the one thousand replicate weights across one thousand regressions yields a distribution of estimates, resulting in greater precision.

The HFCS also employs five different imputations to reduce the margin of error for responses to complex questions. This multiple imputation model uses various predictions to determine likely answers, and averaging these imputations results in more reliable data.

The data in each wave of the HFCS is divided into several sections: personal core variables, personal non-core variables, household core variables, household non-core variables, derived variables, and replicate weights. Note that both the weights and the derived variables are at the household level. Each section is further divided into five .dta files to facilitate smooth loading into statistical programs such as STATA or R.

The first step involves understanding the variable codes from the HFCS documentation that are relevant to the research question and noting these codes. The second step requires working through each section and merging all four waves to create a final dataset that includes the selected variables with complete information. This merging process presents various challenges that need to be addressed.

Firstly, some variables have been coded differently in earlier waves (particularly waves 1 and 2). It is essential to standardize these codes to enable consistent subsetting of variables across waves. Secondly, merging household-level variables with personal-level variables is challenging due to the higher number of observations at the personal level. To address this, certain assumptions must be made to disaggregate household-level variables to the personal level. For example, household-level variables can be divided by the number of household members, allowing for the merging process with personal-level variable observations.

However, some variables, such as consumption, are provided at the household level and cannot be simply divided by the number of household members, as this does not accurately represent individuals such as children. In these cases, assumptions used by the OECD are applied, where variables like consumption are divided by the number of economically active household members. If a household includes at least one pensioner, the division is by the total number of household members to reflect that pensioners are unlikely to have young children in the household. While this approach is not ideal, it yields more accurate results than dividing by the total number of household members, which often includes many children whose costs are covered by their parents.

A similar issue arises when new variables are introduced in waves 3 or 4 that were not present in earlier waves. This necessitates manual adjustment by creating void observations with the same variable codes for the earlier waves to maintain the dataset's structure.

When merging all waves for the replicate weight files, it is crucial to track the household-level IDs and keep the dataset for replicate weights separate from the overall dataset. Conversely, the HW0010 weight variable is part of the household core variable section, requiring the assumption of dividing the weight by the number of individuals in the household. This division does not affect the estimation of standard errors or regression means but could distort totals. Dividing the household weight by the number of household members inflates the population estimate for the country, although the proportions remain consistent.

After merging all waves for each data section, the sections are combined into a final master dataset, along with a corresponding master dataset for replicate weights. From this point, the master datasets can be filtered by country to facilitate analysis at the national level.

The final dataset, whether at the master or country level, includes approximately fifty variables. These variables encompass several identification markers at both the household and personal levels, the HW0010 weight, and various income streams such as employment, self-employment, and pension income. The dataset also contains essential demographic information, including age and gender. Additionally, variables like degree of urbanization and risk-taking attitude are included to account for demographic effects in the regressions. These variables, among others, are highly relevant to the research question and will be described in detail in the methodology section of this thesis. This study also utilizes the OECD Tax Database for several purposes. Firstly, it provides actual data on current income tax levels in major European Union countries. Secondly, it offers a reliable source for the methodology of income taxation across different years and EU countries. This is crucial for accurately extrapolating individual income tax rates and amounts paid. Figure A.1 shows how the circuvention of data limitation allow for greater generalizability across the Euro Area.

3 Estimation Strategy

To estimate an optimal income tax for the Euro Area[1], it is essential first to consider the normative relevance of the optimal income tax. This paper focuses on identifying an optimal tax that enhances social welfare, mitigates inequality, and aligns with societal preferences.

The suggested optimal tax formula, reflecting the normative relevance of this study, is adapted from (Piketty and Saez, 2013):

$$\tau = \frac{1 - \overline{g}}{1 - \overline{g} + \epsilon}; \overline{g} = \frac{\int g_i z_i d(i)}{Z} \tag{1}$$

In Equation 1, two parameters of interest are highlighted: the elasticity to income taxation (ϵ) and the average normalized social welfare weight ($\overline{g}$). The intuition behind this formula is straightforward: $\overline{g}$ ranges from 0 to 1. If $\overline{g}$ reaches its maximum value, the optimal tax becomes 0, implying that society thrives with perfect equality and there is no need for redistribution.

In this context, 1 - $\overline{g}$ can be interpreted as a measure of inequality in a specific country; the lower the value of $\overline{g}$, the higher the prevalent inequality.

The elasticity to income taxation (ETI), ϵ, measures how a change in tax rates (tax reform) affects an individual's taxable income (Saez and Giertz, 2012). The ETI is expected to be a positive parameter, based on empirical literature, income and substitution effects, and other factors influencing behavioral responses (Saez and Giertz, 2012).

To be more explicit, the tax reforms analyzed in this research focus on minimal tax increases over 1-4 years. These increases are often adjusted for inflation and do not significantly impact labor supply through income or substitution effects due to their limited scope. Concurrently, government incentives to encourage business activity, such as exclusive tax breaks, contribute to achieving a positive ETI parameter, especially during periods of economic growth. This was evident during the periods analyzed in this research when the EU experienced gradual recovery from the financial crisis post-2010.

[1] For the purposes of this empirical research thesis, the Euro Area is defined as the combination of four EU countries: Austria, Germany, Finland, and Italy. These countries were selected to provide a sample with longitudinal differences in geographic location and economic policy, thereby increasing the variation in the final estimates at the Euro Area level. It is important to note that this research could be extended to cover up to 90% of the actual Euro Area population.

3.1 Elasticity of Income Taxation - ETI

This section aims to explicitly detail the estimation of the Elasticity of Income Taxation (ETI) parameter for this research. To estimate the ETI for the Euro Area, it is crucial to consider the previously discussed data limitations to achieve a reliable estimate. For this analysis, I extrapolate individual tax rates for each person in the Household Finance and Consumption Survey (HFCS) panel using the OECD Tax Database (OECD, 2023), where specific year-by-year tax reforms are detailed. Combining HFCS data with the OECD Tax Database, Germany emerges as the only country with sufficient tax reform detail to satisfy the data requirements. The method used to extrapolate individual tax rates yields more reliable estimates with lower variance than the non-core variable HNG0710[2].

Using Germany's ETI as a proxy for the Euro Area is valid as long as the results align with empirical literature. Germany, being the largest economy in the EU and highly representative of the EU average, provides a reliable and reflective estimate for the Euro Area ETI[3].

The following equation is the main IV regression model utilised to estimate the ETI based on Burns and Ziliak (2015):

$$\triangle \ln(y_{ict}) = \beta \triangle \ln(1 - \tau_{ict}) + \delta f(y_{ict-1}) + x_{it}\theta + \gamma_c + \mu_t + \epsilon_{ict} \tag{2}$$

Equation 2 illustrates how the change in gross income between two different years (waves 3 and 4 of the HFCS) $\ln(y_{ict})$[4] for each individual in a cohort group is affected by the change in income tax $\ln(1 - \tau_{ict})$[5] during the same years. Logs are used to mitigate non-linearities.

