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# A Tax-Benefit Microsimulation Model for Personal Income Taxation in Italy[1]

Elena Miola[a], Marco Manzo[b]

*Abstract*

*The paper presents a static tax-benefit microsimulation model developed by combining the IT-SILC 2016 dataset, a survey on Italian incomes and living conditions, and administrative tax return micro data in the same year. The dataset derives from the exact matching of survey and administrative data. The microsimulation model reproduces in detail the features of Italian personal income tax and benefit system and is aimed at evaluating tax revenue and fiscal policies distributive impact. Redistribution analysis is carried out by using concentration, progressivity and redistribution indices for individual taxpayers and equivalent households. Inequality issues are analysed further through the computation of decile and quintile distribution of household gross and disposable income, by using the tax-benefit microsimulation model.*

**Keywords:** tax-benefit microsimulation model, personal income taxation, redistribution, inequality

**JEL Classification**: D31, H20, H24

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## 1. Introduction

The paper describes a static tax-benefit microsimulation model developed to reproduce the main features of Italian Personal Income Tax (PIT) and benefit system, such as gross and net income, deductions, tax credits, gross and net tax liabilities, surtaxes, the so-called bonus on Irpef (or "80 euro bonus") and family allowance ("*assegni familiari"*). The aim of the model is to evaluate the tax revenue and the distributive impact of existing or proposed fiscal policies related to Italian PIT. The developed microsimulation model is a useful tool to aid the design of proposed reform and evaluate how alternative approaches could result in PIT's revenue and redistributive effects, in order to figure out results for the policy maker and for study purposes. Designing a PIT reform becomes a more and more complex task if one considers the multi-objective nature of the problem, from the classical revenue objective to other issues related to social equity and efficiency of the newly designed systems (Pellegrino et al., 2019).

Microsimulation models are increasingly used tools to evaluate fiscal policies and possible fiscal reforms, in terms of their impact on government revenue and income distribution among the population (Figari et al., 2015). Evidence from microsimulation methods is glowingly contributing to policy debate and academic literature. According to Figari et al. (2015), tax-benefit microsimulation models are unique tools to conduct ex-ante analysis through the simulation of counterfactual scenarios reflecting alternative policy regimes. The literature on microsimulation models is rich and expanding due to the increase of data availability (Curci et al., 2017). However, the quality of microsimulation models is related to the availability of good quality data (Azzolini et al., 2017). There is an increase in use of administrative tax data in economic research. The future of best-practice tax policy analysis will likely combine the unique advantages of tax microdata with survey and national account data (Kennedy, 2019).

The model developed in this working paper is based on a combination of survey and administrative tax return micro data. It provides an updated version of the model described in Di Nicola et al. (2015), which was the first one proposed for Italy with these characteristics, and to which we are much indebted. The dataset has been built up by exactly merging the 2016 IT-SILC (*Survey on Income and Living Conditions for Italy*) dataset, a representative sample survey on Italian incomes and living conditions provided by the Italian Institute of Statistics (Istat), and personal tax return administrative micro data on the same year. Both IT-SILC and tax return data refer to 2015 fiscal year for incomes and fiscal variables. The administrative dataset is managed by the

Department of Finance of the Ministry of Economy and Finance and contains complete and detailed information on tax returns, allowing simulating every aspect of Italian PIT legislation. The SILC dataset is rich in demographic information and representative of total population, so very useful for redistributive analysis.

The developed model, which is described in detail in the working paper, proves to reproduce well the tax revenue and the main variables related to personal income taxation, once the results are compared to the official ones provided by the Department of Finance's Statistics on Tax Return. This makes the microsimulation model a reliable tool to evaluate revenue and redistributive impact of the current PIT system and of possible fiscal reforms. In the working paper, microsimulation analysis takes into account redistribution operated by the Italian PIT. The redistributive effect of taxes and transfers is quantified by comparing taxpayers and household income inequality before and after taxes and transfers and providing concentration, progressivity and redistribution indices. Inequality issues are analysed further through the decile and quintile distribution of the household disposable income computable with the implemented tax-benefit microsimulation model. A focus on the quintile share ratio, which is an indicator calculated and updated every year in the Italian Public Budget in the group of the Equitable and Sustainable Well-Being Indicators (ESWB, the so-called *BES Indicators*), is presented.

The paper is structured as follows. Section 2 presents the main features of the microsimulation model, its modular structure, the data sources exploited and the implemented algorithms. Section 3 discusses the redistributive impact of personal income taxation in Italy. Section 4 goes deeply into inequality analysis providing the decile and quintile distribution of household disposable income and the assessment of informative inequality indicators. Section 5 concludes by reporting possible further developments for the model.

## 2. The Tax-Benefit Microsimulation Model

In this section, the static tax-benefit microsimulation model is described in detail. The model reproduces the main features of Italian Personal Income Tax (PIT) and benefit system, such as gross and net income, deductions, tax credits, gross and net tax liabilities, surtaxes, the so-called bonus on Irpef and family allowance ("*assegni familiari"*). The dataset has been built up by merging the IT-SILC (*Survey on Income and Living Conditions for Italy*) dataset, a representative sample survey on

Italian incomes and living conditions provided by the Italian Institute of Statistics (Istat), and the corresponding personal tax return data of each individual within the SILC dataset[2]. Both IT-SILC and tax return data refer to 2015 fiscal year for incomes and fiscal variables. Administrative data on tax return are managed by the Department of Finance of the Ministry of Economy and Finance. The fiscal code is used for a punctual matching and then deleted for privacy purposes. The working paper provides an updated version of the paper by Di Nicola et al. (2015), which was the first one proposed for Italy with these characteristics and where the IT-SILC in 2009-2010 and tax return data from the same year are merged.

In the model developed in the working paper, administrative data are mainly used to reproduce the PIT fiscal revenue in every aspect of the Italian legislation, whereas the complete IT-SILC dataset is the landmark for the redistributive analysis and the computation of indicators. Benefits such as the family allowance ("*assegni familiari*") are not in the tax return form and are computed using available information in the SILC dataset. Tax return dataset contains complete information on every source of income and every passage for the calculation of the tax liabilities from total income to net Irpef, through deductions, taxable income, gross Irpef and tax credits. The administrative dataset allows simulating every aspect of the Italian PIT legislation precisely. SILC dataset is rich in demographic information and representative of total population, so very useful for redistributive analysis. According to Di Nicola et al. (2015), the choice of alternative input data sets for static tax-benefit microsimulation models is a key issue for their performance. The integration of the two datasets provides all the information necessary for the elaboration of the tax-benefit microsimulation model.

Administrative tax microdata are greater in scale and coverage than survey data. However, according to Di Nicola et al. (2015), tax microdata suffer a number of limitations. First, they provide little demographic and socioeconomic information on taxpayers. Then, they are limited to the taxpaying population rather than total population, so administrative data underrepresent the very lower end of the income distribution. For example, in Italy, in 2015, employee or retirement incomes under 8,145 per year do not have to be declared by tax return to the administrative authority.

[2] Cadastral data of the real estate properties from the Land and Building Register are administrative data at disposal of the Department of Finance and are merged to the dataset using the fiscal code. However, the goal of the first part of the developed model is to reproduce the fiscal revenue for taxpayers presenting tax return form and, in order to calculate the building income included in the total income, variables in the tax return dataset suffice for our purpose. In the model, cadastral data are used when analysis focusing on property taxation and real estates are needed.

Therefore, it can happen that the poorest are not well represented in the sample. In addition, incomes subject to the substitutive taxation, for example financial incomes, are not to be declared by tax return and are not present in the administrative data set.

On the contrary, SILC dataset is rich in demographic information and representative of total population, included lower end incomes of the distribution. Moreover, the sample survey is based on the household (group of individuals who live together and are relatives, as they are recorded in the family register) whereas tax return forms observe the fiscal family. Administrative data do not register socio-economic characteristics at household level, which are important for implementing redistributive analysis of the tax system. See Di Nicola et al. (2015) for a complete discussion about reasons and opportunities for an exact match approach. As observed by the authors, matching survey and administrative data can overcome some of the respective weakness.

For individuals within the SILC dataset with correct corresponding tax return data about incomes and fiscal variables, the information contained in the tax return is used. Individuals without a tax return but declaring taxable incomes within SILC dataset are not considered among taxpayers in the model. This is a difference between the present working paper and Di Nicola et al. (2015). Income integrations from the different dataset (survey and tax return) allow catching the shadow economy. Shadow economy can be identified by comparing survey incomes and tax returns incomes and assuming that incomes in tax return data are underreported for tax evasion purposes. In the present work, the main goal is to reproduce properly the tax revenue and the availability of administrative data solves the typical problem of under-statement (or inaccurate statement) of the information provided by respondents in a sample survey. The use of administrative data constitutes an advantage, assuming that the propensity to tax evasion is invariant with respect to simulated fiscal policy. The tax-benefit microsimulation model presented here is a static one, tax evasion is assumed invariant to fiscal policy and behavioural changes in individuals are not considered.

Following Di Nicola et al. (2015), the tax-benefit microsimulation model reproduces the fiscal legislation of the fiscal year of the dataset (in our case 2015) in every aspect, as a benchmark analysis. Then incomes, fiscal rules and results are updated to the fiscal year of interest, or the last fiscal year for which official statistics for Irpef are available (in our case 2018). A set of algorithms has been created to replicate the transition from total income to the net tax liabilities for all taxpayers within the dataset. Every aspect of the PIT system corresponds to an algorithm, computed in a different STATA file *.do. The integrated sample is made up by 21,325 families and 47,316

individuals. The tax return data are available for 32,444 individuals, while the remaining 15,872 individuals do not have tax return information (because they are not required to submit the tax return to the administrative authority, or because it was not possible to match the fiscal code[3]). For each observation presenting tax return in the sample, the passage from the total income to the net tax has been reconstructed.

For the construction of the model, the programming language STATA is used, following a modular logic: each work phase is contained in *.do files that are activated by a master *.do file. Through the master *.do file, it is possible to recall or not the individual modules, making the use of the model flexible. The master *.do file activates the various modules in the order in which they must be executed. A number of *.do files reproduce the tax legislation relating to the 2015 and 2018 tax period following the tax return instructions for these two fiscal years. For a proof on Italian PIT fiscal legislation and its history, see Pellegrino and Panteghini (2020). In the model, the fiscal legislation of the immovable properties, the calculation of tax credit for family burden and for type of earned incomes, gross and net Irpef starting from total income, the bonus on Irpef provided for employees, the regional and municipal surtaxes, and the family allowance ("*assegni familiari*") are reproduced. The file structure is appropriately flexible, so changes can be made, thanks to the presence of global parameters in the master file and the slowing organization of files, permitting estimate of the revenue variation that would occur if changes in some aspect of the current legislation or more complex reforms have to be implemented.

*The structure and peculiarity of the *.do files for 2015 fiscal legislation*

In order to go from the global comprehensive personal income to the tax liability for 2015 fiscal year, a number of *.do files are developed to reproduce the 2015 fiscal legislation. Every aspect of the PIT system corresponds to an algorithm, computed in a different STATA file *.do. In this sub-section, the different files are described in detail. The files operate on each observation of the tax return dataset, in order to reconstruct every passage from the total income to the net tax liability.

[3] Only 320 individuals are without fiscal code in the dataset. A few individuals are not matched, even if they are identified by a fiscal code. It is possible that among these individuals, some has a wrong fiscal code, but we have no elements to say so. However, the majority of people without tax return data are young people and children. A few individuals do not have tax return but declare an income in SILC. Individuals without a tax return form in the dataset are not considered in the reproduction of the tax revenue, but they are involved in the redistribution analysis.

