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(Occasional Papers)

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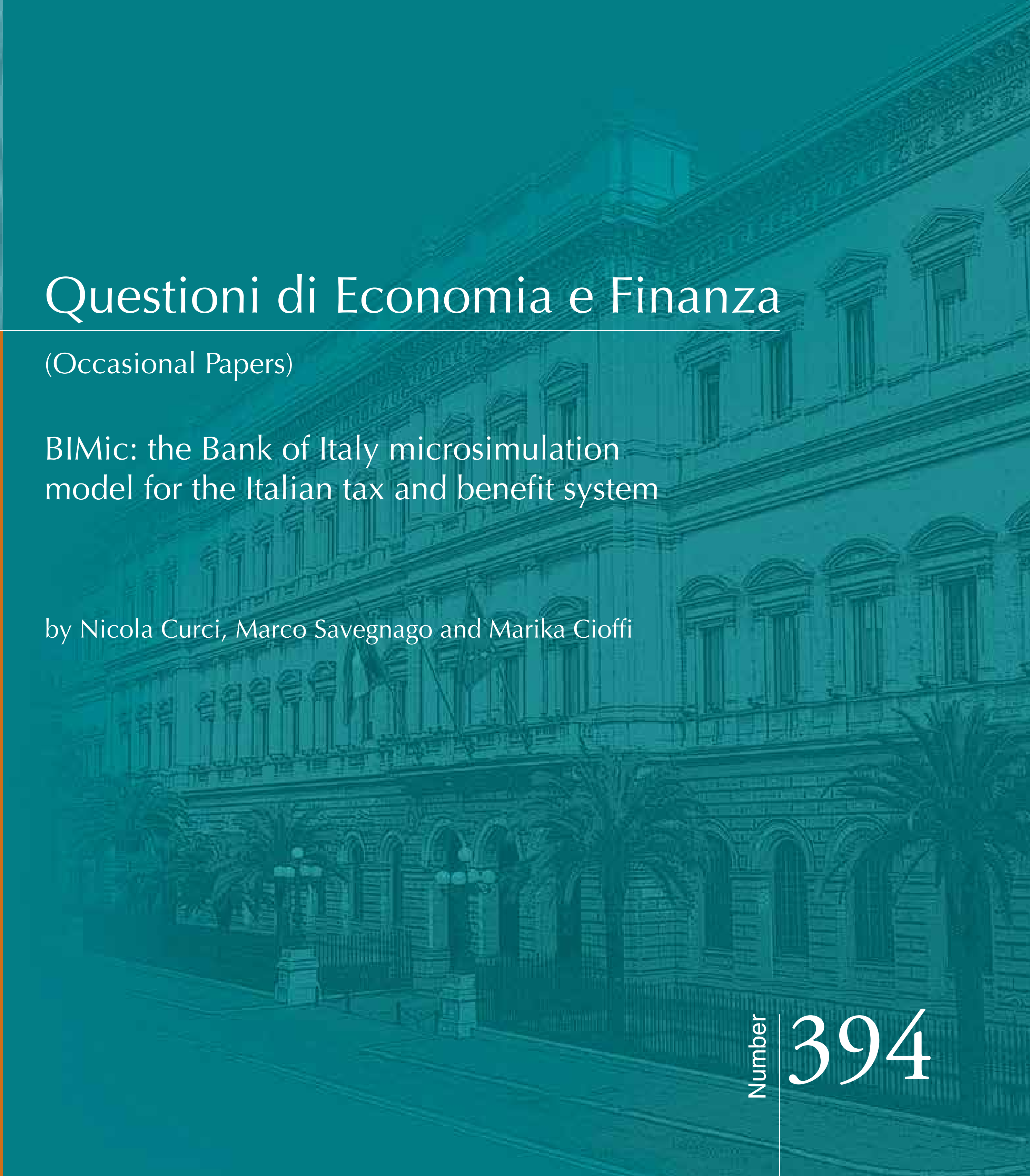

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BIMic: THE BANK OF ITALY MICROSIMULATION MODEL FOR THE ITALIAN TAX AND BENEFIT SYSTEM

by Nicola Curci*, Marco Savegnago* and Marika Cioffi*

Abstract

The paper presents BIMic, a static and non-behavioural microsimulation model developed at the Bank of Italy. BIMic reproduces the main features of the Italian tax and benefit system, such as social security contributions, personal income tax, property taxes, family allowances and some other social benefits. It aims to evaluate the budgetary impact and distributive effects of tax-benefit programmes. Such programmes may be actually operating at a given point in time or may be a counterfactual set. To illustrate a potential use of BIMic, this paper discusses the distributive impact of a recently approved legislative innovation regarding the additional transfer to pensioners (known as the *quattordicesima ai pensionati*).

JEL Classification: H22, H23, H31, C15, C63.
Keywords: fiscal policy, tax-benefit, microsimulation model, redistribution, progressivity.

Contents

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* Banca d'Italia, Structural Economic Analysis Directorate, Public Finance division.

1 Introduction

Microsimulation models (henceforth, MSM) are useful tools to evaluate tax and expenditure programs in terms of their impacts on both the general Government budget and income distribution.

A taxonomy of MSM may be proposed according to at least two dimensions. Depending on the time horizon of the analysis, MSM can be static or dynamic. *Static* models normally focus on a period that is relatively close to the date when relevant data are collected, featuring – where necessary – some sort of reweighting schemes;[1] therefore they are useful for the analysis of the day-after effects induced by policy changes. *Dynamic* models relax the hypothesis of constant individual characteristics: typically they include several demographic and labour market modules[2] that allow people ageing, changing marital status, entering into (or exiting from) labour force, and so on. Then dynamic MSM evaluate the effects of reforms over the medium-long run, a feature that allows analysing, for example, the relationship between the demographic structure of a society and the saving rate (as in Ando and Altimari, 2004) or the inter-temporal distributive effects of social security systems (as in Mazzaferro and Morciano, 2008).

The second relevant dimension over which MMS may be classified is the choice between non-behavioural versus behavioural models. *Non-behavioural* models assume that individuals do not change their choices after a policy change, for example in terms of labour supply (both on intensive and extensive margins). On the contrary, *behavioural* MSM use microeconometric models of individual preferences to analyse the consequences induced by policy changes to individuals' behaviour.

While this taxonomy has a long tradition in MSM literature, modern models often combine elements of each type, depending on the research question to be addressed. Normally, a static non-behavioural model is the obvious starting point

[1]For example, within static MSM it is generally possible to analyse the distributive effect of the tax-benefit system for year $t + s$, starting from data collected in t and applying a different inflationary constant to different sources of income in order to account for changes in nominal incomes. As such, individuals characteristics such as age, marital and occupational statuses are kept constant.