Other important components included in the regression model are δ, which captures trends in income inequality, x_{it}, a vector of demographics, and cohort γ_c and time μ_t effects. The vector of demographics is a composite index of marital status or cohabitation, degree of urbanization, health status, gender, and degree of education.

To instrument for $(1 - \tau_{ict})$, I utilize the Gruber-Saez instrument (Gruber and Saez, 2002) like in Burns and Ziliak (2015) to predict tax changes $\widehat{\tau}_{it}$[6]. A mean value for each cohort-year

[2] A non-core variable representing taxes paid at the household level.

[3] For subsequent references, ETI implicitly refers to the ETI estimated for the Euro Area.

[4] The log of the sum of: employee, self-employed, and pension incomes for each individual.

[5] Parameter of interest.

[6] The predicted tax rate is used to avoid multicollinearity in the main model and is the extrapolated tax rate, including the sum of yearly consumption of each individual added to the gross incomes before extrapolating the tax.

cell is used to predict, in the first stage of the IV regression, the variable of interest: the predicted tax change:

$$\left[\frac{\ln(1-\widehat{\tau}_{it})}{(1-\tau_{it-1})}\right]_{ct}$$

The final regression model, after performing the first stage regression, is as follows:

$$\triangle \ln(y_{ict}) = \beta \triangle \left[\frac{\ln(1-\widehat{\tau}_{it})}{(1-\tau_{it-1})}\right]_{ct} + \delta f(y_{ict-1}) + x_{it}\theta + \gamma_c + \mu_t + \epsilon_{ict} \tag{3}$$

In the first stage regression, I utilize the HW0010 personalized weights to obtain point estimates for the predicted instrument for each imputation[7]. For the regression equation 3, I employ both HW0010 personalized weights and a set of 1000 replicate weights. By using a bootstrap method, these replicate weights provide even more accurate final estimates.

In practice, the bootstrap method generates a distribution composed of the relative coefficients of β from 1000 regressions per imputation. This approach enhances the robustness of the estimates by accounting for variability across different imputations and sampling variations.

3.2 Aggregate Normalised Social Welfare Weights

To estimate the second crucial parameter, $\overline{g}$ (aggregate normalized social welfare weight), for the optimal tax model (1), I consider three different inclinations[8]. These inclinations are crafted to mirror the normative relevance initially discussed. The inclinations examined are: Strictly Progressive, Libertarian, and Progressive societal preferences. It is important to note that the formulations of these inclinations are based on assumptions using variables available in the HFCS dataset.

An average normalized social welfare weight at the country level for Austria, Germany, Finland, and Italy is calculated for each inclination. Subsequently, an overall average, considering the results of all inclinations for each country, is estimated. This step reflects societal preferences and provides a more accurate result closer to the actual tax rate, making the final optimal tax more feasible for implementation and comparison with actual income tax rates.

[7] Recall that there are five different imputations in the HFCS dataset.

[8] The inclinations are formulated based on assumptions designed to reflect the mitigation of inequality and emphasize progressive societal preferences over libertarian ones.

Table 1 provides a comprehensive representation of the inputs and intuition behind each inclination. For instance, I utilize Saez and Stantcheva (2016) to filter out the most important practices used in tax reform that cannot be captured by a standard welfarist criterion[9].

	Actual Practice	Standard Welfarist Criterion	$\overline{g}$	Inclination
Luck vs Deserved Income	Important	Cannot be Distinguished	Distinguished	Strictly Progressive
Free Loaders	Important	Cannot be Captured	Captured	Libertarian
Tax Increase - Decrease Asmmetry	Important	Cannot be Captured	Captured	Progressive

Table 1: Practices used to Calibrate Generalised Social Welfare Weights

3.2.1 Strictly Progressive - Luck vs Deserved Income

Tables 2 and 3 illustrate the assumptions behind Luck vs. Deserved income, which fall under the inclination of Strictly Progressive. This input is characterized as Strictly Progressive due to the assumptions formulated to yield a relatively low level of aggregate social welfare weights, resulting in higher optimal taxation. This calibration method is also used by various progressive countries, such as Finland. This simplistic theoretical model takes inspiration from (Piketty, Postel-Vinay, and Rosenthal, 2011).

As mentioned, $\overline{g}$ is a parameter ranging from 0 to 1. The sum of luck income for each individual is compared to the sum of deserved income for each individual in a country. The more deserving individuals are assigned a value of 1. An average is then calculated for each country, resulting in the average normalized social welfare weight for the Strictly Progressive inclination.

3.2.2 Libertarian - Free loaders

The Libertarian Inclination is measured by considering societal preferences and limited government intervention (redistribution). In this case, individual taxpayers are considered deserving and are assigned a value of 1. Transfer receivers are considered deserving if their earnings are in the lowest 2% of the given country and are also assigned a 1. However, individuals who do not receive transfers and have earnings higher than the lowest 2% but also do not exceed the minimum tax threshold are considered potential freeloaders and are assigned a value of 0[10]. This model aims to be fair to deserving transfer receivers while

[9]The goodness of a state of affairs is measurable with respect to the profile of individual preferences (Leduc, 2023)

[10]This can also be considered a state of equilibrium between freeloaders and taxpayers (Saez and Stantcheva, 2016)

filtering out potential freeloaders. It is expected to yield a high value for $\overline{g}$, reflecting that very few are considered complete freeloaders, and the majority of the population have an individual self-interest in lower income taxation.

3.2.3 Progressive - Tax Increase vs Decrease Assymetry

The final inclination is Progressive. A wealthy individual[11] is assumed to be at risk from any marginal increase in income tax and is thus assigned a 0. Conversely, an individual with below-average income is positively affected by a tax break and receives a 1. These assumptions, at the opposite extremes of wealth status, aim to create a progressive inclination where a relatively larger proportion of the population could benefit individually from a tax break. This approach defines wealth to estimate an aggregate normalized social welfare weight reflective of progressive tax rates, as shown in (Piketty and Saez, 2013).

Luck Income
Annualised Gift / Inheritance
Real Estate Rental Income
Income From Financial Assets
Lottery
Unexpected Income Gains - Non Financial Assets

Table 2: Defining Luck Income

Deserved Income
Employee Income
Self Employed Income
Public Pension Income
Private Pension Income
Social Transfers

Table 3: Defining Deserved Income

Once an estimate for the ETI is determined and various measures under different inclinations are calculated for the Euro Area, inputting these parameters into Equation 1 will yield different optimal taxes for each inclination. By averaging the results of all inclinations for each country, we derive an optimal average income tax with a progressive inclination that incorporates societal preferences, including the Libertarian perspective.

Subsequently, this allows for a straightforward comparison between current average income tax levels and the estimated optimal income taxes. This comparison will help assess the feasibility and accuracy of the estimated optimal income taxes and how they align with optimal income taxes estimated in other studies, such as those by Piketty and Saez (2013).