The first two modules manipulate the data coming from the IT-SILC dataset (label assignment and encoding of string variables, transformed into numeric variables, and of the variables of interest).

Then, a number of *.do files are devoted to the calculation of immovable property taxable income[4]. Depending on the kind of use of buildings ("*utilizzo*"), there are different rules to determine the property income useful for fiscal purpose. In particular, taxable incomes subject to ordinary taxation (Irpef) and taxable incomes subject to the proportional tax "*cedolare secca*" (with two tax rates 21% and 10%) are evaluated. The "*cedolare secca*" is a substitutive tax to Irpef that has been applied to some income deriving from rented properties since 2011 fiscal year. Property taxable income subject to Irpef is included in the global comprehensive personal income. Taxable incomes subject to the proportional tax "*cedolare secca*" have to be added to the global comprehensive personal income in order to determine the tax base for tax reliefs and for tax credits ("*reddito per agevolazioni fiscali*" and "*reddito per detrazioni*"). Also, taxable income for the main dwelling is quantified, because it is part of the global comprehensive personal income and then deducted from it.

In an appropriate file, the property income and the property taxable income, which is often a share of the property income, are computed depending on the kind of use the buildings are devoted to. Table 2.A in Appendix A describes the different uses ("*utilizzo*") of the immovable properties according to the tax return form, for which different rules apply in order to calculate the related property income. Table 3.A in Appendix A summarizes the main rules applied to calculate immovable property taxable income. The calculation in the files is different for buildings that change their use during the fiscal year or not. In fact, buildings that change their use during the fiscal year are reported in more than one module in the tax return form, so the STATA routines need to be different for them. The results obtained for immovable property taxable income are good and are presented in the following Table 1 (a more complete report of the results of the model for the property taxable income is in Table A.1 in Appendix A). Table 1 describes the results of the model for immovable property income referring to the sample of 32,444 taxpayers in the dataset. The

[4] In particular four *.do files are devoted to the calculation of immovable property taxable income. A file separates the buildings that change their use during the fiscal year from buildings that do not chance their use during the fiscal year. Another file reproduces precisely the fiscal legislation for immovable property. Then two files applies the fiscal legislation to buildings that change their use during the fiscal year and to buildings that do not change their use during the fiscal year respectively. The files are described properly in the section.

32,444 taxpayers in the dataset own 16 million of property income taxable by Irpef. The table compares the immovable property income obtained by the described files in the model and the same variables in the sample of taxpayers, showing that the model reproduces well the data. Results in Table 1 are not weighted or calibrated, they refer to the sample of taxpayers with a tax return form in the dataset and not to all the Italian tenants.

*Table 1 – Results of the model for immovable property income for 2015 fiscal year, without calibration*

| Immovable Property Income | Sample data in the tax return dataset | The simulation of the model for 2015 on the sample (without weights) | % Error |
|---|---|---|---|
| Ordinary Taxable Income (Irpef) | 16,283,819 | 16,285,239 | 0.01% |
| Taxable income to "*cedolare secca*" 21% | 6,367,425 | 6,362,839 | -0.07% |
| Taxable income to "*cedolare secca*" 10% | 2,388,425 | 2,388,425 | 0.00% |
| Main dwelling (subject to IMU) | 327,694 | 327,692 | 0.00% |
| Main dwelling (not subject to IMU) | 7,752,079 | 7,752,037 | 0.00% |

*The table refers to the sample of 32,444 taxpayers in the tax return dataset without weights or calibration.*
*Note: IMU is the municipal property tax.*
*Data in euro.*
*Source: own elaboration*

In a following *.do file, the global income is determined and, for the calculation, the rules contained in the instructions of the tax return form are considered. Total income is obtained by summing up the different types of income declared in the tax return form: income from land and rental, immovable property income calculated in the previous files, income from subordinate employment and income treated as income from subordinate employment, retirement income, self-employment income, income from commercial activities and business and other incomes[5]. The income for tax relief ("*reddito per agevolazioni fiscali*") is determined by adding property incomes subject to the proportional tax "*cedolare secca*" to the global income. The income for tax credits ("*reddito per detrazioni*") derives from the income for tax relief minus the deduction of income from the principal residence. The income for tax credits is the tax base for the assessment of tax credits for family burden and of tax credits for working taxpayers.

A file *.do is dedicated to the calculation of tax credits for family burden. The tax credit for dependent spouse and the tax credit for dependent children (differentiated for children under or

[5] Global comprehensive personal income includes just a few types of income from stocks ("*reddito di partecipazione*") and financial capital gains ("*plusvalenze finanziarie*"). The exclusion of financial and property incomes from Irpef tax base undermines the redistributive role of the Italian PIT, as discussed later in the working paper.

over 3 years old) are computed. A further tax credit for large families (more than 3 dependent children) and a tax credit for other dependent relatives are determined. In order to implement tax credit for family burden, every rule from the tax return form instructions is applied. These rules provide formulas and parameters. The parameters are global variables in the *.do files, which can be changed in order to simulate new parameters in case the policy maker varies them. Parameters and formulas are different if the dependent children or dependent relatives have a disability, because higher tax credits are provided in this case. Tax credits for family burden have to be multiplied by the percentage of burden and the number of days the relatives are dependent.

A *.do file is devoted to the calculation of tax credit for working taxpayers differentiated by type of job. There are different tax credits for retired, employees and self-employed taxpayers. If different types of income are earned in the same year, the relative tax credits cannot be cumulated with the others. In the file, first, tax credits are quantified by applying the rules stated in the instructions of the tax return form (for retired, employees and self-employed taxpayers) and then, for taxpayers earning different types of income, the final tax credit is corrected for the non-comulation. If the employee and retirement earnings refer to different periods of the year, both the tax credits are due in proportion to the number of months the taxpayer has been employee or retired. In the tax return form, taxpayers indicate themselves the number of days for which employee and pension tax credits are due. In addition, tax credits for retired taxpayers are different in relation to age (older or younger than 75 years). The numerous tax credits for personal expenses are not determined inside the model but taken exogenously.

After a file that collects all the different results obtained in the previous files, a *.do file calculates the net tax liability (net Irpef) starting from the global income. The file reproduces the tax return form in every passage for the assessment of net tax liability. From the total income, all the deductions are applied, including the deduction for the main residence, in order to obtain the taxable income. The Irpef tax rates are applied according to different income brackets of taxable income. The gross tax liability is computed keeping into account every particular rule provided for by fiscal legislation. Tax credits for dependent relatives and tax credits for working taxpayers differentiated by type of job (as calculated in the previous files) and the tax credits for personal expenses are considered in order to obtain the net tax liability.

A specific *.do file is devoted to the computation of the bonus on Irpef, also called “80 euro bonus”, which is an in-work benefit introduced in mid-2014 and targeted to specific taxpayers, in

particular employees. Another file assesses the regional surtax, applying the different tax rules provided by every Italian Region. Municipal surtax and the family allowance ("*assegni familiari*") are not quantified for the 2015 fiscal year but only for 2018 fiscal year. In fact, the part of the model referring to 2015 is built as a benchmark, whereas the model applied to simulate fiscal reform and to calculate indicators is the one referring to 2018 fiscal year. Municipal surtax and family allowance ("*assegni familiari*") are estimated in 2018 and the computation of the same variables in 2015 are not needed for the purposes of the model.

Following Di Nicola et al. (2015), new weights reproducing the fiscal official statistics in 2015 are computed, in order to bring the sample back to the Italian population. The SILC sample weights were designed for demographic representativeness and do not fit well fiscal data. In an appropriate *.do file of the model, SILC sample weights are reweighted by the STATA command SREWEIGHT, developed by Pacifico (2014), in order to use the weights for fiscal purposes. SREWEIGHT calibrates survey data to external totals. The variables used to build the new weights (used for the calibration) are the total income, the net Irpef, employee income, retirement income and the frequencies of the same incomes, the total Italian population and the number of Italian households. The totals of the fiscal variables are taken from the official data on tax returns for fiscal year 2015, published by the Department of Finance, whereas data on the Italian population are provided by Istat. The specified variable to be used for the original survey weight is the SILC sample weights. The command needs a distance function to be specified when computing the new weights.

The results of the model referring to 2015 fiscal year are presented in the following Table 2 that describes the main variables calculated by the Stata routines in the *.do file, in order to reproduce the variables in the dataset. Table 2 presents the results of the programming compared to the sample data of 32,444 taxpayers in the tax return dataset, without weights or calibration. In the administrative data set, the complete set of fiscal variables are present. In the second column of Table 2, the main fiscal variables are reported for the sample data in the tax return dataset. In the sample administrative data, the 32,444 taxpayers declare a global income of 695 million euros and a net tax liability of about 131 million euros. In the third column of Table 2, the same variables are reported as simulated by the model for 2015 using the *.do files described widely in this section and without calibration. The goal of Table 2 is to show that the model for 2015, developed by the described files, reproduces well the fiscal variables of interest, and so the fiscal legislation, given that the percentage error varies from -0.69% to 2.14%.

Table 3 describes the main variables calculated in the model for 2015 fiscal year weighted by means of the weights built by manipulating the weights in SILC, as described. Table 3 compares the results of the model for 2015 fiscal year (in the second column) and the same variables in the official data (in the third column) provided by the Department of Finance in the Statistics on Tax Return in 2015 fiscal year. According to Table 3, the weighted values of the 2015 microsimulation model fit well the corresponding ones observed in the official Statistics on Tax Return, released by the Department of Finance and referring to all the Italian taxpayers in the same year. The developed microsimulation model proves to simulate well total income, taxable income, gross tax liability, net tax liability, regional Irpef surtax and can be employed to run distributive analysis of PIT, tax revenue and redistributive analysis of possible PIT reforms.

*Table 2 - Results of Tax-Benefit Microsimulation Model, fiscal year 2015, without calibration*

| Variables | Sample data in the tax return dataset | The simulation of the model for 2015 on the sample (without weights) | % Error |
|---|---|---|---|
| Global Income | 695,415,331 | 695,415,332 | 0.00% |
| Income for tax reliefs | 705,653,451 | 705,653,452 | 0.00% |
| Deduction for the main dwelling | 7,752,079 | 7,752,079 | 0.00% |
| Deductible expense (*"oneri deducibili"*) | 21,795,972 | 21,795,973 | 0.00% |
| Taxable Income | 667,909,306 | 667,909,306 | 0.00% |
| Gross Tax Liability | 180,592,260 | 179,348,651 | -0.69% |
| Tax credits for family burden and tax credit for working taxpayers | 43,084,258 | 44,005,655 | 2.14% |
| Net Tax Liability | 131,570,401 | 131,566,338 | 0.00% |
| Bonus on Irpef | 7,105,603 | 7,136,872 | 0.44% |
| Regional Surtax | 9,757,805 | 9,792,227 | 0.35% |

*The table refers to the sample of 32,444 taxpayers in the tax return dataset without weights or calibration.*
*Note: the income for tax relief ("reddito per agevolazioni fiscali") is determined by adding property incomes subject to the proportional tax "cedolare secca" to the global income.*
*Data in euro.*
*Source: own elaboration*

Appendix B contains several figures displaying the frequency density function of the main tax variables according to the microsimulation model and the official statistics made available by the Department of Finance. Figures of gross income, taxable income and gross tax liability and net tax liability are provided. Given the similarity of all tax variables in the transition from the pre- to the post-tax income, the microsimulation model can be employed to estimate concentration and inequality indices and the tax revenue and redistributive effect of changes in the PIT legislation.