[2]For example, individual survival probabilities, based on gender and age, may be introduced. As well, conditioning on surviving, probabilities of getting married, divorcing, having children and so on may be included. Those probabilities are typically estimated from surveys data.

for any MSM project. For example, labour supply models require the calculation of budget sets for individuals (namely, household disposable incomes under alternative labour supply decisions of the components) and need an underlying static tax-benefit model to serve the scope.

This paper presents BIMic, the Banca d'Italia static and non-behavioural microsimulation model for the analysis of tax-benefit programs. It continues a long tradition of tax-benefit models, both world-wide and in Italy[3]. BIMic needs to be continuously updated to reflect policy changes and modifications in the sample data, based on the Banca d'Italia Survey of Household Income and Wealth (SHIW).[4]

BIMic can be used to analyse a variety of characteristics of the Italian tax-benefit system, both the one *actually* operating at a given point in time and a *simulated* system, where the latter differs from the former by one or more features. Many examples of possible uses of BIMic can be provided. An assessment of the redistributive properties of any tax-benefit system can be carried out comparing the (reported) net incomes and the (computed) gross incomes, also by means of progressivity, poverty and inequality indices (Lambert, 2001). Another typical use of BIMic is computing marginal effective tax rates (METR) in order to assess the financial incentives to work. They capture the individual's convenience to increase labour supply, through longer working hours and higher gross wages, in terms of the share of additional income that remains after taxes. All these exercises can also be performed on a simulated tax-benefit system resulting from a policy change: this approach not only would shed light on the impact of the new regime on the public finance, but also would identify the winners and losers implied by the change.

The paper is structured as follows. Section 2 introduces the general structure of BIMic, its modular architecture and the algorithm used to estimate the gross incomes. Section 3 describes the data sources exploited and how they have been

[3]The literature on MSM is rich and is expanding, also due to the increase of data availability (Figari et al., 2015). An European-wide MSM, EUROMOD, has been developed at Essex University (Sutherland and Figari, 2013). Most countries feature one o more MSM, developed by researchers in both universities and institutions. For Italy, it is worth mentioning MAPP (Baldini et al., 2011), TABEITA (Ceriani et al., 2013), BETAMOD (Albarea et al., 2015) and the one managed at Prometeia (Baldini et al., 2015).

[4]In the future, BIMic could serve as a basis to model behavioural reactions to policy changes in some *ad-hoc* analyses.

integrated with external relevant information. Section 4 discusses more in depth the most relevant modules featured in BIMic, namely social security contributions (Section 4.1), personal income tax (4.2), taxes on income from financial assets and on dwellings (4.3), means-tested benefits (4.4). Section 5 performs a validation analysis to show that the relevant fiscal aggregates featured in BIMic (including total taxable income, tax credits, personal income tax, amount of family allowances) closely match official data. Finally, section 6 shows an example about how BIMic can be used to conduct analysis on an actual policy change. We discuss the distributive impact of a recently approved legislative innovation to additional transfer to pensioners (known as the *quattordicesima ai pensionati*). Section 7 concludes reporting some further developments of BIMic project.

2 The BIMic model

2.1 The structure of the model: an overview

BIMic is a static and non-behavioural micro-simulation model based on SHIW data. The aim of the model is to simulate the main features of the tax and social security system in order to assess distributional and efficiency issues.

Let Y^{BT} and Y^{AT} be vectors denoting before- and after-tax incomes respectively, such as:

$$Y_i^{AT} = \tau(Y_i^{BT}, X_i), \quad i = 1, \dots, N \tag{1}$$

where τ denotes the set of rules governing social security contributions (SSC), personal income tax (PIT) and other taxes, while X_i represents a set of socio-demographic characteristics for individual i. Policy changes modify τ, thus affecting the distribution of Y_i^{AT}.[5] Let τ' be the gross-to-net income transformation after a policy change. Then a typical microsimulation exercise aims at studying the distribution of net incomes $Y_i'^{AT} = \tau'(Y_i^{BT})$, and of gains and losses in terms of disposable income after the reform $(Y_i'^{AT} - Y_i^{AT})$. To perform such exercise one would need the gross income Y_i^{BT}, not collected in SHIW as respondents in the survey are asked only about their after-tax incomes Y_i^{AT}. In principle, Y_i^{BT} can be recovered

[5]In a non-behavioural MSM such as BIMic, it is assumed that gross incomes do not change in response to a new fiscal policy.

by inverting the transformation τ from equation (1). Inverting τ yields:

$$Y_i^{BT} = \tau^{-1}(Y_i^{AT}, X_i) \tag{2}$$

for $i = 1, 2, ..., N$. Two complications make this inversion not trivial. First, tax transformation is not identical for each individual since it stems from individual-specific characteristics X_i, such as type of incomes earned (e.g. self-employment, employment or pension income, etc.), number of dependent children and/or other relatives, etc. Second, tax transformation is highly non linear: tax schedule is normally not smooth and then not invertible. This implies that Y^{BT} has to be obtained numerically, by recursive approximations (see section 2.2).

The estimation of the gross incomes relative to the fiscal year t allows us to evaluate policy changes implemented in $t + s$. Fiscal transformation τ for year $t + s$ is identical to the one valid for t except for the policy changes implemented meanwhile. In the current version of BIMic the transformation τ^{-1} used in the recursive procedure contains welfare and fiscal rules referring to 2012 and 2014 years (the last two available SHIW waves).

As software scripts for reproducing welfare and fiscal legislation may result in a very long sequence of lines, BIMic features a modular structure. Each single component of the welfare and fiscal system is enclosed in one module that is explicitly recalled in the programming sequence calculating individual taxes and social benefits. These modules are normally called twice: the first time in the recursive procedure to recover gross incomes from the original SHIW dataset reporting net incomes; the second one in evaluating the effects of policy changes, modifying welfare and fiscal rules according to the new policy to recover disposable from gross incomes. Normally these policy changes result in changes of just one or few modules, while the others remain unchanged. The modular structure lowers the risk of making programming errors and helps ensuring internal consistency of the model, which is verified when the net incomes originally reported in SHIW are equal to the net incomes obtained applying fiscal rules to estimated gross incomes.[6]

BIMic is programmed in Stata. The current version of the model can work indifferently over both the 2012 and the 2014 SHIW database. Future releases of

[6]Notice that microsimulation models built over database that already report gross incomes are less subject to this type of risks as they do not need any grossing-up procedure.