[11] A wealthy individual is assumed to satisfy two conditions: having a main residence larger than average (in square meters) and an income larger than average.

4 Results

The Results Section is divided into two parts: the descriptive statistics pertaining to the main datasets used in this thesis, specifically the Household Finance and Consumption Survey (HFCS), and the empirical findings derived from these datasets, utilizing the methodology detailed in Section 3. These results provide critical insights with direct implications for the research question explored in this thesis.

4.1 Descriptive Statistics

Table 4 presents general descriptive statistics that serve as key indicators for estimating the primary parameters in the optimal income tax formula: the Elasticity of Taxable Income (ETI) and normalized social welfare weights, within the German dataset. Although 4 focuses specifically on Germany, additional tables B.1, B.3, B.2 in the appendix provide a comprehensive overview for a subset of countries within the European Union.

Table 5 compares the average income tax rates derived from the Household Finance and Consumption Survey (HFCS) with those reported by the OECD. The similarity in values, taking into account minimal tax reforms over the observed period, underscores the accuracy of the extrapolation method used. This reliability is crucial for the subsequent estimation of the relevant parameters.

4.1.1 General Descriptive Statistics

Characteristic	**Value**
Average Number of Working Hours per Week (Main Employment)	20.85
Average Time in Employment (Years)	32.82
Mean Individual Tax Rate	0.256
Median Individual Tax Rate	0.255
Standard Deviation	0.09
First Quartile	0.194
Third Quartile	0.325
Mean Taxes Paid (Yearly)	€ 15413.819
Median Taxes Paid (Yearly)	€ 8726.470
Standard Deviation	€ 26838.826
First Quartile	€ 4226.061
Third Quartile	€ 18124.560
Mean Total Personal Gross Income (Yearly)	€ 47180.22
Median Total Personal Gross Income (Yearly)	€ 34000.00
Standard Deviation	€ 56292.58
First Quartile	€ 21600.00
Third Quartile	€ 55800.00
Mean Total Consumption (Yearly)	€ 16526.80
Median Total Consumption (Yearly)	€ 13200.00
Standard Deviation	€ 12088.87
First Quartile	€ 9390.00
Third Quartile	€ 19750.00

Table 4: Tax, Income and Other Characteristics - Germany

	AVG. INCOME TAX HFCS (2010-2017)	AVG. INCOME TAX - OECD (2022)
AUSTRIA	0.191	0.223
GERMANY	0.256	0.271
FINLAND	0.315	0.2994
ITALY	0.257	0.2553
EU AVERAGE[1]	0.25475	0.26075

Table 5: Extrapolated vs Actual Average Income Tax Rates

4.1.2 ETI Descriptive Statistics

This section presents descriptive statistics with a specific focus on the regression model employed for estimating the Elasticity of Taxable Income (ETI).

Table 6 outlines the cohort characteristics within the German dataset of the Household Finance and Consumption Survey (HFCS). The dataset is selectively filtered to include only individuals actively participating in the labor market and paying taxes, thereby allowing for an accurate assessment of the impact of tax reforms on incomes in subsequent regressions.

Table 7provides additional detailed characteristics of the German dataset, offering a more comprehensive understanding of the data used in estimating the ETI. A notable limitation emerges from these descriptive statistics: approximately 75% of the dataset comprises married couples, compared to about 25% non-married individuals. This discrepancy can distort the reporting of individual tax rates, as it is often more economically advantageous in Germany for married couples to file taxes jointly. However, the HFCS data does not distinguish whether married individuals live in the same household, thereby limiting the precision of ETI estimates by necessitating an assumption strictly at the individual level.

Factors such as education, household composition, gender, and marital status are included in the demographic vector to enhance the precision of the estimates.

Characteristic	**Percentage**
Age Group: 18-24	0.66%
Age Group: 25-31	2.46%
Age Group: 32-39	6.13%
Age Group: 40-50	15.40%
Age Group: 51-60	22.95%
Age Group: 61-75	34.74%
Age Group: 76 +	17.63%

Table 6: Cohort Characteristics

Range of Interview Follow Up (Years)	2010 - 2017
Characteristic	**Percentage**
Gender: Female Gender: Male	42.03% 57.97%
Mean Age Median Age Standard Deviation First Quartile Third Quartile	60.61698 62 14.50 51 72
Marital Status: Married/In a Relationship Marital Status: Not Married / Not in a relationship	74.61% 25.38%
Education Level: No Education up to Primary Education Education Level: Lower Secondary Education Education Level: Post/Upper secondary but Non-Tertiary Education Education Level: University level Education up to a Doctoral Degree	0.52% 3.13% 44.95% 51.39%
Most Frequent Household Composition	Two adults, at least one aged 65 years and over
Least Frequent Household Composition	Single parent with dependent children

Table 7: Demographic Characteristics, Unweighted and Excluding Population Under 18

4.2 ETI Regressions Results

Table 8 presents the key results from the regression model estimating the Elasticity of Taxable Income (ETI) for the first imputation. The variable of interest, which captures the ETI, is statistically significant and approximates a value of 0.2, closely aligning with the estimate of 0.25 reported by Piketty and Saez (2013) in the literature. It is important to note that these results are specific to the German context. The regression indicates that approximately 30% of the variation in income changes can be attributed to changes in the individual tax rate.

The other parameters in the model also demonstrate statistical significance at the 1% level, corroborating the consistency of the primary model as suggested by Burns and Ziliak (2015).

To enhance the robustness of the findings, a bootstrap method was employed, using 1000 replicate weights for each imputation. This approach involved running 1000 regressions per imputation, thereby generating a distribution of ETI estimates, which is depicted in Figures 1 and A.2

The overall ETI estimate is 0.2161, with a standard error of 0.1216 and a p-value below 0.05, indicating statistical significance. These results are consistent with existing literature like Saez and Giertz (2012) and appear realistic, considering the model's fit and the influence of external factors such as economic recovery on individual incomes.