*Table 3 - Validation of the Results of the Tax-Benefit Microsimulation Model, fiscal year 2015, weighted (calibrated) variables*

| Variables | The Model 2015, weighted | Department of Finance Statistics on Tax Return – 2015 | % Error |
|---|---|---|---|
| Global income | 821.7 | 821.7 | 0.0 |
| Income for tax reliefs | 833.4 | 833.0 | 0.05 |
| Deduction for the main dwelling | 8.9 | 8.7 | 3.12 |
| Deductible expense ("*oneri deducibili*") | 24.7 | 25.5 | -2.84 |
| Taxable Income | 790.1 | 790.1 | 0.0 |
| Gross Tax Liability | 214.2 | 214.2 | 0.0 |
| Net Tax Liability | 155.2 | 155.2 | 0.0 |
| Bonus on Irpef | 9.2 | 9.0 | 3.10 |
| Regional Surtax | 11.9 | 11.8 | 0.03 |

*Note: the income for tax relief ("reddito per agevolazioni fiscali") is determined by adding property incomes subject to the proportional tax "cedolare secca" to the global income.*
*Data in billions of euros*
*Source: own elaboration*

*The application to fiscal year 2018*

Following Di Nicola et al. (2015), once the model is implemented for the tax year of the dataset, the further step is to update it to the tax year of interest. In the model, all datasets refer to 2015 tax year, so fiscal variables are reproduced for 2015 as a benchmark analysis, then incomes, fiscal rules and results are updated to the 2018 fiscal year. The model for 2018 tax year is used for the further analysis in the working paper. As in Di Nicola et al. (2015) that is strictly followed in this section, in order to update the model from 2015 fiscal year to 2018, three phases are considered: a) update of the most relevant incomes from 2015 to 2018; b) update the algorithms described in the previous section according to 2018 tax rules; c) compute new sample weights to bring the sample back to population reproducing the fiscal official statistics in 2018, taking into account the differences in the new fiscal year. When the model was built, the official statistics from the fiscal year 2018 were not available, so we used the model for 2018 applying the weights developed for 2015, producing prudential simulations for 2018. Once the official statistics for 2018 are available, the weights are recalculated accordingly.

In the first phase, all the relevant incomes in 2015 are updated to 2018 applying different rules. Retirement incomes are updated according to the rules of pension schemes in the period 2015-2018, calculated considering the inflation rate and released by INPS (the National Social

Security Institute). The inflation rate in 2016 and 2017 is zero, so retirement incomes have not been updated by INPS in those years. Whereas, retirement incomes have been updated in 2018 in the model, considering an inflation rate of 1.1% and the equalization rules for brackets of incomes defined by INPS. Labour incomes of employees are updated according to the increase rate of labour incomes provided by the Italian Document of Economics and Finance (DEF). Incomes of self-employed vary according to the nominal GDP growth rate at market prices, provided by the Italian Document of Economics and Finance (DEF). Cadastral income of buildings has not been updated since it has not changed over the period 2015-2018 in Italy, and data about cadastral and rental incomes are taken from tax return data.

Secondly, the algorithms have to be updated according to the 2018 tax rules. There are a number of differences in the tax law between 2015 and 2018. Some of them are: the changes in some parameters in calculating the tax credit for the retirement income and for the period check paid by the spouse; the change in calculating the tax credit for retirement income: no more difference between retirees whose age is less than or over 75; the abolition of the so called "*solidarity contribution*", a 3% contribution for taxpayers earning more than 300 thousands euro that was previously deductible from the total income. Regional surtaxes are updated according to new legislative rules introduced in some Regions. The municipal surtax is estimated by computing the implicit tax rate in 2015 (which is 0.56%) and applying it to 2018 re-evaluated taxable income (so assuming that legislation has not changed). In 2018, the family allowance ("*assegni familiari*") is evaluated considering the available data in the SILC dataset because it is not present in the tax return form.

Third, in order to bring the sample back to population, new weights reproducing the fiscal official statistics for 2018 are computed. The procedure is the same described in the previous section for 2015. When the model was built, the official statistics for 2018 fiscal year were not available, so the weights developed for 2015 were applied to the model for 2018, which proved to underestimate the total income for 2018. However, prudential simulations were produced for 2018. Once the official statistics for 2018 were available, the weights were recalculated accordingly.

The output of the model for 2018 is in Table 4. The table compares the output of the model for 2018 with the official data published by the Department of Finance for fiscal year 2018, which is the last available. The model fits well the corresponding variables observed in the official tax return data set released by the Department of Finance and results are in line with other microsimulation

models. The model is able to simulate well total income, taxable income, gross tax liability, net tax liability and regional Irpef surtax. Given the similarity of all tax variables in the transition from the pre- to the post-tax income, the microsimulation model can be employed to estimate concentration and inequality indices and the tax revenue and redistributive effect of changes in the PIT legislation for 2018.

*Table 4 – Validation of the Results from the Microsimulation Model, fiscal year 2018, weighted (calibrated) variables*

| Variables | The Model 2018, weighted | Department of Finance Data on Tax Return - 2018 | % Error |
|---|---|---|---|
| Global Income | 864.2 | 864.2 | 0.00% |
| Taxable Income | 829.5 | 829.5 | 0.00% |
| Gross Tax Liability | 226.7 | 226.7 | 0.00% |
| Net Tax Liability | 164.2 | 164.2 | 0.00% |
| Bonus on Irpef | 10.1 | 9.9 | 1.76% |
| Regional Surtax | 12.4 | 12.3 | 0.97% |
| Municipal Surtax | 4.9 | 5.0 | -0.45% |
| Family Allowance* | 6.2 | 6.3 | -2.58% |

**Data on family allowance ("assegni familiari") are from National Account (Istat).*
*Data in billions of euros.*
*Source: own elaboration*

## 3. Redistributive Analysis - Income and Tax-Benefit Concentration Indices

*Redistribution, Progressivity and Inequality*

In recent years, income inequality has become an important economic issue for policymakers and economists, for its potential negative consequences on social distress and economic performance (Jantti et al., 2016). Market income inequality refers to inequality in the labour market (inequality in wages and salaries). Inequality of disposable income (or consumption inequality) is what we are interested in, because it relates to redistribution implemented by governments in order to shift resources from rich to poor. Personal income taxation plays a major role in the redistribution of resources in the Italian system (Bosi and Guerra, 2018). The developed tax-benefit microsimulation model is very useful for analysing gross and net income distribution and redistribution provided by government fiscal policies. The income distribution analysis using tax microdata is essential for supporting the policy maker in designing effective tax policy. Moreover, tax

policy plays an important role in supporting inclusive growth, to ensure that the benefits of growth are broadly shared (Kennedy, 2019). In recent years, inequality has become a key economic and social policy concern for policymakers for potential negative consequences, not only on the economic performance, but also in social disease.

Inequality measures provide a series of indicators whose natural ground of application is the redistributive action carried out by the public budget, in particular through the tax system. In this context, the instrument that governments mainly use is progressive personal income tax (Baldini and Toso, 2009). The theory of the measure of progressivity of income tax received a strong impulse in the 1970s following Kakwani, Reynolds and Smolensky's studies. They show that the progressive taxation system determines an equalizing effect on net income and a greater concentration of the tax burden with respect to the distribution of gross income. The expression "redistributive effect" may seem improper because taxation itself reduces all incomes, including those of the poor. Progressive tax reduces inequality in the sense that we are implicitly comparing this type of taxation with a proportional tax, which leaves the relative differentials of income unchanged and has a neutral effect on inequality (Baldini and Toso, 2009).

Governments implement redistribution by using fiscal policies, taxes and benefits, in order to redistribute resources from rich to poor. The difference between gross and net income inequality is linked to the amount of taxes and benefits that are levied by government fiscal policies. According to Jantti et al. (2016), much less is known about redistribution in the world than inequality in the world, even if redistributive policies are actually a direct and quick policy instrument that governments can use to try to modify disposable income inequality. The main way tax policy can reduce income inequality is through progressive income taxation, i.e. designing a tax system so that the average tax rate rises with income (Gerber et al., 2018). The structure of the tax system determines how much average tax rates rise. It should be noted that gross income differs from market income (income before taxes and transfers), because the latter contains social insurance benefits (as the unemployment related transfers and the retirement related transfer). In this working paper, redistribution operated by public spending is not considered (except for bonus on Irpef and family allowance ("*assegni familiari"*)), but the focus is on redistribution operated through fiscal policies.

According to the OECD (2018), income inequality has increased in most OECD countries over the past two decades. This has come about both because incomes before taxes and transfers have

become more unequally distributed, and because the extent of redistribution through taxes and transfer has fallen. The decline in income redistribution since the mid-1990s was primarily driven by a reduction in cash transfer (for example less generous social insurance benefit). At the same time, in many OECD countries, income taxes have frequently become more redistributive as taxes have been reduced for lower-income working families (OECD, 2018). According to the OECD (2018), taxes and transfers reduce the Gini index of market income inequality by slightly more than 25% (or 11 Gini points) on average across OECD countries. It should be noted that cash transfer and public spending are considered in the OECD analysis.

*Income and Tax-Benefit Concentration Indices Definitions*

In this sub-section, the main coefficients and indicators reported in literature for assessing the distributive effects of PIT are presented. The description derives from Lambert (2004) and Bosi (2015). All indices derive from generalized Gini coefficients of inequality and generalized concentration coefficients.

The Gini (1914) index measures the extent to which income distribution among individuals or households deviates from perfect equal distribution. The Gini index varies from zero (that represents perfect equity) to 1[6] (extreme inequality).

Redistribution is measured by the difference between a concentration index before personal income taxes and transfers (pre-tax income) and the concentration index after taxes and transfers (post-tax income). Redistribution increases if the post-tax income is less concentrated.

The Reynolds-Smolensky (1977) index of redistribution is:

$$RS = Gpre - Cpost,$$

where *Gpre* is the Gini index of income before tax and *Cpost* is the concentration index of income after tax. The concentration index *C* differs from the Gini index *G* because it is calculated according to the income distribution before tax. If you consider the Gini Index after tax instead of the concentration index in the formula, you obtain the global redistribution index:

[6] In particular, the Gini index varies from zero to *(N-1)/N*, where *N* is the number of observations. For a history of the Gini Index, see Pellegrino (2020).

$$R = Gpre - Gpost.$$

The Reynolds-Smolensky index is equal to the global redistribution index if there is no re-ranking effect in the distribution after and before taxation. The R index differs from the RS index if income after tax has a different re-ranking than before tax. For both the indices, redistribution operated by tax is larger as the indices increase. According to Bosi (2003), an ideal progressive tax has marginal tax rate less than 1 and no re-ranking among the individuals, but this situation is actually difficult because of the presence of fiscal rules for horizontal equity.

The re-ranking effect results in the difference between the Gini index after tax *Gpost* and the concentration index after tax *Cpost*:

$$RE = Gpost - Cpost.$$

Between the Reynol-Smolensky index (RS) and the global redistributive effect (R), the following equation applies:

$$RS = R + RE.$$

Musgrave and Thin (1948) proposed a different index of redistributive effect:

$$MT = (1-Gpost) / (1-Gpre),$$

which measures the percentage variation of the Gini index of the distribution after taxation and the Gini index of the distribution before taxation.