SHIW will be included in the model as soon as they become available.[7] Once the database with net incomes is loaded, BIMic performs the grossing-up procedure[8] that entails the fiscal and welfare legislation valid for the survey's year. This procedure returns gross incomes of the basis year. In order to properly simulate policy changes for successive years, gross incomes have to be inflated to better represent the counterfactual scenario. To this scope, BIMic applies nominal GDP growth rates (actually recorded or forecast, as reported by Government's planning documents) to the estimated gross incomes of last survey year.

2.2 Recovering gross incomes

The iterative algorithm to recover gross from net incomes assumes that net incomes are reported in the survey without errors (no mis-reporting) and that fiscal evasion is null. We acknowledge that these assumptions may appear heroic and an attempt to relax them will be carried out in the future.[9]

To better follow the functioning of the algorithm, its graphical description is reported in figure 1.

Our starting point in the grossing-up procedure is $y_i^S = (y_{i,1}^S, \dots, y_{i,q}^S, \dots, y_{i,Q}^S)$, the vector of the Q net income components for individual i reported in SHIW. We aim at recovering the corresponding vector of before-tax components $y_i^{BT} = (y_{i,1}^{BT}, \dots, y_{i,q}^{BT}, \dots, y_{i,Q}^{BT})$. Of course, $Y_i^S = \sum_{q=1}^{Q} y_{i,q}^S$ and $Y_i^{BT} = \sum_{q=1}^{Q} y_{i,q}^{BT}$. For the sake of simplicity, from now on we omit the index i from notation. Note that, under our assumptions of absence of mis-reporting and fiscal evasion, $y_q^S \equiv y_q^{AT}$ for the generic qth income component.

Let us denote $\overline{Y}_k^{BT}$ the guess of total gross income at iteration k. We assume it evolves according to the following law of motion:

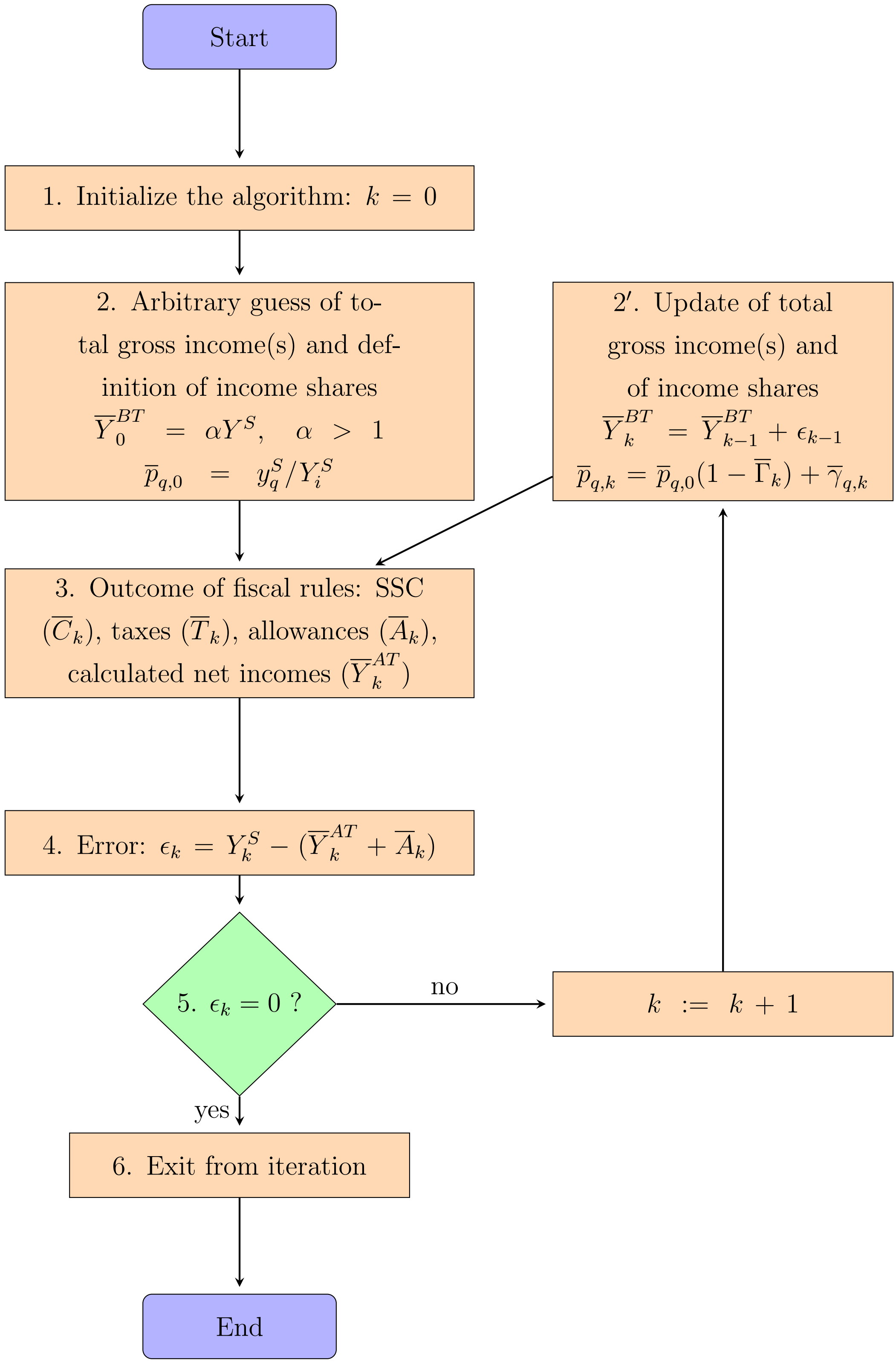
$$\overline{Y}_k^{BT} = \begin{cases} \alpha Y^S & \text{if } k = 0 \\ \overline{Y}_{k-1}^{BT} + \epsilon_{k-1} & \text{if } k > 0 \end{cases} \tag{3}$$

[7] SHIW is a biennial survey. The next version of the survey, referring to 2016 incomes and wealth, will be available by the end of 2017.

[8] See Section 2.2 for a general discussion and Section 4 for a detailed description of the relevant modules.

[9] On this issue, see also Cannari and Violi (1989) and Baffigi et al. (2016).

Figure 1: The grossing-up algorithm



where $\alpha > 1$ denotes an arbitrary factor, Y^S the total net income reported in SHIW and ϵ_{k-1} the grossing-up iteration error at step $k-1$. Gross income components are related to total gross income by $\overline{p}_{q,k}$, the share of income component q over total gross income at iteration k. To initialize these shares, we assume that their starting values are equal to the corresponding net (observed) values, namely $\overline{p}_{q,0} = y_q^S / Y_i^S$.