Variable	Coefficient	Std. Error	t-value	p-value
Predicted Tax Change	0.1925	0.0305	6.3216	3×10^{-10} ***
Income Function	-0.9699	0.0279	-34.7394	9.8×10^{-219} ***
Demographics	-0.0071	0.001	-6.8835	7.2×10^{-12} ***
Significance Codes: 0 *** 0.001 ** 0.01 * 0.05 . 0.1 ‘ ’ 1				
Balanced Panel:		$n = 7$	$T = 1$	$N = 2697$
Total Sum of Squares:		2070.8		
Residual Sum of Squares:		10347000		
R-Squared:		0.31132		
Adjusted R-Squared:		0.30901		
F-statistic:		472.692		
(on 3 and 2687 DF) p-value: $< 2.22 \times 10^{-16}$				

Table 8: Summary of Imputation 1 Regression Model (Point Estimate, Individual Weights)

Statistic	Mean	Median
Imputation 1	0.2099	0.2102
Imputation 2	0.2336	0.2370
Imputation 3	0.2089	0.2074
Imputation 4	0.2186	0.2192
Imputation 5	0.2095	0.2091
Overall Estimate	0.2161	0.2102

Table 9: Means and Medians of Elasticities

Imputation	Sample Variance
1	0.002900
2	0.003481
3	0.002229
4	0.00393
5	0.002261

Table 10: Sample Variances of Elasticities

Statistic	Value
Between Groups	0.4472
Within Groups	14.794
F-statistic	7.520
p-value	5.726015e-06
Standard Error	0.1216

Table 11: Between and Within Group Variations

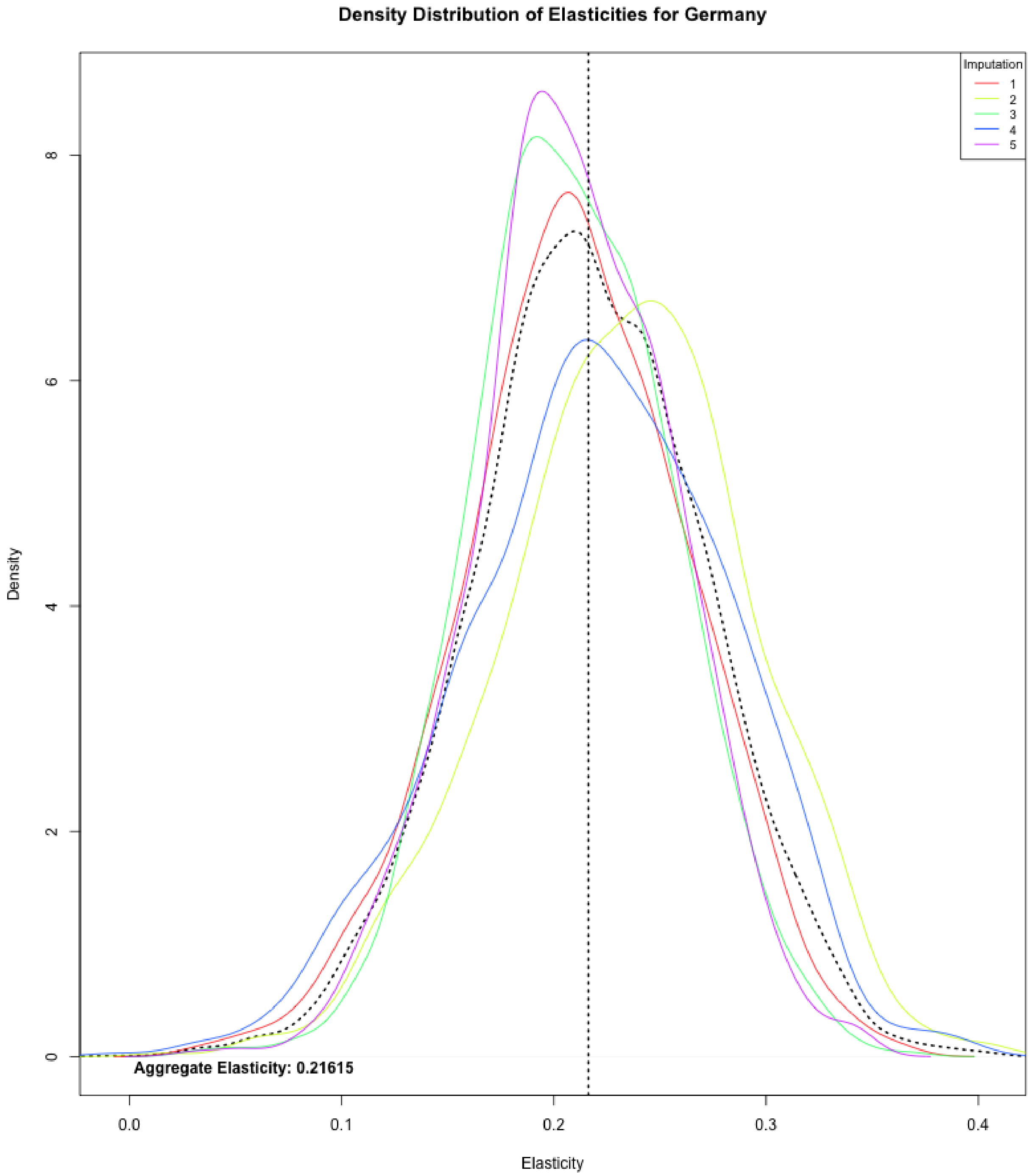

Figure 1: Density Ditribution of Elasticities Based on 1000 Regressions Per Imputation

4.3 Social Welfare Weight Calibration Results

The calibrated social welfare weights for the strictly progressive inclination are closer to zero compared to other inclinations across all sets of countries. This suggests that, from a strictly progressive perspective, there is a higher level of inequality, which results in normalized social welfare weights being closer to zero. It is important to note that this calibration method was designed to yield lower social welfare weights by applying stricter assumptions, as detailed in Tables 2 and 3. Additionally, the results achieved under this inclination are comparable to the social welfare weight assumed by Piketty and Saez (2013) for the EU under the median voter theorem, which is approximately 0.7.

Luck VS Deserved Income	
COUNTRY	**SOCIAL WELFARE WEIGHTS - STRICTLY PROGRESSIVE**
AUSTRIA	0.6623961
GERMANY	0.6566577
FINLAND	0.7034173
ITALY	0.7322335
EU AVERAGE	0.683762433

Table 12: Social Welfare Weights in a Strictly Progressive Tax Structure

In contrast, the results for the Libertarian inclination, which filters out potential freeloaders from society from the perspective of the individual, show that the social welfare weight is significantly higher and closer to 1. This higher weight suggests that most individuals are not freeloaders and contribute fairly to taxes. A high social welfare weight under this inclination supports the rationale for a lower income tax, aligning with the perspective of individuals in the labor market who could personally benefit from a tax reduction. It is also noteworthy that Finland, typically considered a progressive country, has the lowest social marginal welfare weight under the Libertarian inclination among the EU countries sampled. This finding is consistent with the fact that Finland provides substantial social transfers, which may increase the perceived presence of freeloaders in society, thereby leading to a perception of greater unfairness from the standpoint of the average Finnish individual.

Freeloaders - Tax Payers VS Transfer Receivers	
COUNTRY	**SOCIAL WELFARE WEIGHTS - LIBERTARIAN CASE**
AUSTRIA	0.9745703
GERMANY	0.9839898
FINLAND	0.972821
ITALY	0.9873903
EU AVERAGE	0.97969285

Table 13: Social Welfare Weights in a Libertarian Tax Structure

Under the final inclination, it is assumed that the government implements policies to increase taxes for the wealthy while providing tax breaks for individuals below the average income level, aiming to promote equality. The results under this last inclination (progressive) exhibit the highest variance at the country level compared to other inclinations. Notably, Austria and Finland have the lowest aggregate normalized social welfare weights, indicating a larger proportion of individuals who might face increased income taxes to achieve the progressive ideal. This is in contrast to countries like Italy and Germany, where the distribution of social welfare weights suggests a different impact on income taxation across the population.