The Kakwani (1980) index of tax progressivity compares the concentration index of the tax *Ctax* and the Gini index of income before tax *Gpre*:

$$K = Ctax - Gpre.$$

If the tax is proportional, the concentration of the tax and the concentration of income before tax are the same, so the Kakwani index is zero. If the tax is progressive, concentration of the tax is greater than concentration of the income before tax. The greater is the difference, the more progressive is the tax.

Between Reynolds-Smolensky and Kakwany indices, in case of no re-ranking, the following relation applies:

$$RS = K * t / (1-t),$$

where *t* is the average tax rate, that is a measure of the incidence of the tax. The relation means that redistribution increases as the tax became more progressive, or, keeping progressivity constant, redistribution increases if the incidence increases. For example, the proportional decrease of all tax rates does not change progressivity but makes the distribution more unequal (Bosi, 2003).

The Suits (1977) index is a measure of progressivity calculated by comparing the area under the Lorenz curve to the area under a proportional line:

$$S = 1- L/K,$$

where *K* denotes the area below the line of proportionality, and *L* denotes the area below the Lorenz curve of tax payments against income. The Suits Index varies from 1 (for a theoretical tax where the richest person pays all the tax) to -1 (for a tax where the poorest person pays everything). For a progressive tax, the Suits index is positive, a proportional tax has a Suits index of zero, and a regressive tax has a negative Suits index.

The Atkinson (1980)-Plotnick (1981) index of horizontal inequity is:

$$AP = 0.5 * RE / Gpost,$$

where $RE = Gpost - Cpost$ is the re-ranking effect. The index measures the extension of the re-ranking occurred in the transition from the pre- to the post- tax income. Horizontal inequity occurs if, in the transition from pre-tax distribution to post-tax distribution, the relative position (rank) of individuals in the income distribution changes. A tax variation that modifies the income distribution is horizontally equal if, despite the changes, individual relative positions are preserved and horizontally unequal if relative positions change.

*Income and Tax-Benefit Concentration Indices for Taxpayers, computed by the model for 2018 fiscal year*

In this sub-section, the indices described in the previous sub-section are calculated using the microsimulation tax-benefit model. In particular, the redistributive effects operated by Irpef, local surtaxes and, among benefits, the bonus on Irpef are analysed through microsimulation for Irpef taxpayers. The distribution of global comprehensive income and of net income for Irpef taxpayers is

examined. The analysis focuses on the difference between the indices with and without the bonus on Irpef, following Baldini et al. (2015), Morini and Pellegrino (2018) and Pellegrino et al. (2019). In the following sub-section, the households' equivalent disposable income distribution is investigated by spreading the analysis to all the IT-SILC dataset. The analysis about the households' equivalent disposable income distribution is carried out both with and without the imputed rents in the household disposable income, in order to discuss the importance of imputed rents in the gross income definition.[7] Indices proposed herein derive from generalized Gini coefficients of inequality and generalized concentration coefficients.

Table 5 displays income and tax-benefit concentration indices for Irpef taxpayers, calculated by the model for the 2018 fiscal year, distinguishing between the redistributive effect of Irpef before and after the 80 euro bonus. The column "without the bonus" in Table 5 shows the indices for taxpayers before the bonus on Irpef, so considering the redistributive effect of Irpef and local surtaxes. The Gini index of global comprehensive income is 0.4636, while for net income it is 0.4080. The global redistributive effect, that is the difference between these two indices, is therefore equal to 0.0556. The Reynolds-Smolensky index, equal to the global redistribution index plus the re-ranking effect in the distribution after and before taxation, is 0.0568. The tax concentration index is 0.6774; the Kakwani index, which measures the degree of progressivity of the tax, that is the difference between the tax concentration index and the Gini index of total income, is therefore 0.2138. The average incidence is 21% of total income.

The first column in Table 5 is the reference situation for analysing the redistributive impact of the bonus on Irpef. The second column of Table 5 presents the indices considering the bonus on Irpef in the net income. The results show that the global redistribution index increases, passing from 0.0556 to 0.0609, with the reduction in incidence (-5.6%) more than compensated for by the strong increase in the degree of progressivity of the tax (+18.1%). The increase in redistribution is confirmed by the increase of the Musgrave and Thin index (+0.9%) that measures the percentage variation of the Gini index of the distribution after taxation and the Gini index of the distribution before taxation. The increase in progressivity shown by the Suits index (+18.0) reflects the increase observed for the Kakwany index of progressivity.

[7] For the calculation of indices, the *progress* Stata command is used. The command *progress* takes unit-record data on pre-tax and post-tax income and computes several classic measures of net redistributive effects, progressivity and re-ranking (horizontal inequity). All indices derives from generalized Gini coefficients of inequality and generalized concentration coefficients.

It is important to note that the presence of the bonus on Irpef determines a deterioration of the Atkinson-Plotnick index (+33.3%) indicating a considerable re-ranking effect produced by the presence of the bonus on Irpef in the transition from the pre- to the post-tax income. The more the tax or benefit causes re-ranking, the greater the negative contribution of re-ranking to the overall redistributive effect (Morini and Pellegrino, 2019). The Atkinson-Plotnick index shows a deterioration of the horizontal equity (according to horizontal equity the same treatment has to be given to people in an identical situation); in fact, the bonus on Irpef discriminates on the types of work, constituting a preferential treatment to certain taxpayers, in particular employees.

*Table 5. Income and Tax-Benefit Concentration Indices for Irpef taxpayers, fiscal year 2018*

| Indices | Without bonus on Irpef | With bonus on Irpef | Difference | % Difference |
|---|---|---|---|---|
| Gini Index of total income (G-pre) | 0.4636 | 0.4636 | 0.0000 | 0.0 |
| Gini Index of net income (G-post) | 0.4080 | 0.4027 | -0.0053 | -1.3 |
| Average Tax Rate | 0.2100 | 0.1983 | -0.0117 | -5.6 |
| Global Redistribution Index (R) | 0.0556 | 0.0609 | 0.0053 | 9.5 |
| Re-ranking (RE) | 0.0012 | 0.0016 | 0.0004 | 33.3 |
| Kakwani Progressivity Index | 0.2138 | 0.2526 | 0.0388 | 18.1 |
| Reynold-Smolensky Index (RS) | 0.0568 | 0.0625 | 0.0057 | 10.0 |
| Tax-Benefit Concentration Index (C-tax) | 0.6774 | 0.7162 | 0.0388 | 5.7 |
| Concentration Index of the Post-Tax Income (C-post) | 0.4068 | 0.4011 | -0.0057 | -1.4 |
| Suits Progressivity index | 0.2707 | 0.3194 | 0.0487 | 18.0 |
| Musgrave-Thin Redistributive Effect | 1.1036 | 1.1135 | 0.0099 | 0.9 |
| Atkinson-Plotnick Horizontal Inequity | 0.0015 | 0.0020 | 0.0005 | 33.3 |

*Note: the total income does not include property incomes subject to the proportional tax "cedolare secca".*
*Source: own elaboration*

The redistributive implications of the bonus on Irpef (greater redistribution and progressivity, less incidence, a considerable re-ranking effect and a deterioration of horizontal equity) are in line with the ones in Morini and Pellegrino (2018), Baldini et al. (2015) and Pellegrino et al. (2019). However, there are some differences in the Gini index (the Gini index of global comprehensive income is 0.44338 for the authors instead of 0.4636, while for net income without the bonus on Irpef, it is 0.39138 instead of 0.4080, and for the net income with bonus on Irpef, it is 0.38727 instead of 0.4027). The differences could be imputed to the different fiscal year considered in the calculation (2014 fiscal year, instead of 2018 considered herein) and the different data set (the Bank of Italy SHIW data - Survey on Household Income and Wealth - are used by the authors).

The results presented herein are in line with Di Nicola et al. (2015), providing a Gini coefficient for the gross income of 0.46059. In addition, the Gini index results presented in Table 5 are in line with the ones in Acciari (2016) and Di Caro (2019), which use for their calculations the so-called "Irpef Tax File" provided by the Department of Finance. The "Irpef Tax File" contains information on a sample of about 80,000 Irpef taxpayers, equal to about 0.2% of the universe of taxpayers filling an Irpef tax return form, allowing a representation of the population of taxpayers. Whereas, in the exercise herein, the sample of taxpayers matching with SILC dataset is considered and it proves to be representative of the Italian population and of the Irpef taxpayers. In Acciari (2016), the Gini index for the gross income is around 0.4520 in 2014 fiscal year. In Di Caro (2019), the Gini index for the gross income is 0.4595, the Gini Index for net income without the bonus on Irpef is 0.4092, and for the net income with bonus on Irpef is 0.4059 for 2014 fiscal year.

*Income and Tax-Benefit Concentration Indices for Equivalent Households, computed by the model for 2018 fiscal year*

In this sub-section, the complete IT-SILC sample is considered, not only taxpayers, in order to make a picture of redistribution operated by PIT among Italian households. The redistributive effect of PIT (Irpef, local surtaxes and the bonus on Irpef) is assessed by comparing household equivalent income inequality before and after PIT. Inequality is measured by concentration indices such as the Gini coefficient. Household disposable income is an available variable in the IT-SILC dataset and contains all incomes and transfers to Italian households, minus direct taxes. Tax liabilities (net Irpef and local surtaxes), as calculated in the microsimulation model in the 2018 fiscal year, are added to household disposable income, in order to obtain gross household income. Actually, gross household income (present in the SILC dataset) contains also other elements, such as the social insurance contribution and taxes on wealth, but here we are interested in analysing the redistributive effect of PIT, by isolating net Irpef and local surtaxes.

Gross and disposable household incomes are made equivalent by the application of the modified-OECD-equivalence scale[8]. The SILC dataset contains two main variables for household disposable income, with and without imputed rents. Concentration indices are analysed first without

[8] The modified-OECD-equivalence scale provides that aggregated familiar variables be divided by a quotient that is the sum of individual coefficients. Individual coefficients are 1 for the first adult, 0.5 for every other adults and 0.3 for every component younger than 14.

imputed rents, then considering them in the household gross and disposable income, in order to discuss the redistributive effects of the presence of imputed rents in the household disposable income. As in the previous subsection, the analysis is presented with and without the bonus on Irpef, in order to point out the redistributive implications of the bonus on Irpef.

The bonus on Irpef turns out to benefit the middle class people that has a job, in particular employees, whereas poor households do not profit from the bonus on Irpef, which is an in-work kind of benefit (Baldini et al., 2015). Table 6 displays concentration indices for equivalent households, calculated by the model for the 2018 fiscal year, distinguishing between the redistributive effect of PIT before and after the 80-euro bonus. The Gini index of disposable equivalent income should decrease from 0.3357 to 0.3323, a small change that confirms the redistributive implication of the reform, favouring the middle class. As expected, PIT after the bonus on Irpef is more concentrated among families with medium-high income, significantly reducing the average incidence that decreases from 18.36% to 17.28% of disposable household income. The household tax concentration index increases from 0.6101 to 0.6452, as well as the Kakwani progressivity index, from 0.2263 to 0.2614. Even at the household level, the global redistribution index undergoes an increase, passing from 0.0482 to 0.0516.