At each iteration, tax transformation τ is applied to the guess for gross incomes to reproduce social security contributions $\overline{C}_k$, personal income tax $\overline{T}_k$ and total net income $\overline{Y}_k^{AT}$:

$$\overline{Y}_k^{AT} = \overline{Y}_k^{BT} - \overline{C}_k - \overline{T}_k \tag{4}$$

In order to update the guess of gross income, the iteration error needs to be calculated. Such error has to account for the fact that family allowances and some other benefits are reported in employees' payslip and they are included in the definition of net income reported in SHIW. Let us define the kth guess of these allowances as $\overline{A}_k$. Therefore, the iteration error takes the following form:

$$\epsilon_k = Y_k^S - (\overline{Y}_k^{AT} + \overline{A}_k) \tag{5}$$

The guess of total gross income in equation (3) is updated with the information about the error. The shares of income components are then updated accordingly:

$$\overline{p}_{q,k} = \overline{p}_{q,0}(1 - \overline{\Gamma}_k) + \overline{\gamma}_{q,k} \tag{6}$$

where $\overline{\gamma}_{q,k} = \overline{C}_{q,k} / \overline{Y}_k^{BT}$ are the simulated fractions of social security contributions due to income component q on total gross income and $\overline{\Gamma}_k = \sum_q \overline{\gamma}_{q,k} = \overline{C}_k / \overline{Y}_k^{BT}$ is the ratio between total social security contributions and total gross income. Equation (6) implies that more weight is given to income components subject also to social security contributions than to those subject only to the personal income tax.[10] Once guesses of gross income components are updated according to equations (3)–(6), the procedure runs again until iteration error (5) is lower than a fixed level of tolerance, set equal to 0.1 euros.

[10]For example, assume that an individual reports 10,000 euros of *net* labour income and 10,000 euros of *net* capital income. Initial guesses for the income components shares are 0.5 for both income sources. However, the procedure acknowledges that SSC are due on labour income only. Therefore, once SSC have been calculated in the first iteration, the share of before-tax labour (capital) income will necessarily be larger (smaller) than 0.5.

The above procedure runs for each observation in the sample (notice that we suppressed index i for the sake of notation) and stops when convergence is reached for all individuals. Since incomes of individuals within the same family are likely to be correlated (due, for example, to family tax credits), the iterative process stops only when all observations within the households reach convergence.

3 Data description

Static MSM may be run over either administrative or sample data. Usually the first choice is taken for models used in Governmental institutions responsible for fiscal policies and mainly interested on budgetary impacts of the policy changes. Indeed, few socio-demographic characteristics are needed if such a perspective is preponderant. On the contrary, when the policy question focuses on redistributive aspects, a detailed set of socio-demographic characteristics (usually available only in survey data) is important to conduct a reasonable analysis. As BIMic is designed to assess distributive effects, we resort to survey data.

For a model aimed at replicating the Italian tax-benefit system, two surveys can be used: the Italian module of the European Statistics on Income and Living Conditions (EU-Silc), collected by ISTAT, and the Survey of Household Income and Wealth (SHIW), conducted by the Bank of Italy. Both databases have pros and cons. On one side, sample size of EU-Silc is larger and before-tax incomes of individuals are already provided, based on an exact matching with administrative data. This nullifies risks of errors in estimating gross incomes (see section 2). On the other side, SHIW provides a much richer set of wealth information than EU-Silc, which can be of paramount importance in performing redistributive analysis. For this reason, we chose to build BIMic on the basis of SHIW. In this section, we describe our use of SHIW dataset more in details and how we complemented it with external sources.

3.1 SHIW

SHIW is conducted every two years on a sample of about 8,000 households representative of the Italian population.[11]

SHIW reports detailed information on wealth and income. Wealth information attain to both real (real estate and business properties, valuables) and financial wealth (saving instruments), even though only at the household level. However, at least for real assets, it is possible to recover the owner among household components. Incomes are, on the contrary, already reported at individual level, as well as information about labor market participation in terms of type of labour (payroll employees, self-employed, family business, atypical contracts), sector of employment, qualification (white *versus* blue collar), relative importance of the activity (primary *versus* secondary).[12]

We use information about kinship and affinity to define fiscal dependency, as described in Section 3.2. Reported information about real estate properties is exploited to derive cadastral values, which are the tax base for these assets in the Italian system, as explained in detail in Section 3.3. SHIW's rich information about labour characteristics are employed to derive very specific fiscal treatments, which is a characteristic of the Italian system. For example, we identified 25 professional categories and we modeled different SSC rules applying to each of them accordingly (see section 4.1).

[11] The sampling design consists in two steps: first, municipalities are selected by stratifying over regions and populations; then, within each municipality households are randomly chosen. For further details, see Supplements to the Statistical Bulletin – Household Income and Wealth in 2014 (https://www.bancaditalia.it/pubblicazioni/indagine-famiglie/bil-fam2014/en_suppl_64_15.pdf?language_id=1)

[12] In SHIW respondents are requested to list labour incomes from different sources. In principle, there may be workers with multiple labour activities. In these (few) cases, we consider as main labour activity the one declared as such by respondents. The remaining activities were summarized in a total secondary activity, whose income is given by the sum of the different incomes. Other characteristics of the activities (such as working hours, duration, etc.) were attributed to the secondary (fictitious) activity either by summing them up or by calculating means or modes. The final outcome of the process is that people in BIMic have only one or two labour activities in the single year but not more. This is to simplify analysis and save calculation power.

3.2 Fiscal-relevant family definition

Analogously to other similar surveys, households in SHIW are defined as a group of individuals living in the same dwelling and sharing at least part of their incomes. Obviously this definition does not coincide with the definition of kinship and affinity that is relevant for fiscal dependency, as needed for example for the simulation of tax credit for family dependents. From a fiscal point of view, families are composed by a taxpayer, his/her spouse and the other dependent relatives (living in the same dwelling and having a gross income below a certain threshold, about 2,840 euros in 2016). Definition of fiscal-relevant family relationships from SHIW relies on information about the degree of kinship linking each household member to the household head.[13] On the basis of the Italian fiscal rules, one or more fiscal-relevant families may co-exist in SHIW households: for example, a household composed by fiscal independent grandparents living together with one of their sons and his family result in two fiscal-relevant families.

It has to be noted that BIMic takes into account that the composition of fiscal-relevant families may vary at different iterative steps within the grossing-up procedure, because the gross income (which ultimately determines whether an individual is fiscally independent or not) is updated at each step. As the composition of fiscal-relevant families is updated, the same happens to tax debits and estimates of gross incomes for other family members (see Section 2.2). The modular structure of the model helps in dealing with this kind of subtle points that otherwise would have been difficult to take into account.