Marginal Increase in Taxation VS Marginal Decrease in Taxation	
COUNTRY	**SOCIAL WELFARE WEIGHTS - PROGRESSIVE**
AUSTRIA	0.7756705
GERMANY	0.8158275
FINLAND	0.7860902
ITALY	0.8518847
EU AVERAGE	0.807368225

Table 14: Social Welfare Weights in a Progressive Tax Structure

4.4 Optimal Income Tax

Table 15 integrates the final ETI results with the corresponding aggregate normalized social welfare weights into the optimal tax formula as presented in equation 1.The calibration method effectively produces optimal tax rates under various inclinations.

For instance, the strictly progressive inclination in this study yields results similar to the actual implemented income tax rates for the top 3% earners in several European countries, approximately 55%. The Libertarian inclination, though less realistic, provides insights into individual preferences, underscoring the normative considerations established at the outset of this research. The progressive inclination results in less extreme optimal income taxes, which still facilitate substantial redistribution.

A comparison of derived optimal income taxes across countries reveals interesting patterns. In all inclinations, Italy exhibits the lowest level of redistribution, with the greatest variance observed under the Libertarian approach. Analyzing the optimal income tax for each country within each inclination reveals a positive relationship: the smaller the difference between the tax rates of the Strictly Progressive and Libertarian inclinations, the greater the equality within that society. Under this metric, Finland appears to have the highest level of equality among the countries studied.

Returning to the normative relevance of this research, maintaining progressivity in the tax system is crucial for mitigating inequality while aligning with societal preferences. Table 16 averages the different inclinations in various ways to derive an average optimal income tax rate, which is then compared to the actual average income tax rate (OECD, 2023).

Specifically, the second column of Table 16 presents the average optimal income tax rate derived from combining the Libertarian and Strictly Progressive inclinations. The upper bound considers the average of all inclinations, suggesting a more progressive tax rate for implementation. To achieve lower inequality, an 8 percentage point increase in the average income tax rate across the EU is required. However, this recommendation comes with caveats related to implementation, timing, and potential repercussions, which will be discussed in the following section.

These results offer a more nuanced analysis compared to previous literature, which often employed arbitrary calibration methods. While the results are realistic, they do not definitively indicate which income groups should bear the burden of the optimal tax rate.

TAX SYSTEM	INCLINATION	COUNTRY	OPTIMAL TAX
Luck VS Deserved Income	Strictly Progressive	AUSTRIA	0.6222455
		GERMANY	0.6144085
		FINLAND	0.5784353
		ITALY	0.5566844
		EU AVERAGE	0.5929434
Free Loaders - Tax Payers VS Transfer Receivers	Libertarian	AUSTRIA	0.1052642
		GERMANY	0.1148449
		FINLAND	0.1116965
		ITALY	0.05512203
		EU AVERAGE	0.1052768
Marginal Increase in Taxation VS Marginal Decrease in Taxation	Progressive	AUSTRIA	0.5092848
		GERMANY	0.4600603
		FINLAND	0.4973955
		ITALY	0.4066138
		EU AVERAGE	0.4683386

Table 15: Optimal Income Tax Accross Different Tax Structures

COUNTRY	OPTIMAL AVERAGE INCOME TAX	OPTIMAL AVERAGE INCOME TAX - UPPER BOUND	ACTUAL AVERAGE INCOME TAX - OECD (2022)
AUSTRIA	0.33149	0.39075	0.223
GERMANY	0.36463	0.39644	0.271
FINLAND	0.34507	0.39584	0.2994
ITALY	0.30590	0.33947	0.2553
EU AVERAGE	0.34911	0.38885	0.26075

Table 16: Optimal Average Income Tax Rates

To highlight further the importance of societal opinion and precision, the averaging procedure considers Strictly Progressive and Libertarian inclinations as opposing forces, while taking the average of all three inclinations as an upper bound.

5 Discussion

5.1 Relation to Existing Literature and Theoretical Implications

Throughout this research paper, various methodologies have been employed to identify essential parameters for determining the optimal income tax. The inspiration for this study is grounded in three main pillars: Piketty and Saez (2013) for the general model framework, Burns and Ziliak (2015) for the estimation of the ETI parameter, and Saez and Stantcheva (2016) for the modeling and calibration of social welfare weights.

To begin with, Saez and Giertz (2012) defines the ETI as the change in taxable income in response to changes in marginal tax rates. The approach in Saez and Giertz (2012) aligns with this paper when regressing the change in tax rates on taxable income (gross income). Notably, the ETI results in Saez and Giertz (2012) fall within the range of 0.1 to 0.4, corroborating the mid-range ETI estimate of 0.21 found in this paper. This consistency lends credibility and generalizability to the results. However, it is important to note that the ETI estimate in this paper does not align with the findings of Burns and Ziliak (2015), which estimates the ETI to be over 0.5. Although Burns and Ziliak (2015) argue that their refined model, compared to Gruber and Saez (2002), drives the ETI upwards, this paper employs a similar approach to Burns and Ziliak (2015) with the exception of utilizing HFCS Data instead of CPS and not considering State effects, yet finds an estimate closer to the literature, such as Saez and Giertz (2012) and Gruber and Saez (2002).

Moreover, referring to Kuziemko and Stantcheva (2015), it is evident that the elasticity of preferences regarding redistribution is constantly evolving. Thus, the intuition behind calibration methods and the utilization of microdata for estimating elasticity is relevant for understanding societal preferences, which can be further linked to literature in the field of political economics.

On the other hand, social welfare weights are constructed via a calibration method based on specific assumptions. While this technique is inspired by Saez and Stantcheva (2016), other literature supports the efficacy of calibration, arguing that the underlying assumptions can be validated by different studies. For instance, Kopzuk (2013) utilizes microdata from France and the United States to calibrate optimal tax rates for inheritance taxation.

Consider Besley (1992), who argues that imperfect information can complicate the assessment of whether an individual is deserving of social transfers, potentially deterring eligible individuals from applying due to stigma. The calibration method employed in the Libertarian approach uses information from the HFCS to filter out potential free-loaders, thus bypassing any stigma and yielding more accurate results in distinguishing deserving individuals from free-loaders.

Similarly, Will (1993) provides valuable insights into the criteria the public uses to perceive individuals as deserving or undeserving. This paper incorporates these insights when modeling social welfare weights. The notion of perceived effort highlighted in Will (1993) is reflected in certain assumptions, such as "Deserved Income," in this study.