*Table 6 - Income and Tax-Benefit Concentration Indices for Equivalent Households, without imputed rents, 2018 fiscal year*

| Indices | Without bonus on Irpef | With bonus on Irpef | Difference | % Difference |
|---|---|---|---|---|
| Gini Index of gross income (G-pre) | 0.3838 | 0.3838 | 0.0000 | 0.0 |
| Gini Index of disposable income (G-post) | 0.3357 | 0.3323 | -0.0034 | -1,0 |
| Average Tax Rate | 0.1836 | 0.1728 | -0.0108 | -5.9 |
| Global Redistribution Index (R) | 0.0482 | 0.0516 | 0.0034 | 7.1 |
| Re-ranking (RE) | 0.0027 | 0.0030 | 0.0003 | 11.1 |
| Kakwani Progressivity Index | 0.2263 | 0.2614 | 0.0351 | 15.5 |
| Reynold-Smolensky Index (RS) | 0.0509 | 0.0546 | 0.0037 | 7.3 |
| Tax-Benefit Concentration Index (C-tax) | 0.6101 | 0.6452 | 0.0351 | 5.8 |
| Concentration Index of the Post-Tax Income (C-post) | 0.3330 | 0.3293 | -0.0037 | -1.1 |
| Suits Progressivity index | 0.2659 | 0.3062 | 0.0403 | 15.2 |
| Musgrave-Thin Redistributive Effect | 1.0782 | 1.0837 | 0.0055 | 0.5 |
| Atkinson-Plotnick Horizontal Inequity | 0.0041 | 0.0045 | 0.0004 | 9.8 |

*Note: gross and disposable household income do not include social security contributions, property tax and imputed rents.*
*Source: own elaboration*

Again, the redistributive implications of the bonus on Irpef are in line with the ones in Morini and Pellegrino (2018), but there are some differences in the Gini index that could be imputed to the different fiscal year considered in the calculation (2014 fiscal year, instead of 2018 considered herein) and the different data set. However, the Gini index results of the microsimulation model are in line with the last available information by Istat (2019), according to which the Gini index of household disposable income without imputed rents is 0.334 for 2017 fiscal year.

Now, the same analysis is conducted with the inclusion of imputed rents in the gross and disposable household income. Imputed rents reflect the economic benefits of owner-occupied and social housing[9] and are one of the most significant components of household disposable income (Tormalheto and Sauli, 2013). In this section, the calculation of inequality and redistribution indices is provided including the imputed rents, in order to discuss the role of imputed rents on income inequality. In the Italian system, homeownership is favoured in term of taxes in several dimensions. The main residence is exempted from PIT (and property) tax base. Imputed rents considered in the PIT tax base (e.g. for dwellings other than the main residence) are quite far from current market values, in fact exempting a large share of the potential tax base (Pellegrino and Turati, 2011). Actually, tax bases are locked at cadastral values (i.e. imputed rents administratively defined) that are lower than market prices. In addition, there is an increasing number of tax credits and housing subsidies linked to ownership.

The presence of extensive housing subsidies characterizes the current Italian tax system as inefficient and conducive to excess investment in housing with respect to alternative assets (Pellegrino et al., 2012). Housing subsidies are justified by equity considerations. However, by including imputed rents from owner-occupied dwellings as a component of the PIT gross income, and proposing alternative scenarios that keep revenue constant, it is possible to reduce the overall inequality and, considering changes in tax liability for individual taxpayers, taxing imputed rents will favor the young and penalize the elderly (Pellegrino et al., 2012). The issues related to housing taxation are beyond the goal of this working paper. For a proof on housing taxation in Italy, see Pellegrino and Turati (2011) and Pellegrino et al. (2012). For a complete discussion on imputed rents, the computation methodology and the problems in data quality availability see Tormalheto and Sauli

[9] The definition of imputed rent in SILC database takes into account both the returns to home ownership, i.e. that the main residence is an asset, as well as the in-kind transfers accruing to those whose rent is below the prevailing market rent.

(2013). The issue analysed here is the redistributive implications of including imputed rents in household disposable income.

Table 7 shows the concentration and redistribution indices calculated for household equivalent incomes in the model, including imputed rents. The presence of imputed rents reduces relative inequality in the distribution of the household disposable income calculated by the model. The Gini index of gross household income decreases from 0.3838 without imputed rents to 0.3587 including imputed rents. Whereas, the Gini index of disposable household income decreases from 0.3357 and 0.3323 (respectively without or with the bonus on Irpef) to 0.3121 and 0.3090 considering imputed rents. Imputed rents increase average income levels (by 15.5% for disposable household income) and reduce relative inequality. The distributive effect is a result of the change in the average income, the change in the distribution of imputed rents among individuals and the correlation between imputed rents and cash disposable income (the shape of the initial distribution matters as well). A large share of imputed rents and a higher dispersion of imputed rents among households implies more inequality in disposable income. Both of these reflect the tenure structure including mortgage indebtedness (Tormalheto and Sauli, 2013).

*Table 7 - Income and Tax-Benefit Concentration Indices for Equivalent Households, including imputed rents, 2018 fiscal year*

| Indices | Without bonus on Irpef | With bonus on Irpef | Difference | % Difference |
|---|---|---|---|---|
| Gini Index of gross income (G-pre) | 0.3587 | 0.3587 | 0.0000 | 0.0 |
| Gini Index of disposable income (G-post) | 0.3121 | 0.3090 | -0.0031 | -1.0 |
| Average Tax Rate | 0.1637 | 0.1541 | -0.0096 | -5.9 |
| Global Redistribution Index (R) | 0.0466 | 0.0497 | 0.0031 | 6.7 |
| Re-ranking (RE) | 0.0024 | 0.0025 | 0.0001 | 4.2 |
| Kakwani Progressivity Index | 0.2503 | 0.2869 | 0.0366 | 14.6 |
| Reynold-Smolensky Index (RS) | 0.0490 | 0.0523 | 0.0033 | 6.7 |
| Tax-Benefit Concentration Index (C-tax) | 0.6090 | 0.6456 | 0.0366 | 6.0 |
| Concentration Index of the Post-Tax Income (C-post) | 0.3097 | 0.3065 | -0.0032 | -1.0 |
| Suits Progressivity index | 0.2906 | 0.3320 | 0.0414 | 14.2 |
| Musgrave-Thin Redistributive Effect | 1.0727 | 1.0776 | 0.0049 | 0.5 |
| Atkinson-Plotnick Horizontal Inequity | 0.0038 | 0.0041 | 0.0003 | 7.9 |

*Note: gross and disposable household income do not include social security contributions and property tax.*
*Source: own elaboration*

Italy has a high initial inequality if compared to other European countries and experience a significant decrease in inequality when considering the imputed rents in household income. The

concentration coefficient depends on the share of beneficiaries because it is measured over all households, and in Italy, there is a relative high homeownership rate. In addition, imputed rents re-rank households and consequently individuals in the income distribution. The re-ranking effect increases income inequality, while holding cash income ranks constant and adding imputed rents (gap effect) decreases income inequality (Tormalheto and Sauli, 2013). The results for Italy mean that the gap effect dominates the re-ranking effect.

*Income and Tax-Benefit Concentration Indices for Equivalent Households by Area, computed by the model for 2018 fiscal year*

The following Table 8 displays the concentration and redistribution indices calculated for household equivalent incomes in the model, by geographical area. The Gini index of both gross income and disposable income is greater in the South (0.3853 and 0.3379 respectively), indicating a higher concentration of incomes followed by the North-West, the Centre and the North-East, that has less inequality in the distribution of both gross incomes and disposable incomes (0.3276 and 0.2834 respectively). According to Kakwany, the redistributive effect of taxation can be decomposed into a size effect (the average tax rate) and a progressivity effect. The size effect is measured as the effective tax rate by computing total taxes paid by households in percentage of their income before taxes, and averaging across all households. Progressivity is defined as concentration coefficient of tax minus the Gini coefficient of pre-tax income. In the South there is a higher Kakwany progressivity index (0.3153), which means greater progressivity, but incidence (the average tax rate) is the lowest (0.1364), because less taxes are payed (probably because of a higher tax evasion). This fact dampens the redistributive effect of taxation, and the global redistributive effect turns out to be smaller in the South (0.0474) than in the North-West (0.0562) and in the Centre (0.0534).

Interestingly, in the North-East, global redistributive effect proves to be the lowest (0.0442), but households disposable income is the most equally distributed among the different areas, because households gross income is more equally distributed as well, and their Gini indices are the lowest accordingly. The reason for this could be that the better household gross income distribution is in turn determined by a better market income distribution in the Northeast. The results are in line with the information provided by Istat (2019), which provides a Gini index for the household disposable income of 0.346 in the South and Islands, 0.326 in the Centre, 0.312 in the Northwest

and 0.289 in the Northeast for 2017 fiscal year. The following Table 9 displays the concentration and redistribution indices calculated for household equivalent incomes in the model, by geographical area, including imputed rents.

*Table 8 - Income and Tax-Benefit Concentration Indices for Equivalent Households by Area, without imputed rents, 2018 fiscal year*

| Indices | North-West | North-East | Centre | South and Islands |
|---|---|---|---|---|
| Gini Index of gross income (G-pre) | 0.3790 | 0.3276 | 0.3744 | 0.3853 |
| Gini Index of disposable income (G-post) | 0.3227 | 0.2834 | 0.3210 | 0.3379 |
| Average Tax Rate | 0.1950 | 0.1748 | 0.1796 | 0.1364 |
| Global Redistribution Index (R) | 0.0562 | 0.0442 | 0.0534 | 0.0474 |
| Re-ranking (RE) | 0.0033 | 0.0036 | 0.0035 | 0.0024 |
| Kakwani Progressivity Index | 0.2458 | 0.2259 | 0.2599 | 0.3153 |
| Reynold-Smolensky Index (RS) | 0.0595 | 0.0478 | 0.0569 | 0.0498 |
| Tax-Benefit Concentration Index (C-tax) | 0.6248 | 0.5535 | 0.6343 | 0.7006 |
| Concentration Index of the Post-Tax Income (C-post) | 0.3194 | 0.2798 | 0.3175 | 0.3355 |
| Suits Progressivity index | 0.2879 | 0.2540 | 0.2973 | 0.3701 |
| Musgrave-Thin Redistributive Effect | 1.0906 | 1.0657 | 1.0853 | 1.0771 |
| Atkinson-Plotnick Horizontal Inequity | 0.0051 | 0.0064 | 0.0055 | 0.0036 |

*Note: gross and disposable household income do not include social security contributions, imputed rents and property tax.*
*Source: own elaboration*

*Table 9 - Income and Tax-Benefit Concentration Indices for Equivalent Households by Area, including imputed rents, 2018 fiscal year*

| Indices | North-West | North-East | Centre | South and Islands |
|---|---|---|---|---|
| Gini Index of gross income (G-pre) | 0.3545 | 0.3037 | 0.3460 | 0.3567 |
| Gini Index of disposable income (G-post) | 0.2996 | 0.2606 | 0.2941 | 0.3114 |
| Average Tax Rate | 0.1754 | 0.1558 | 0.1592 | 0.1210 |
| Global Redistribution Index (R) | 0.0549 | 0.0432 | 0.0519 | 0.0453 |
| Re-ranking (RE) | 0.0028 | 0.0030 | 0.0030 | 0.0021 |
| Kakwani Progressivity Index | 0.2709 | 0.2497 | 0.2900 | 0.3441 |
| Reynold-Smolensky Index (RS) | 0.0576 | 0.0461 | 0.0549 | 0.0474 |
| Tax-Benefit Concentration Index (C-tax) | 0.6254 | 0.5534 | 0.6360 | 0.7008 |
| Concentration Index of the Post-Tax Income (C-post) | 0.2968 | 0.2576 | 0.2911 | 0.3093 |
| Suits Progressivity index | 0.3131 | 0.2778 | 0.3265 | 0.3977 |
| Musgrave-Thin Redistributive Effect | 1.0850 | 1.0620 | 1.0794 | 1.0704 |
| Atkinson-Plotnick Horizontal Inequity | 0.0046 | 0.0057 | 0.0051 | 0.0033 |

*Note: gross and disposable household income do not include social security contributions and property tax.*
*Source: own elaboration*

Concluding, the analysis of the results provided in this section reveals that PIT system has an important redistributive function. PIT proves to be the most redistributive tax in Italy. The gradual erosion of Irpef tax base causes a deterioration of progressivity of the tax system and of the redistributive capacity of the Italian PIT. When Irpef was implemented in the '70s, the referring model was the Comprehensive Income Tax (Cit), characterized by the inclusion of all taxpayer's incomes in the tax base. Nevertheless, over the years, the tax base has been eroded by excluding different kind of incomes from the global comprehensive personal income, in order to subject them to a substitutive proportional tax rate. Erosion of the tax base (but also Irpef evasion) makes Irpef different from the initial theoretical model of Cit and makes the goal of vertical equity difficult to achieve, because of the deterioration of progressivity of the tax system (Bosi et al., 2018).