3.3 Cadastral values

Although SHIW reports detailed information on each real asset owned by the household (including the self-assessed market value, the year of construction, the surface expressed in squared-meters, and so on), the relevant variable for fiscal purposes is represented by the cadastral value of each building.[14] The cadastral value is

[13]The household head is defined as the member responsible for the household budget, or at least the most knowledgeable about it.

[14]Rules determining the inclusion of cadastral value into taxable income differ according to the specific use of each building (main residence, unrented and rented buildings). As regards the main residence, the cadastral rent is entirely deducted from the PIT base, although it still counts for

estimated with procedures differentiated for the main residence and for other buildings.

The estimation of cadastral value for the main residence takes into account property taxes paid in 2012 or 2014 as reported in SHIW, tax rates deliberated by each municipality and other socio-demographics characteristics relevant for possible tax deductions. For example, the property tax for the main residence in 2012 takes the form $t = max(0, \omega 168CV - 200 - 50NC)$, where t is the amount in euros of the property tax paid in 2012 and reported in SHIW, ω is the municipality-specific tax rate, 168 a scaling factor, CV the cadastral value, 200 euros a fixed tax deduction, 50 euros a variable tax deduction for each dependent child aged less than 26 (NC). The cadastral value CV is then obtained inverting the above relation.[15]

The estimation of cadastral value for other buildings (including dwellings different from the main residence) takes into account the self-assessed value of each building as reported in SHIW and the geographical distribution of market values and cadastral incomes from Land Registry data. For example, according to Land Registry data (Agenzia delle Entrate, 2015), the market value of dwellings different from the main residence in Lombardy for 2012 was 2.70 times higher than the corresponding values for fiscal purposes: we then derive the cadastral values for such dwellings deflating the self-assessed property values by an appropriate factor.

4 Modules of BIMic

This section describes more in detail the main modules embedded in BIMic, discussing where necessary the methodological choices that have been adopted. Unless differently stated, the discussion below refers to 2014 tax-benefit rules, which are

determining the eligibility and the amount of means-tested benefits. As regards other dwellings, unoccupied buildings' cadastral values do not enter PIT base (but only property taxes' base); for rented buildings, the actual rent is included in the PIT base unless taxpayers opt for a witholding tax on rental incomes (see footnote 16). Noteworthy, the estimation of cadastral value for each dwelling is necessary for the simulation of property taxes, as well.

[15] For those households with $t = 0$ (because the amount of fixed and variable deduction is larger than the tax liability) it has been assumed a cadastral value equal to the 80% of the break-even value of CV for having a t strictly larger than 0. A similar procedure is applied for the 2014 property tax. See also Messina and Savegnago (2014, 2015).

exploited in the grossing-up procedure applied to the most recent wave of SHIW. The list of modules and the respective paragraphs is shown in table 1.

Table 1: Main modules featured in BIMic

Module	Subsection
Social security contribution	4.1
Personal income tax	4.2
Definition of total income	4.2.1
Deduction and gross tax	4.2.2
Tax credits and net tax	4.2.3
Other taxes	4.3
Means-tested benefits	4.4

4.1 Social security contributions

BIMic exploits the extremely rich information contained in SHIW data to derive social security contributions paid by workers and employers. The amount of SSC greatly differs according to different dimensions, the most important of which is the type of work.

Employees. For dependent workers SSC rates change according to sector of activity (agriculture, manufacturing, construction, trade, logistic, banking and insurance, services, public administration), number of employees in the firm, occupational status of the employee (blue collars, white collars, executives) and type of contract (open ended versus fixed term). All these information are retrieved from SHIW. SSC are almost always proportional to labour income (approximately 30% paid by employers and 9-10% paid by employees). We also model deviations from the general rule of flat rates contribution. In particular, we consider the so-called *minimale contributivo*, a threshold income below which a fix amount of SSC is due, and the so-called *massimale di reddito*, a threshold income above which SSC are no more due.

Self-employed workers. For self-employed and similar workers (members of a profession and individual entrepreneurs) a very large set of specific rules is modeled. We identify 25 categories of self-employed workers, ranging from regimes whose contributions are collected by the National Social Security Institute (henceforth, INPS), such as those valid for shopkeepers, craftsmen, farmers, to regimes for workers in professional services, whose contributions accrue to the so-called *Casse professionali* (e.g. lawyers, physicians, accountants, etc.). As a rule, also for self-employed workers, SSCs are proportional to labour income and – for members of professions – to business volume (i.e. VAT base). As *Casse professionali* are largely autonomous in defining SSC rules, many exceptions or special regimes apply (for example, SSC contributions for some professions are smaller for younger workers). We are generally able to model these exceptions given the rich structure of our database. Finally, the SSC base for farmers is determined on cadastral values of the land they farm, analogously as their taxable income (see section 4.2.1).

4.2 The personal income tax: Irpef

This section describes the most salient features of the Italian personal income tax, *Imposta sul reddito delle persone fisiche* (Irpef, henceforth), and the relevant methodological choices adopted in BIMic for its simulation. Irpef, the most important tax in the Italian system in terms of revenues (accounting for almost 40% of total tax revenues) is a personal and progressive tax on total income. It is personal because individual tax burden depends on individual characteristics, the most important of which is total income; among other personal characteristics, family dimension and composition (relevant for tax credits) may be cited as an example. It is the primary instrument through which progressivity is achieved within the tax-benefit system (Bosi and Guerra, 2015). Given its relevance on the general Government budjet, Irpef module is the most important in BIMic. It consists in the following steps: identification of the tax base, i.e. the sum of different income sources subject to the personal income tax (discussed in section 4.2.1); simulation of tax deductions, which returns taxable income, and calculation of tax liability before tax credits, namely the amount of tax resulting from the mere application of tax rates to taxable income (section 4.2.2); simulation of tax credits and local surcharges to Irpef, which return final tax liability (section 4.2.3). Table 2 visualizes the relevant steps in the calculation of Irpef.

Table 2: Irpef calculation

Step	Section
Tax base (sum of incomes subject to Irpef)	4.2.1
– **deductions** = **taxable income**	4.2.2
Application of tax rates = **tax liability before tax credits**	
– **tax credits** = **final tax liability**	4.2.3

4.2.1 Irpef: the tax base

In principle, Irpef applies to the comprehensive personal income, irrespectively of its sources: we reconcile SHIW information about sources of income with income categories that constitute the Irpef tax base, which are reported in table 3.

In practice, mostly for efficiency reasons, many income sources receive a special fiscal treatment in Italy and are excluded from the Irpef tax base. In BIMic we account for the most important special tax regimes, which we discuss below.