As previously mentioned, the overall results for social welfare weights with a strictly progressive inclination align with the median voter optimum (70%) proposed by Piketty and Saez (2013). Consequently, for the strictly progressive inclination, the optimal income tax identified in this paper closely matches the calibrated result of Piketty and Saez (2013). This paper advances the discussion by utilizing an averaging method that incorporates different inclinations, taking into consideration the significance of horizontal equity Auerbach (2002) and ideas proposed by Weinzierl (2012), such as the principle of equal sacrifice in society, to determine the final optimal income tax.

5.2 Policy Implications

Designing an optimal income tax enables policymakers to address significant societal issues. Calculating an optimal income tax that aligns with specific normative goals helps policymakers understand how current tax rates relate to their new agenda, facilitating informed decisions such as adjusting income tax rates. Implementing calibration methods in tax structures can strengthen democratic systems, a core principle of the European Union.

The results of this paper indicate an approximate 8 percentage point increase in income tax is necessary to achieve greater equality, reflecting the normative relevance initially discussed. Policymakers can use this information to recognize that income taxation may be approaching its limits in terms of increasing tax rates to achieve equality. This suggests that it may be time to reform the tax system and consider whether inheritance taxation could better accommodate further tax increases. This thesis, therefore, opens opportunities for further research, specifically in finding an optimal balance between different tax systems within a country and examining the effects on various income or wealth distributions.

Overall, policymakers in the Euro Area should view the results of this thesis as encouraging. The difference between actual and optimal income tax rates is not drastic, considering the simplicity of the general model. The flexibility of the methodology provides a clear indication of inequality levels in the EU and sets a path toward achieving Pareto improvements through various taxation methods, not necessarily limited to income taxation.

Considering that the calibration of the aggregate normalised social welfare weights is implemented based on Saez and Stantcheva (2016) with the specific inclusion of valued criteria by policymakers, the results of this paper also prove to reflect positevely the agenda set by policymakers.

5.3 Limitations and Caveats

The primary limitation of this thesis is the restricted availability of accurate HFCS panel data, which permits the estimation of the Elasticity of Taxable Income (ETI) only for Germany. According to Saez and Giertz (2012), higher ETIs are typically observed among higher-earning individuals, which affects the generalizability of using a single ETI to represent the entire Euro area. Consequently, the final optimal tax rate would be higher if the ETI is lower than 0.21 and lower if the ETI is higher than 0.21. Given that Germany is a high income earning country relative to the EU, it is plausible that the overall ETI is slightly lower, leading to a minimally higher optimal income tax rate.

Furthermore, determining the factors that positively influence the ETI in terms of labor supply remains challenging. An in-depth exploration of how different models impact the intensive and extensive margins of labor supply, akin to the approach of Saez (2002), is necessary. This could provide a deeper understanding of the ETI and the underlying effects (substitution or income effects) influencing individuals at different income levels. For instance, Burkhauser and Larrimore (2009) finds that over the decades, most inequality is driven by the top 1% of earners. Therefore, a more detailed understanding of the ETI could yield a clearer picture of the optimal income tax.

Despite the data limitations, the ETI result for Germany has been shown to be generalizable and has only a minimal impact on the overall optimal tax calculation. This allows for the calculation of an optimal tax rate for the Euro area, as depicted in Figure A.1, for the countries shaded in green.

Fleurbaey and Maniquet (2007) offers a valuable example of how progressivity functions as a principle of fairness in the construction of optimal taxes. This insight is particularly relevant when considering a potential caveat of this thesis: the inclinations used for constructing the normalized aggregate social marginal welfare weights, and the rationale behind their aggregation, appear predominantly progressive without explicit justification.

This research paper focuses on optimal taxation's purpose of mitigating inequality, aligning with societal preferences, and enhancing social welfare, albeit with some lack of sophistication. This approach does not capture other crucial economic situations, such as the effects on government revenue or corporate entities, but it underscores the importance of normative relevance in model calibration. For example, Kopczuk (2012) demonstrates how a base-broadening tax reform combined with tax reductions in Poland lead to increased tax revenue and a Pareto improvement. In contrast, this paper offers a real EU-level example that validates societal equality while suggesting further research into how tax reform should be distributed. It also raises the question of whether it is time to explore other means of taxation, such as inheritance taxation, to better achieve desired goals.

6 Conclusion

Given the continuous debates among policymakers regarding income tax reforms and the integral role of taxation in upholding core EU values of democracy, understanding optimal income taxation using real EU microdata becomes imperative. The primary aim of this research paper was to assess the extent to which EU countries apply optimal taxation principles that address the normative goal of mitigating inequality, while considering societal preferences and enhancing social welfare in the context of income tax reforms.

This study distilled a theoretical understanding of optimal taxation principles that can be universally applied at different times by calibrating individual-level microdata. The resulting optimal tax model is both simple and flexible, underscoring its universal applicability. A regression analysis was conducted to capture a key parameter in the model, the elasticity of taxable income (ETI). Due to data limitations, the ETI was estimated solely for Germany, as there was a lack of highly specific data on tax reforms from OECD (2023) and critical variables from HFCS. Nevertheless, existing literature affirms that the ETI estimates for Germany are consistent with estimates for other countries, allowing for generalization across the EU. Utilizing the ETI for Germany across the EU enabled the research to proceed without relying on estimates from external literature.

The study employed a calibration method to determine social welfare weights and utilized assumptions that purposefully reflect horizontal equity and the notion of equal sacrifice, while also implementing an averaging method that incorporates societal preferences. When analyzing the optimal income tax results across different EU sample countries, the strictly progressive inclination closely aligns with the calibration performed by Piketty and Saez (2013). Although this thesis does not define the accuracy extents of the final result calculations, the averaging method brings the calculated optimal income tax closer to the actual income tax. This suggests that, across the EU, optimal taxation principles with progressive inclinations are generally implemented without significant deviations.

This research sets the stage for further studies to better determine the ramifications of the ETI through a deeper examination of its impact on labor supply. Additionally, it calls for a more comprehensive understanding of how the optimal income tax affects individuals at different income levels. This could lead to broader research objectives, such as determining whether social welfare can still be feasibly achieved through income taxation or if other forms of taxation need to be explored.