In particular, the exclusion of financial and property income from Irpef tax base undermines the redistributive role of the Italian PIT. From the '70s, incomes from financial activity were excluded from Irpef's tax base and subject to substitutive and proportional tax rate. From 2011, taxpayers can apply the substitutive proportional tax "*cedolare secca"* with two tax rates (21% and 10%) to income deriving from rented properties for residential use. In addition, a deduction on the main residence applies. More recently, a flat tax of 15% has been introduced for self-employed with a revenue less than 65 thousand euros. Excluding incomes from Irpef tax base further distances the Italian PIT from the notion of Cit causing a reduction in Italian PIT redistributive power. According to Bosi et al. (2018), the trade-off between equity and other goals should be evaluated with great attention when proposing reforms to the taxation system that disempower the current PIT system. In all developed countries, the PIT is the most important tax with respect to the total tax revenue as well as to its influence on the economic efficiency and equity (Pellegrino et al., 2019). There is the need of developing a rational and balanced design for the PIT, which explicitly addresses the theme of the most appropriate mix of taxes, also assessing its redistributive impact.

## 4. Indicators of Inequality in Household Disposable Income

In this section, inequality issues are analysed further through the computation of decile and quintile distribution of household gross and disposable income, by using the tax-benefit microsimulation model. The analysis includes a focus on the Quintile Share Ratio (QSR or S80/S20), an indicator calculated and updated every year in the Italian Public Budget in the group of the

Equitable and Sustainable Well-Being Indicators (ESWB, the so-called *BES Indicators*). In order to provide the decile and quintile distribution of the household disposable income, variables from the SILC dataset are used (FYTOT and FYTOT_IMP, without and with imputed rents respectively), which are updated to 2018 using results from the tax-benefit microsimulation model. In particular, incomes and tax liabilities are updated according to the results of the microsimulation model for 2018 fiscal year.

Table 10 provides important insight on the redistributive effects of PIT on households, by showing the distribution of household gross and disposable income by deciles of household equivalent disposable income. As before, household income is equalized by using the modified OECD scale. The first decile includes the 10% of households with lowest disposable income, while the tenth decile comprise the 10% of households with the highest disposable incomes. Households are ordered from the lowest household disposable income to the highest. In a hypothetical situation of equity, every decile of the households should have 10% of total household disposable income. The household disposable income distribution over deciles is a synthetic measure of inequality.

*Table 10 - Percentage Distribution of Household Gross and Disposable Income by Deciles of Household Equivalent Disposable Income, without imputed rents*

| Deciles of Equivalent Disposable Income | % Household Gross Income | % Household Disposable Income | Difference | Incidence* |
|---|---|---|---|---|
| 1 | 1.6 | 1.9 | 0.3 | 1.6 |
| 2 | 3.9 | 4.6 | 0.7 | 2.8 |
| 3 | 5.2 | 5.9 | 0.7 | 5.7 |
| 4 | 6.4 | 7.0 | 0.6 | 9.5 |
| 5 | 7.8 | 8.3 | 0.5 | 11.5 |
| 6 | 9.2 | 9.6 | 0.4 | 13.3 |
| 7 | 10.6 | 10.9 | 0.3 | 14.8 |
| 8 | 12.5 | 12.6 | 0.0 | 16.7 |
| 9 | 15.5 | 15.1 | -0.4 | 18.8 |
| 10 | 27.3 | 24.3 | -2.9 | 25.7 |

**Incidence of the Tax Liability (Irpef, Local Surtaxes) and Bonus on Irpef to the Gross Income.*
*Note: gross and disposable household income do not include social security contributions, imputed rents and property tax.*
*Source: own elaboration*

Gross income of the poorest families, which are in the first decile, is 1.6% of total gross income, whereas gross income of the richest, the tenth decile, is 27.3%. If disposable income is considered, the share owned by the poorest families increases to 1.9%, and the share of the richest

decreases to 24.3%, because of the redistributive effect of PIT. In particular, the tax liability (Irpef and local surtaxes) and the bonus on Irpef are considered in the calculation. The difference between the two percentages increases up to the second (and third) decile and decreases from the third decile on, meaning that taxation is progressive from the third decile on, while it is regressive for the first two deciles. The difference between the percentages of household gross and disposable income by deciles should be always decreasing to have progressive taxation for every level of income. Incidence increases as household disposable income increases, ranging from 1.6 for the first decile to 25.7 for the tenth decile.

*Table 11 - Percentage Distribution of Household Gross and Disposable Income by Deciles of Household Equivalent Disposable Income, including imputed rents*

| Deciles of Equivalent Disposable Income | % Household Gross Income | % Household Disposable Income | Difference | Incidence* |
|---|---|---|---|---|
| 1 | 2.1 | 2.4 | 0.3 | 0.8 |
| 2 | 4.2 | 4.8 | 0.6 | 2.2 |
| 3 | 5.5 | 6.1 | 0.6 | 5.1 |
| 4 | 6.7 | 7.3 | 0.6 | 7.6 |
| 5 | 8.0 | 8.5 | 0.4 | 10.3 |
| 6 | 9.2 | 9.6 | 0.4 | 11.3 |
| 7 | 10.8 | 11.0 | 0.2 | 13.3 |
| 8 | 12.4 | 12.4 | 0.0 | 14.9 |
| 9 | 15.2 | 14.8 | -0.4 | 17.3 |
| 10 | 25.8 | 23.0 | -2.8 | 24.1 |

**Incidence of the Tax Liability (Irpef, Local Surtaxes) and Bonus on Irpef to the Gross Income.*
*Note: gross and disposable household income do not include social security contributions and property tax.*
*Source: own elaboration*

The Table 11 shows the distribution of household gross and disposable income by deciles of household equivalent disposable income, considering the imputed rents in the gross and disposable household income. As expected, the distribution of both gross and disposable household income are more equalized among deciles if considering the imputed rents. Household gross income varies from 2.1% of the total household gross income in the first decile to 25.8% in the tenth decile. Household disposable income varies from 2.4% in the first decile to 23.0% in the last decile.

The following of the section analyses the distribution of household gross and disposable income by quintiles of household equivalent disposable income, with and without the imputed rents

in gross and disposable household income. The first quintile includes 20% of households with lowest disposable income, while the last quintile comprises 20% of households with the highest disposable incomes. Households are ordered from the lowest household disposable income to the highest. In a hypothetical situation of equity, every quintile of household should have 20% of total household disposable income. Household disposable income distribution over quintile is a synthetic measure of inequality. The Quintile Share Ratio (QSR or S80/S20) is the ratio of households' disposable income in the fifth quintile over the households' disposable income in the first quintile.

Interestingly, the Quintile Share Ratio is one of the indicators involved in the Equitable and Sustainable Well-Being Project (ESWB Project, the so-called *BES Project*). The project involves the Ministry of Economy and Finance, the Italian Institute of Statistics (Istat) and other institutions. It is aimed at studying the level of welfare of the Italian population from the point of view of different aspects (health, education, environment, subjective wellbeing, economic wellbeing and so on), taking into account the distribution of resources (equity) and the possibility to guarantee a proper level of welfare for future generations (sustainability). In order to measure welfare in several respects, the ESWB (*BES*) Project involves the computation of many indicators on different topics, and inequality is one of them. Four of these indicators have also been included in the Italian Economic and Financial Document (and in the Public Budget) and they are monitored over years. The Quintile Share Ratio is one of the ESWB (*BES*) Indicators and it measures income inequality in the Italian population.

The following Table 12 shows the QSR values obtained by the tax-benefit microsimulation for 2015 and 2018 fiscal years. With reference to the distribution of household equivalent disposable incomes[10] in 2015, without the component of imputed rents, the QSR indicates that the poorest 20% of the population owns only 6.3% of total household disposable income while the richest quintile has 39.5%. This means that the total disposable income of the wealthiest households is equal to 6.3 times the total disposable income of households belonging to the first quintile. The inclusion of imputed rents narrows the gap between rich and poor, bringing richer households to possess a disposable income that is 5.3 times that of members of the first quintile. The growth of household disposable income in 2018 is associated with a reduction of inequality: the ratio of the income share of the richest and that of the poorest decreases from 6.3 to 6.1, without considering the imputed

[10] As above, household disposable income is made equivalent by the application of the modified-OECD-equivalence scale.

rents, and from 5.3 to 5.2 including imputed rents in household disposable income. Results are in line with values presented by Istat (*Rapporto BES* and *Condizioni di vita delle famiglie,* 2017 and 2019). In the years between 2012 and 2017, the QRS ratio varies from 5.8 and 6.3 and is higher than the European countries average that varies from 5 to 5.2.

*Table 12 – % Distribution of Equivalent Disposable Income by Quintile and the ESWB (BES) Indicator*

| | % Distribution of Equivalent Disposable Income | | | |
|---|---|---|---|---|
| | 2015 | | 2018 | |
| Quintile | without Imputed Rents | Imputed Rents included | without Imputed Rents | Imputed Rents included |
| 1 | 6.3 | 7.1 | 6.4 | 7.3 |
| 2 | 12.8 | 13.3 | 12.9 | 13.4 |
| 3 | 17.9 | 18.2 | 17.8 | 18.1 |
| 4 | 23.5 | 23.5 | 23.4 | 23.4 |
| 5 | 39.5 | 37.8 | 39.4 | 37.8 |
| Total | 100 | 100 | 100 | 100 |
| | | | | |
| Quintile Share Ratio S80/S20 | 6.3 | 5.3 | 6.1 | 5.2 |

*Note: household disposable income does not include social security contributions and property tax.*
*Source: own elaboration*

*Table 13 - % Distribution of Equivalent Disposable Income by Quintile and the ESWB (BES) Indicator by Geographical Area, 2018 fiscal year*

| | North-West | | North-East | | Centre | | South and Islands | |
|---|---|---|---|---|---|---|---|---|
| Quintile | I | II | I | II | I | II | I | II |
| 1 | 7.4 | 8.0 | 8.3 | 9.1 | 7.0 | 7.9 | 5.5 | 6.8 |
| 2 | 13.4 | 14.1 | 14.2 | 14.7 | 13.2 | 13.9 | 12.9 | 13.3 |
| 3 | 17.9 | 18.1 | 18.3 | 18.5 | 17.8 | 18.1 | 17.4 | 17.7 |
| 4 | 22.9 | 22.8 | 22.7 | 22.6 | 23.0 | 22.8 | 23.8 | 23.6 |
| 5 | 38.4 | 36.9 | 36.6 | 35.0 | 39.0 | 37.2 | 40.4 | 38.6 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | | | | | | | | |
| Quintile Share Ratio S80/S20 | 5.2 | 4.6 | 4.4 | 3.8 | 5.6 | 4.7 | 7.3 | 5.7 |

*Specifications I do not include the imputed rents. Specifications II include the imputed rents.*
*Source: author's own elaboration*

The ESWB (*BES*) indicator by geographical area shows that in the South of Italy there is a higher inequality in the distribution of resources (Table 13). In the South, the disposable income of the richest households is 5.7 times the disposable income of the poorest households, if imputed

rents are included in the household income. In the Centre, the ratio is 4.7, followed by the North-West, where the ESWB (*BES*) indicator is 4.6, and the North-East, where there is less inequality in the distribution and the quintile share ratio is 3.8. The values obtained by area are in line with the values presented in the ESWB Report (*BES Report*) (Istat, 2019). Without considering imputed rents, inequality increases in all the different areas.