Exempted sources of incomes. Incomes exempted from the personal income tax include scholarships, some disability pensions, family allowances (see Section 4.4) and other minor items. Another relevant source of income excluded is the cadastral value of unoccupied dwelling, as these buildings are already subject to property taxes (4.3); rents are instead included in the tax base, after an abatement of 5% that accounts for administrative and maintainance costs born by the taxpayer.[16]

Agricultural incomes. Irpef tax base for farmers does not contain incomes resulting from sales of agricultural products but "conventional" cadastral values that

[16]Since 2011 taxpayers can opt for a witholding tax on rental incomes (*cedolare secca*). If taxpayers opt, rents are subject to a flat tax and are excluded from Irpef's tax base, which may result in a lower final tax burden. Due to lack of data necessary to determine whether taxpayers opt for this special regime or not, in BIMic we assume that rents are included in the Irpef tax base. In the future, the possibility to opt for the *cedolare secca* will be modelled.

Table 3: Income sources included in the definition of Irpef tax base

	labour income
1	payroll employees, including fringe benefits
2	members of a profession, individual entrepreneurs, self-employed workers, members of a family business
3	workers on atypical contracts
4	shareholders/partners working in family business
	non-work non-pension incomes
5	redundancy payments (*cassa integrazione guadagni*)
6	mobility and collective dismissals payments (*indennità di mobilità*)
7	unemployment benefits
8	received alimonies
	pensions
9	retirement pensions
10	survivors' pensions
11	social security disability pensions
12	state (welfare) pensions
	agricultural incomes
13	cadastral land income
14	cadastral agricultural income
	property incomes
15	primary residence income
16	other properties income

represent a sort of "normal" gain from agricultural activity. SHIW does not ask farmers for cadastral values of their lands, so we impute farmers' income on the basis of official statistics from Irpef revenues.

Minimum taxpayer regime (*Regime dei minimi*). Members of a profession, individual entrepreneurs and self-employed workers are eligible to opt for a simplified (and often more favourable) regime, provided their business is "small enough" in terms of revenues, costs and investments.[17] If they opt, their gross income is

[17] The Budget Law for 2015 has replaced this regime with a new one known as *regime forfettario*.

taxed at a flat rate and does not enter Irpef tax base: in this case taxpayers lose tax credits available only within Irpef regime. It cannot be determined *a priori* whether it is convenient to opt or not for the special regime and SHIW does not ask information about this option. Then, for these workers, BIMic simulates tax burdens resulting from the application of both *Regime dei minimi* and Irpef. We suppose that individuals choose the most favourable regime (in terms of tax burden) between the two.

4.2.2 Irpef: deductions and tax liability (before tax credits)

After determining the tax base, the next step for Irpef calculation is the simulation of tax deductions: these are then subtracted from tax base and tax schedule is applied to the resulting taxable income. The most relevant deduction is represented by the SSCs paid by self-employed workers[18] (see section 4.1). Other forms of deductions featured in BIMic are: *i)* the cadastral value of the main residence, if owned by the taxpayer (see also section 3.3); *ii)* voluntary contributions to supplementary retirement accounts; *iii)* legal alimony to spouses, *iv)* donations to charity or other associations. Due to the unavailability of information, deductions granted for health expenditure for disabled individuals and social security contributions paid to housekeepers can not be determined.

Once deductions are taken into account it is possible to compute Irpef liability (before tax credits), that is the amount of tax an individual would virtually pay in absence of tax credits (see next section). It is obtained applying the tax schedule shown in table 4 to taxable income: progressively higher marginal tax rates are applied to higher income brackets (expressed in euros per year).

At this stage, regional (*addizionale regionale*) and municipal (*addizionale comunale*) Irpef surcharges are also determined, although they are due only by those taxpayers whose Irpef liability net of tax credits is strictly positive. For regional surcharge BIMic applies the actual tax schedules designed by the regional authorities.[19] For the municipal surcharge, BIMic assigns a regional-specific effective tax

[18]Payroll employees' contributions are not included among deductions because employees' labour income enters the tax base already as net of SSC.

[19]Starting from 2014, regions can introduce some form of progressivity in their tax rates (in

Table 4: Income brackets and tax rates for the personal income tax

Income brackets	Tax rates
$\leq$ 15,000	23%
15,000 – 28,000	27%
28,000 – 55,000	38%
55,000 – 75,000	41%
$\geq$ 75,000	43%

rate for each municipality in a given region, based on official statistics.

4.2.3 Irpef: tax credits and final tax liability

In order to determine the final tax liability due on personal incomes, it is necessary to determine all tax credits (*detrazioni*) the taxpayer is entitled to. Tax credits serve several aims in the context of the Italian personal income tax (Bosi and Guerra, 2015): *i)* along with the tax schedule, they contribute to tax progressivit, as they generally decrease along with total income and become zero beyond a given income threshold; *ii)* they allow a qualitative discrimination among income sources, as the amount of tax credit differ among them; *iii)* they enhance horizontal equity, as tax credits allow to differentiate tax burden of individuals with the same taxable income but belonging to households of different sizes; *iv)* they provide incentives to some kinds of expenditures, like those related to children education.

As such, tax credits can be divided in: tax credits for income sources, tax credits for dependent family members, tax credits for incentive purposes and tax credits for personal expenses. As a general rule, in Italy tax credits are not refundable.

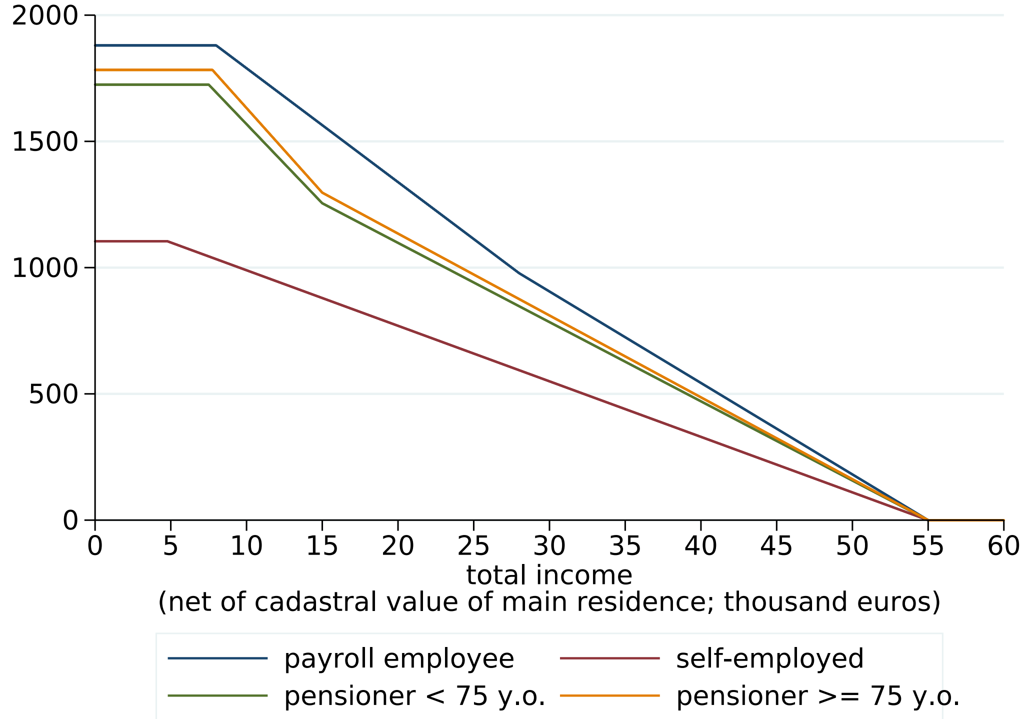
Tax credits for income sources. These tax credits apply differently according to whether the taxpayer is an employee, a self-employed worker or a pensioner.[20] The decreasing schedule of tax credits implicitly defines a no-tax area for the four