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A Appendix: Additional Figures

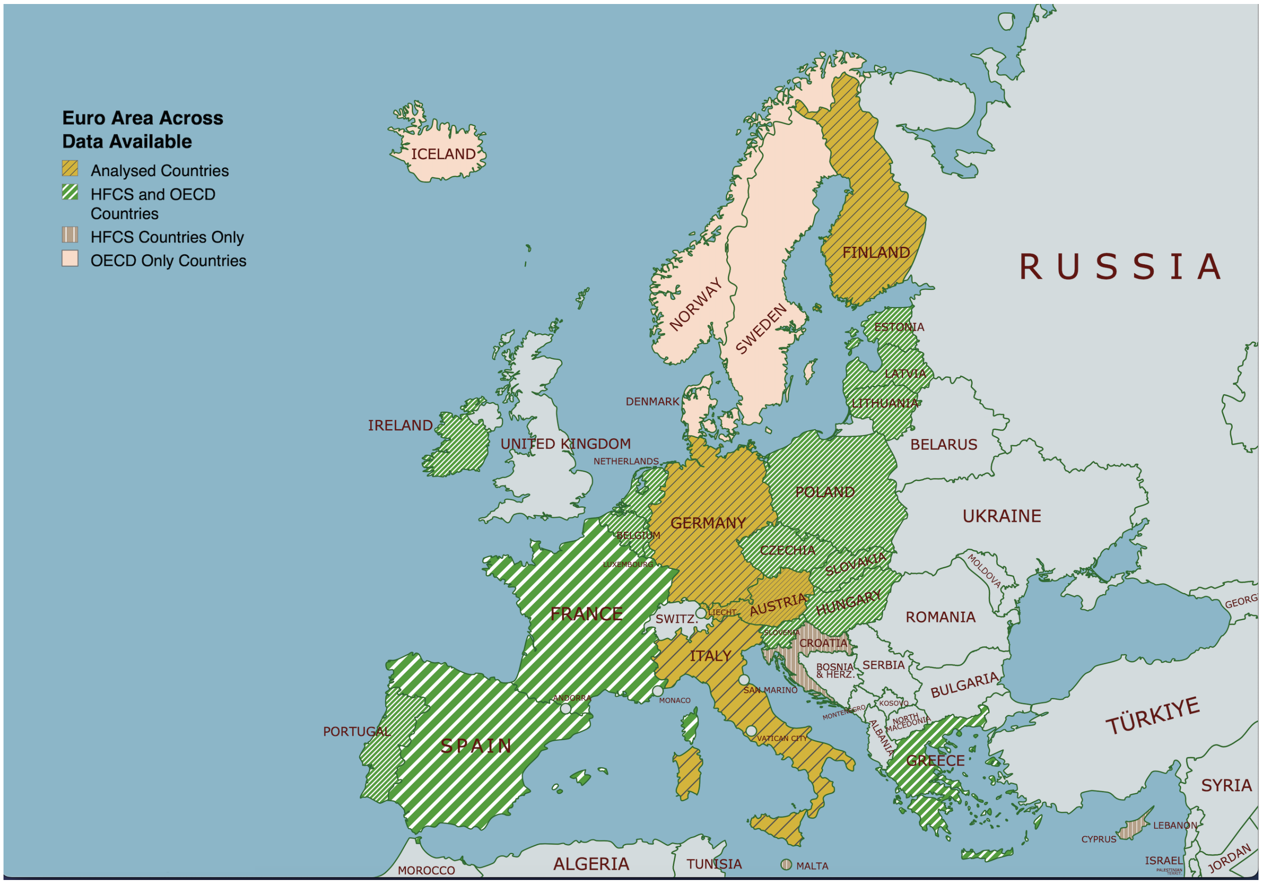

Figure A.1: Visual Representation of Data Availability Across Euro Area Countries

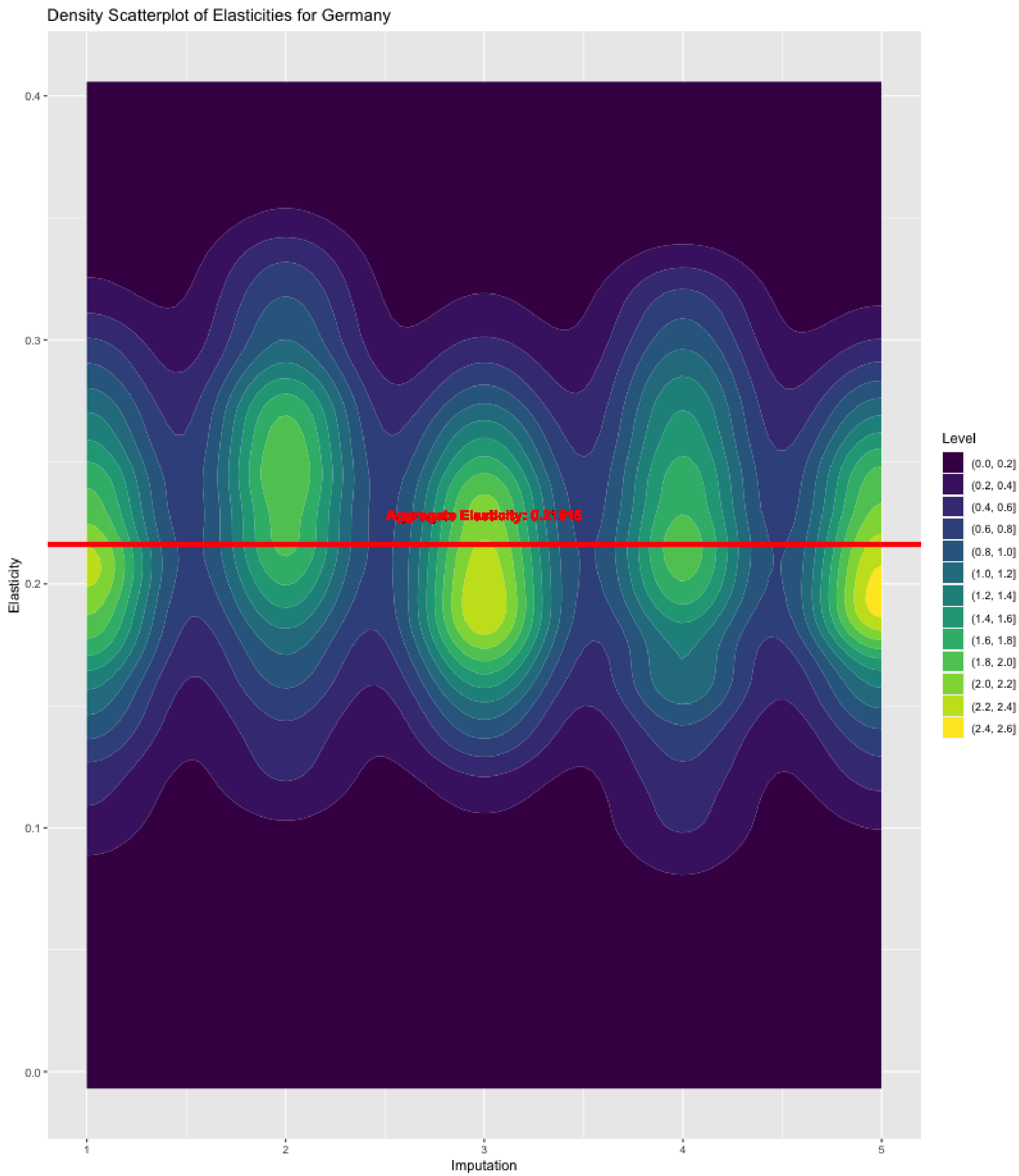

Figure A.2: Density Ditribution of Elasticities Based on 1000 Regressions Per Imputation