## 5. Conclusions

The implemented microsimulation tax-benefit model provides a powerful instrument to support the public policy evaluation of the Italian PIT system. The model is based on a dataset that merge SILC data *(Statistics on Income and Living Conditions*) and administrative tax return data. The database is particularly informative and the simulation of the 2018 PIT system reproduces the actual PIT revenue accurately. The model is able to simulate tax revenue and redistributive effects of PIT reforms. Redistributive analysis in the paper shows that tax policy plays an important role in addressing income inequality and that the PIT system performs a significant redistributive function. Furthermore, efforts are required to reduce inequality in income after taxes and transfers, such as ensuring progressivity in the tax system and targeting transfers to low-income household.

The possible further developments for the model encompass the fact that the database is revised when new SILC and administrative data become available, so that due account is taken of income and socio-demographic changes of the Italian population, and the fiscal legislation is updated every year. Furthermore, the model will be enriched by financial incomes, which are going to be available for the Department of Finance for study and research purpose. Importantly, a new module has been put in the tax-benefit microsimulation model, in order to model changes in taxpayers' behavior in response to personal income tax reforms (efficiency analysis). In particular, it is interesting to analyze household labor supply in response to policy changes, introducing a behavioral response function in the model.

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## Appendix A

*Table A.1 – Results of the model for immovable property income for 2015 fiscal year without calibration*

| Immovable Property Taxable Income | Sample data in the tax return dataset | The Model 2015 without weights | % Error |
|---|---|---|---|
| **Buildings that do not change their use or percentage of possession in the fiscal year** | | | |
| Ordinary Taxable Income (to Irpef) | 10,791,706 | 10,792,781 | 0.01% |
| Taxable income to "*cedolare secca*" 21% | 3,169,687 | 3,169,689 | 0.00% |
| Taxable income to "*cedolare secca*" 10% | 1,192,627 | 1,192,627 | 0.00% |
| Main dwelling (subject to IMU) | 281,552 | 281,552 | 0.00% |
| Main dwelling (not subject to IMU) | 7,183,680 | 7,183,643 | 0.00% |
| **Buildings that do change their use or percentage of possession in the fiscal year** | | | |
| Ordinary Taxable Income (Irpef) | 5,492,113 | 5,492,458 | 0.01% |
| Taxable income to "*cedolare secca*" 21% | 3,197,738 | 3,193,150 | -0.14% |
| Taxable income to "*cedolare secca*" 10% | 1,195,798 | 1,195,798 | 0.00% |
| Main dwelling (subject to IMU) | 46,142 | 46,140 | 0.00% |
| Main dwelling (not subject to IMU) | 568,399 | 568,394 | 0.00% |
| **Total Immovable Property Income** | | | |
| Ordinary Taxable Income (Irpef) | 16,283,819 | 16,285,239 | 0.01% |
| Taxable income to "*cedolare secca*" 21% | 6,367,425 | 6,362,839 | -0.07% |
| Taxable income to "*cedolare secca*" 10% | 2,388,425 | 2,388,425 | 0.00% |
| Main dwelling (subject to IMU) | 327,694 | 327,692 | 0.00% |
| Main dwelling (not subject to IMU) | 7,752,079 | 7,752,037 | 0.00% |

*The table refers to the sample of 32,444 taxpayers in the tax return dataset without weights or calibration.*
*Note: IMU is the municipal property tax.*
*Data in euro.*
*Source: own elaboration*

*Table A.2 – Different type of use (“utilizzo”) of the immovable property in the tax return form (2015 and 2018)*

| Code | Buildings |
|---|---|
| 1 | Main residence |
| 2 | Immovable property kept available |
| 3 | Property leased in the free market |
| 4 | Property leased at a fair rent regime ("*regime di equo canone*") |
| 5 | Appurtenances of the main residence |
| 6 | Property used partly as a main residence and partly for own business |
| 8 | Property located in a municipality with high residential intensity or in a municipality in a state of emergency applying the proportional tax ("*cedolare secca*") option and leased at a subsidised rent ("*canone concordato*") |
| 9 | Cases different from other codes |
| 10 | House or property rented to a family member for free |
| 11 | Property used partly as a main residence and partly leased in the free market |
| 12 | Property used partly as a main residence and partly leased at subsidised rent ("*canone concordato*"), applying the proportional tax ("*cedolare secca*") option for the property located in a municipality with high residential intensity or in a municipality in a state of emergency |
| 14 | Property located in Abruzzo Region and leased to persons affected by the earthquake in 2009 |
| 15 | Property located in Abruzzo Region and granted on loan (“*comodato*”) to persons affected by the earthquake in 2009 |

*Source: own elaboration on tax return form instructions*

*Table 3.A – Fiscal rules for the calculation of the immovable property income and the different taxable income for 2015 and 2018 fiscal year*

Definitions:

Cadastral rent quote = cadastral rent revaluated by 5% (multiplied by the day and the percentage of possession of the building)

Rent quote = rent multiplied by the percentage of possession of the building

| **Buildings** | | **Property Income** | **Ordinary Taxable Income (to Irpef)** | **Taxable income to "*cedolare secca*" 21%** | **Taxable income to "*cedolare secca*" 10%** |
|---|---|---|---|---|---|
| Main residence and its appliances | | Cadastral rent quote | No | - | - |
| Property used partly as a main residence and partly for own business | | Cadastral rent quote | 50% cadastral rent quote | - | - |
| | | | No, for luxury buildings | - | - |
| Property kept available | | Cadastral rent quote*4/3 | Cadastral rent quote*4/3 if the building is not a main residence nor an appurtenance of the main residence and is not taxed by IMU | - | - |
| | | | 50% cadastral rent quote*4/3 if the building is a house, taxed by IMU and located in the same municipality of the main residence | - | - |
| Leased property | in the free market | the greater between cadastral rent quote and rent quote | the greater between cadastral rent quote and rent quote | the greater between cadastral rent quote and rent quote | - |
| | At a fair rent regime ("*regime di equo canone*") | rent quote, if the tenant does not opt for the proportional tax "*cedolare secca*" | rent quote | - | - |
| | | the greater between cadastral rent quote and rent quote, if the tenant opts for the proportional tax "*cedolare secca*" | - | the greater between the cadastral rent quote and rent quote | - |

| | | | | | |
|---|---|---|---|---|---|
| | | Cadastral rent quote, if the rents are not received | Cadastral rent quote | Cadastral rent quote | - |
| | At subsidised rent ("*canone concordato*") in a municipality with high residential intensity | the greater between cadastral rent quote and rent quote | the greater between cadastral rent quote and rent quote | - | the greater between cadastral rent quote and rent quote |
| | At subsidised rent ("*canone concordato*") in a municipality with high residential intensity and in state of emergency | the greater between cadastral rent quote and rent quote | - | - | the greater between cadastral rent quote and rent quote |
| | Located in Abruzzo Region and leased to persons affected by the earthquake in 2009 | the greater between cadastral rent quote and rent quote | (the greater between cadastral rent quote and rent quote)*(1-30%) | the greater between cadastral rent quote and rent quote | - |
| Property located in Abruzzo Region and granted on loan ("*comodato*") to persons affected by the earthquake in 2009 | | Cadastral rent quote | Cadastral rent quote, if the building is not a main residence nor an appurtenance of the main residence and is not taxed by IMU | | - |
| | | | 50% cadastral rent quote if the building is a house taxed by IMU and located in the same municipality of the main residence | | - |
| | | | No, if cadastral rent quote > rent quote | | - |

| | | | | |
|---|---|---|---|---|
| Property partly used as a main residence and partly leased in the free market | the greater between cadastral rent quote and rent quote | the greater between cadastral rent quote and rent quote, if cadastral rent quote < rent quote | the greater between cadastral rent quote and rent quote, if cadastral rent quote < rent quote | |
| Property partly used as main residence and partly leased at subsidised rent ("*canone concordato*") and located in a municipality with high residential intensity | the greater between cadastral rent quote and rent quote | No, if cadastral rent quote > rent quote | | |
| | | (the greater between cadastral rent quote and rent quote)*(1-30%), if cadastral rent quote < rent quote | | the greater between cadastral rent quote and rent quote, if cadastral rent quote < rent quote |
| Property not leased and not kept available | Cadastral rent quote | cadastral rent quote, if the building is not a house or an appurtenance of the house and is not taxed by IMU | | |
| | | 50% cadastral rent if the building is a house, taxed by IMU and located in the same municipality of the main residence | | |