place of the pre-existing flat tax), provided that they use the same income brackets set at the national level.

[20]Tax credits for pensioners depend also on age, being higher for those aged more than 75 years old. Starting from 2017, this higher credit applies also to pensioners aged less than 75 years old.

classes of income sources. For example, tax credit for payroll employees is 1,880 euros for incomes up to 8,000 euros[21], it decreases almost linearly up to 55,000 euros, and it is zero beyond 55,000 (see fig. 2). BIMic fully features these tax credits, accounting also for the option left to taxpayers in choosing the most convenient of them if they are entitled to more than one.

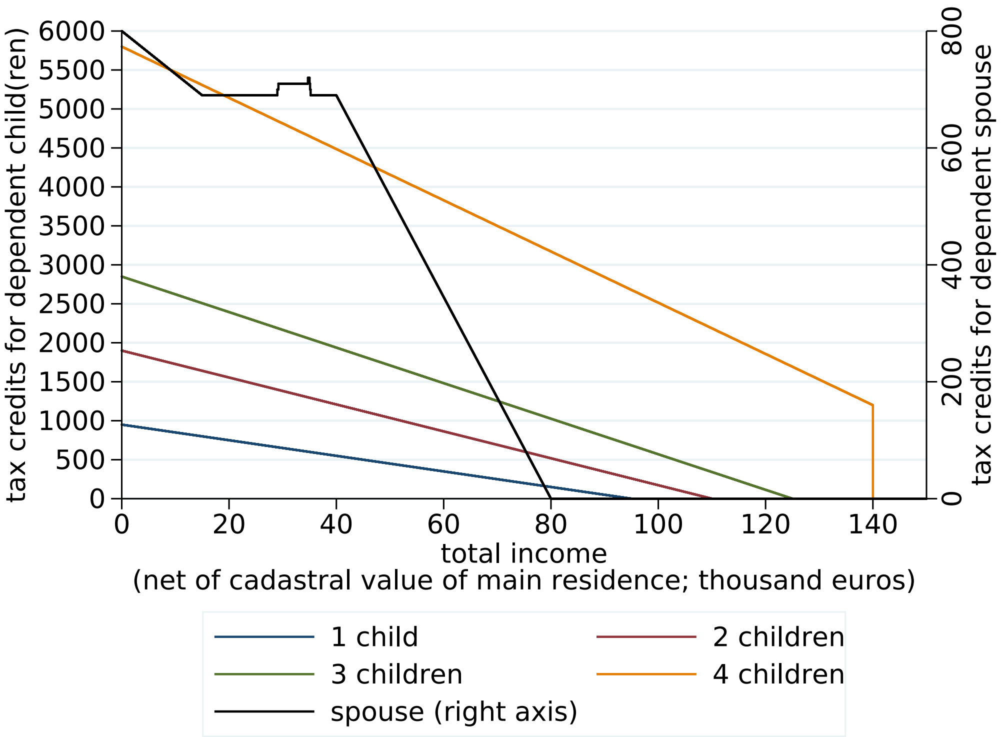
Figure 2: Tax credit for income sources (euros)



Tax credits for dependent family members. These tax credits follow different rules depending on which dependent family member they refer to: the spouse, children or other family members. They also depend on the number and age of children and they decrease as total income (net of cadastral rent from the main dwelling) increases. A family member is defined as dependent if she lives with the taxpayer and her yearly income is below 2,840.51 euros. As an example, figure 3 shows tax credits granted for dependent children (aged more than 3 years old and with no disability) and spouse.

[21] The no-tax area is implicitly defined at 8,000 euros. In fact the gross tax for this level of taxable income would be $23\% \times 8,000 = 1,880$, which is exactly the level of the tax credits.

Figure 3: Tax credit for dependent family members (euros)



BIMic fully features these tax credits, with the exception of the extra credit for disabled children (due to lack of data). In case of more than one taxpayer in a family, the model also imputes tax credit for children to only one of the parents or to both (split in equal part), replicating the option that minimizes family's tax liability.[22]

Tax credits for incentive purposes. The most relevant tax credit of this category refers to expenditures for refurbishment of buildings, which cover a wide range of interventions (from extraordinary maintenance to anti-seismic measures). As much as 36% of such expenses, split in equal amounts over a 10-year period, can be

[22]Given that tax credits are non refundable, in case of low-income families it may happen that attributing all the credit to only one of the two parents results in a negative tax liability for this taxpayer. In this case, it can be more advantageous to split the credit between the two parents to fully exploit it in reducing family's total tax liability. Similar reasoning applies for the case of one parent with a very high income and one parent with a low-medium income. BIMic recognizes that in this case it is advantageous for the family to attribute the credit to the latter, as the former is not entitled to exploit the tax credit.

subtracted from tax liability. Another form of incentive is the possiblity to deduct a 55% amount of the expenses for energy conservation's operations.[23] These tax credits can be simulated in BIMic thanks to specific questions asked in SHIW.

Tax credits for personal expenses. Personal expenses may contribute to reduce tax liability: as much as 19% of them can normally be subtracted from tax debt. There are many expenses for which tax credits are granted: not all of them can be easily replicated with information reported in SHIW. Consequently, BIMic features tax credits only for interest paid on mortgage loans for the purchase of main dwelling, for renting the main dwelling (if total income does not exceed a given threshold), for life insurance premia and for donations to non-profit organisations.