B Appendix: Additional Tables

Characteristic	**Value**
Average Number of Working Hours per Week	23.19905
Average Time (Years) in Employment	29.51682
Mean Individual Tax Rate	0.191
Median Individual Tax Rate	0.177
Standard Deviation of Individual Tax Rate	0.059
First Quartile of Individual Tax Rate	0.145
Third Quartile of Individual Tax Rate	0.228
Mean Taxes Paid (Yearly)	€ 8155.690
Median Taxes Paid (Yearly)	€ 5793.640
Standard Deviation of Taxes Paid (Yearly)	€ 9038.131
First Quartile of Taxes Paid (Yearly)	€ 3866.600
Third Quartile of Taxes Paid (Yearly)	€ 9578.350
Mean Total Personal Gross Income (Yearly)	€ 37505.08
Median Total Personal Gross Income (Yearly)	€ 32769.00
Standard Deviation of Total Personal Gross Income (Yearly)	€ 20067.34
First Quartile of Total Personal Gross Income (Yearly)	€ 26600.00
Third Quartile of Total Personal Gross Income (Yearly)	€ 42000.00

Table B.1: Tax, Income, and Other Characteristics - Austria

The summary statistics are based on the specified custom dataset for Austria.

Characteristic	Value
Average Number of Working Hours per Week	33.23865
Average Time (Years) in Employment	N/A*
Mean Individual Tax Rate	0.315
Median Individual Tax Rate	0.2714283
Standard Deviation of Individual Tax Rate	0.1831089
First Quartile of Individual Tax Rate	0.1981521
Third Quartile of Individual Tax Rate	0.3815786
Mean Taxes Paid (Yearly)	€ 8155.690
Median Taxes Paid (Yearly)	€ 5793.640
Standard Deviation of Taxes Paid (Yearly)	€ 9038.131
First Quartile of Taxes Paid (Yearly)	€ 3866.600
Third Quartile of Taxes Paid (Yearly)	€ 9578.350
Mean Total Personal Gross Income (Yearly)	€ 37505.08
Median Total Personal Gross Income (Yearly)	€ 32769.00
Standard Deviation of Total Personal Gross Income (Yearly)	€ 20067.34
First Quartile of Total Personal Gross Income (Yearly)	€ 26600.00
Third Quartile of Total Personal Gross Income (Yearly)	€ 42000.00

Table B.2: Tax, Income, and Other Characteristics - Finland

* Mean time in employment is not available (NA) for Finland.
The summary statistics are based on the specified custom dataset for Finland.

Characteristic	Value
Average Number of Working Hours per Week	22.78471
Average Time (Years) in Employment	30.26107
Mean Individual Tax Rate	0.257
Median Individual Tax Rate	0.220
Standard Deviation of Individual Tax Rate	0.188
First Quartile of Individual Tax Rate	0.124
Third Quartile of Individual Tax Rate	0.335
Mean Taxes Paid (Yearly)	€ 13171.732
Median Taxes Paid (Yearly)	€ 5099.710
Standard Deviation of Taxes Paid (Yearly)	€ 31480.233
First Quartile of Taxes Paid (Yearly)	€ 2154.048
Third Quartile of Taxes Paid (Yearly)	€ 11624.774
Mean Total Personal Gross Income (Yearly)	€ 44663.03
Median Total Personal Gross Income (Yearly)	€ 23722.45
Standard Deviation of Total Personal Gross Income (Yearly)	€ 89971.83
First Quartile of Total Personal Gross Income (Yearly)	€ 15336.73
Third Quartile of Total Personal Gross Income (Yearly)	€ 38009.91

Table B.3: Tax, Income, and Other Characteristics - Italy

The summary statistics are based on the specified custom dataset for Italy.

Variable	Coefficient	Std. Error	t-value	p-value
Predicted Tax Change	0.2116	0.0327	6.4801	1.086×10^{-10} ***
Income Function	-0.9906	0.0280	-35.3497	$< 2.2 \times 10^{-16}$ ***
Demographics	-0.0072	0.0010	-6.9959	3.315×10^{-12} ***
Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Balanced Panel:		$n = 7$	$T = 1$	$N = 2697$
Total Sum of Squares:		2081.3		
Residual Sum of Squares:		10533000		
R-Squared:		0.3123		
Adjusted R-Squared:		0.3100		
F-statistic:		479.978		
(on 3 and 2687 DF) p-value: $< 2.22 \times 10^{-16}$				

Table B.4: Summary of Imputation 2 Regression Model (Point Estimate, Individual Weights)

Variable	Coefficient	Std. Error	t-value	p-value
Predicted Tax Change	0.1925	0.0297	6.4816	1.076×10^{-10} ***
Income Function	-0.9612	0.0272	-35.3295	$< 2.2 \times 10^{-16}$ ***
Demographics	-0.0066	0.0010	-6.6179	4.381×10^{-11} ***
Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Balanced Panel:		$n = 7$	$T = 1$	$N = 2697$
Total Sum of Squares:		2073.6		
Residual Sum of Squares:		9777000		
R-Squared:		0.3122		
Adjusted R-Squared:		0.3099		
F-statistic:		491.991		
(on 3 and 2687 DF) p-value: $< 2.22 \times 10^{-16}$				

Table B.5: Summary of Imputation 3 Regression Model (Point Estimate, Individual Weights)

Variable	Coefficient	Std. Error	t-value	p-value
Predicted Tax Change	0.1931	0.0315	6.1258	1.035×10^{-09} ***
Income Function	-0.9929	0.0282	-35.2389	$< 2.2 \times 10^{-16}$ ***
Demographics	-0.0069	0.0010	-6.6773	2.946×10^{-11} ***
Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Balanced Panel:		$n = 7$	$T = 1$	$N = 2697$
Total Sum of Squares:		2076.7		
Residual Sum of Squares:		10536000		
R-Squared:		0.3088		
Adjusted R-Squared:		0.3064		
F-statistic:		482.722		
(on 3 and 2687 DF) p-value: $< 2.22 \times 10^{-16}$				

Table B.6: Summary of Imputation 4 Regression Model (Point Estimate, Individual Weights)

Variable	Coefficient	Std. Error	t-value	p-value
Predicted Tax Change	0.1953	0.0288	6.7786	1.486×10^{-11} ***
Income Function	-0.9658	0.0270	-35.7862	$< 2.2 \times 10^{-16}$ ***
Demographics	-0.0074	0.0010	-7.4652	1.118×10^{-13} ***
Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Balanced Panel:		$n = 7$	$T = 1$	$N = 2697$
Total Sum of Squares:		1912.9		
Residual Sum of Squares:		9656200		
R-Squared:		0.3300		
Adjusted R-Squared:		0.3278		
F-statistic:		505.354		
(on 3 and 2685 DF) p-value: $< 2.22 \times 10^{-16}$				

Table B.7: Summary of Imputation 5 Regression Model (Point Estimate, Individual Weights)