*Source: own elaboration on tax return form instructions*

## Appendix B - Frequency density function

*Figure B1 – Distribution of taxpayers by taxable income classes*

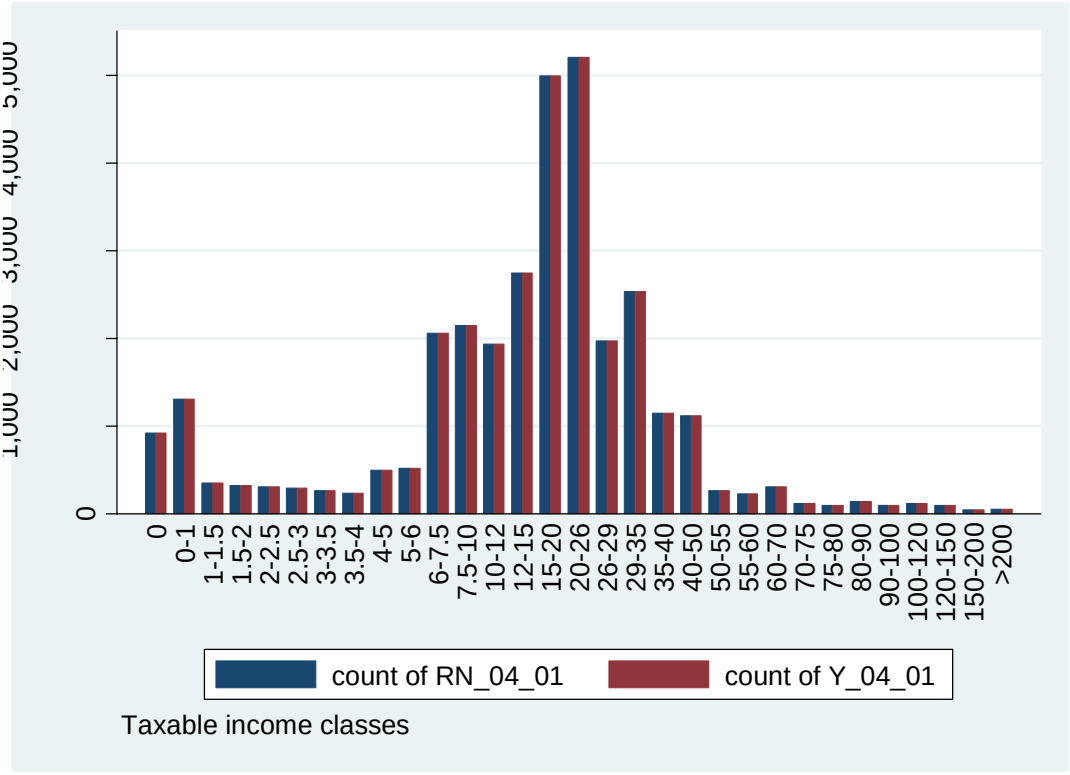


*Figure B2 – Average taxable income by taxable income classes*

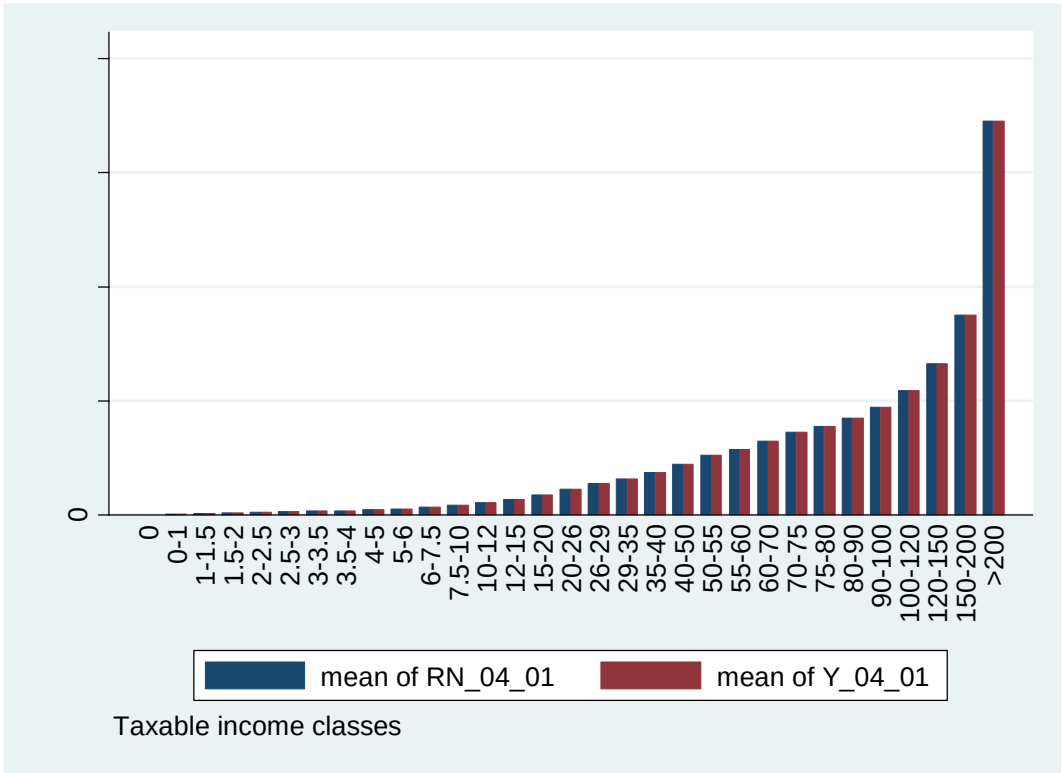

*Figure B3 – Distribution of taxpayers' gross tax liability by taxable income classes*

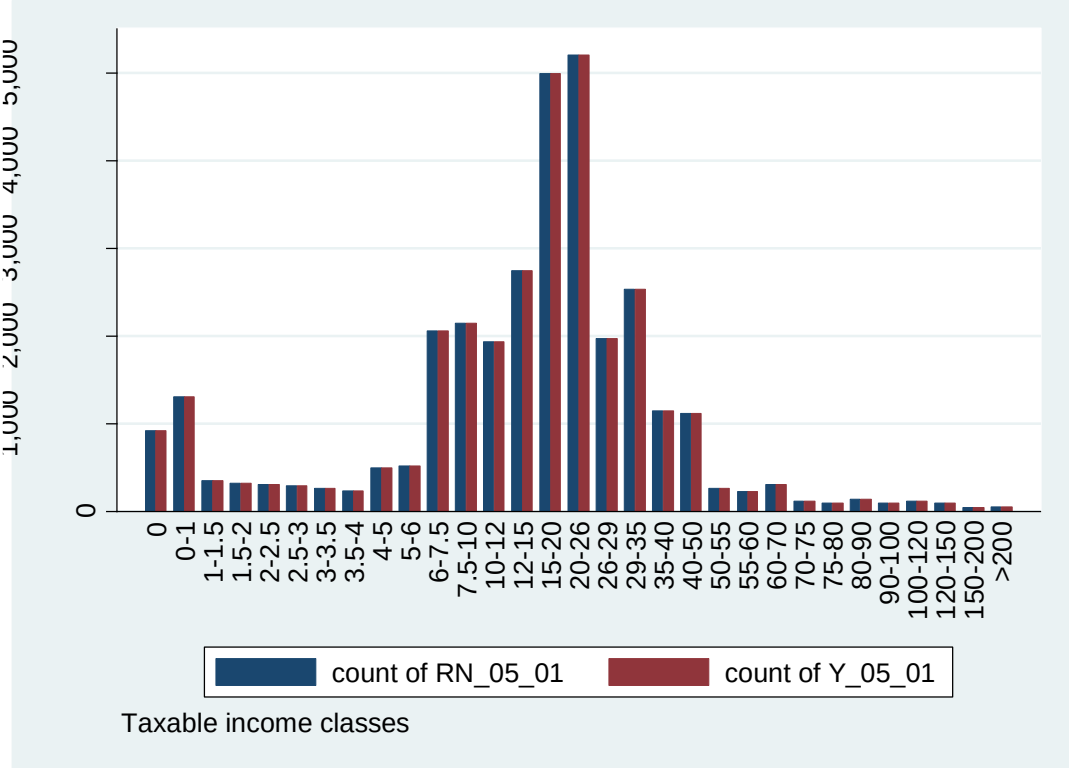


*Figure B4 – Average gross tax liability by taxable income classes*

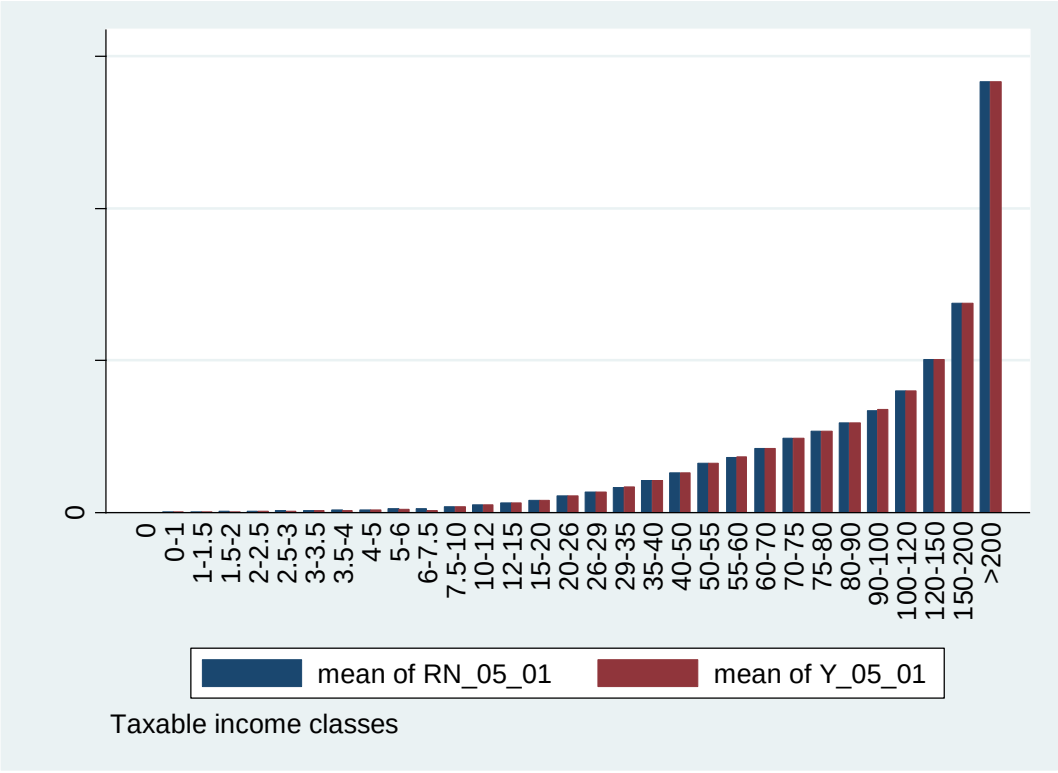

*Figure B5 – Distribution of taxpayers' net tax liability by taxable income classes*

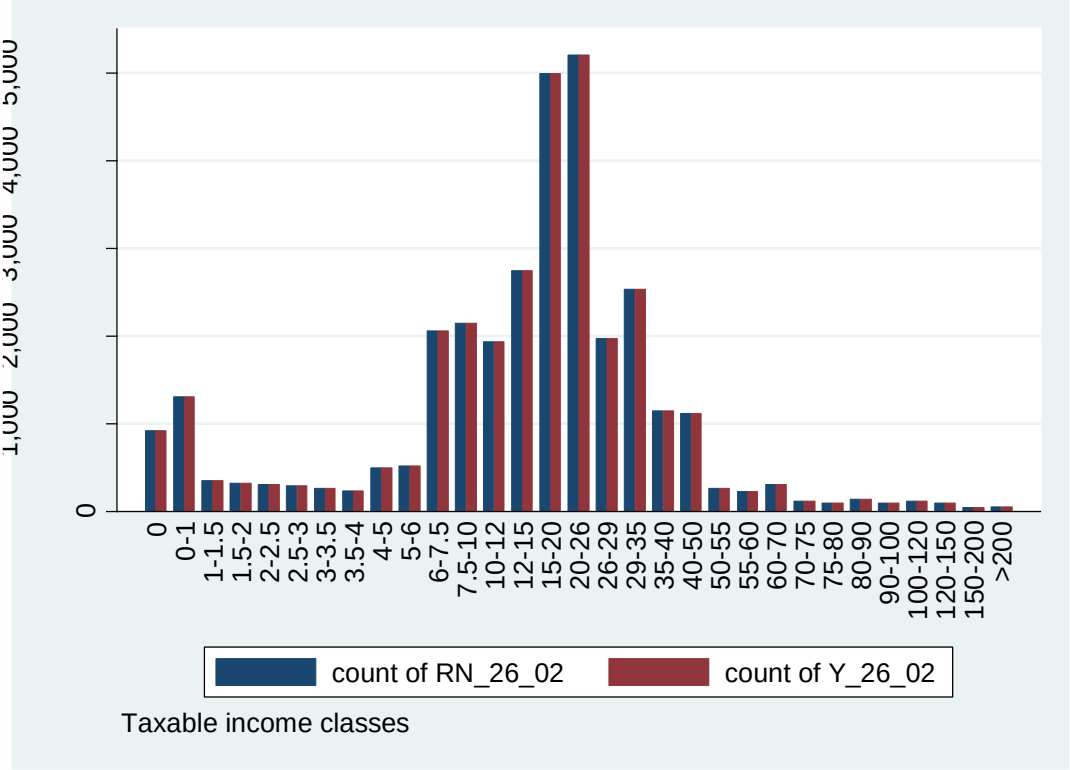


*Figure B6 – Average net tax liability by taxable income classes*