Since we do not have information about many other relevant tax credits, including those related to health expenditures and the ones for secondary and tertiary education, we adopt an imputation procedure for this aggregate as a whole. In particular, we randomly assign a dummy variable E_i taking value of 1 if the taxpayer exploits this kind of tax credits and 0 otherwise: we let the incidence of E increase as income increases, consistently with official data (from about 11% for the first quintile of total income to more than 80% for the fifth quintile). Then, within the grossing up procedure, we attribute to only those individual with $E_i = 1$ a level of expenditures consistent with the one observed in the official statistics.[24] Finally, tax credits are granted for the 19% of this specific amount.

4.3 Other taxes

Taxes on income from financial assets. Some sources of capital income receive a special fiscal treatment. The rationale mainly has to do with efficiency arguments, namely a more favourable taxation of capital with respect to labour due to its higher international mobility. Capital income is subject to a separate flat tax,

[23] These tax credits have been repeatedly revised after 2014.

[24] More in detail, we fit a regression of the relevant amount of expenditures that gives right to the 19% tax credit as a funtion of a 3rd degree polynomial of income; we then use the estimated coefficients to predict a likely amount of expenditures at each iteration based on the i-th guess of total income, until convergence is obtained.

whose rate equals 12.5% for Treasury bonds and 26% for other financial intruments and for corporate dividends distributed to shareholders with no control over the corporation.

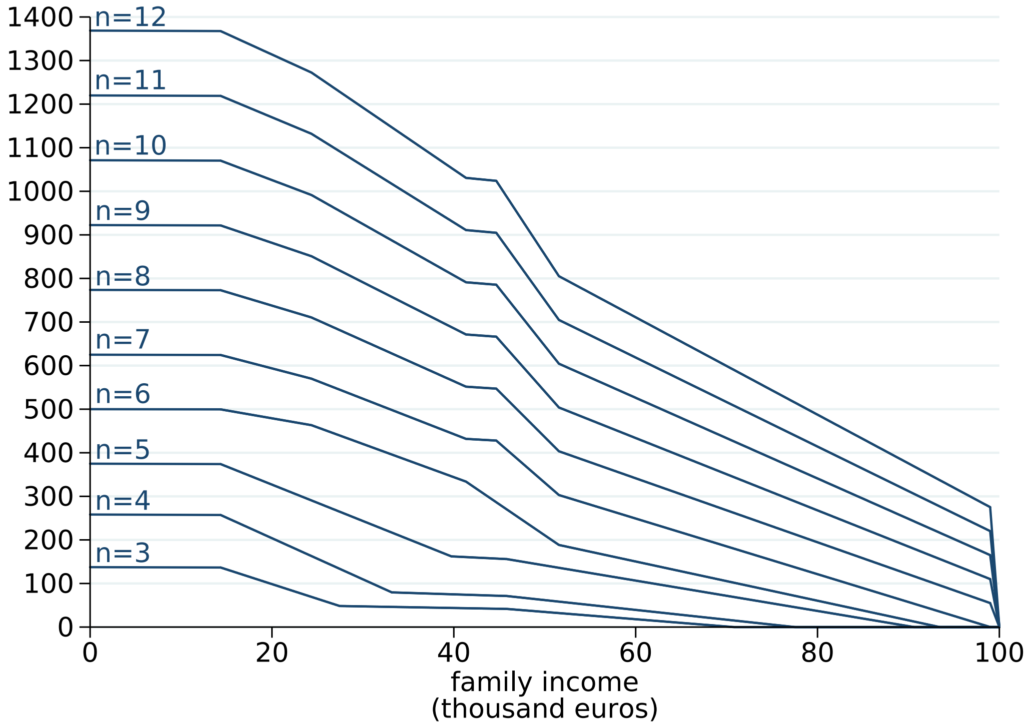
Taxes on dwellings. BIMic features the most relevant taxes levied on dwellings, mainly property and waste disposal taxes. Starting from 2016, property taxes are no longer due on the main residence (unless it is a "luxury" one). Cadastral values, estimated as described in section 3.3, represent the tax base for property taxes while tax rates are decided by each municipality within a range established by the law. Besides property taxes, BIMic also models the waste disposal tax, which is due no matter whether the house is owned or rented: tax base depends on the number of household members and on dwellings floor space (which should proxy for the amount of waste produced by each household) while tax rates are decided by each municipality to cover (in principle) the full cost they bear to deliver this public service.

4.4 Means-tested benefits

BIMic features also the most important benefits of the Italian welfare system. In this section we describe the main means-tested benefits, which are: *i)* family allowances (*assegni al nucleo familiare*); *ii)* the tax credit for payroll employees with low-middle incomes (commonly referred as *80-euro bonus*) and *iii)* the additional sum granted to contributory pensioners (*quattordicesima ai pensionati*). Finally we present the so-called *Indicatore della situazione economica equivalente* (henceforth, ISEE), an indicator capturing the household's financial well-being, used by central and local governments to grant many forms of social assistance, both in-cash and in-kind.

Family allowances. Family allowances are targeted to families of employees and pensioners with total income below a given threshold. Their amount is differentiated according to family composition (e.g. families with only one parent and at least one child aged less than 18 years old) and size, and it decreases non linearly with family income. For example, figure 4 shows the monthly allowance for a family with both parents and at least one child aged less than 18, for different levels of family income and family size.[25] This kind of benefit is paid with monthly salary and reported in the employees' payslip (then the employers are refunded by the Government); for pensioners it is paid by INPS. The way family allowances are disbursed has important consequences for their treatment in the grossing-up procedure (see section 2.2 for a more in depth discussion).

Figure 4: Monthly family allowance for a family with both parents and at least one child under age 18 (euros); by family income and family size (n)



80-euro bonus. The so-called *80-euro bonus* is a tax rebate granted to employees whose income is above the no-tax area and below a certain upper bound. The maximum amount (80 euros per month) is granted to employees with a yearly taxable income below 24,000 euros; beyond that limit, the bonus linearly decreases becoming null at 26,000 euros. The annual amount depends on the number of days worked over the year. The bonus is payable: it generally takes the form of a tax credit (that is, a reduction of tax liability); when the tax liability is lower than

[25]The actual amount may vary in relation to some characteristics of the family members, such as the age of children, the kinship relationship and the presence of disable persons.

the bonus, the taxpayer is granted an explicit cash transfer (equal to the difference between the bonus and the tax debt).

Additional sum to pensioners. This measure aims to support contributory pensioners with age equal or above 64 and total income below certain thresholds (1.5 times the mimimum pension level, the so-called *trattamento minimo*). Incomes to be considered for eligibility include also those exempted from personal income tax or subject to separate taxation, while cadastral income from the main residence, family allowances and few other minor social benefits are excluded. Notice that eligibility depends only on the potential beneficiary's income, while no consideration is given to spouse's or other relatives' income. The additional sum is paid once per year, generally in July. The amount depends on years of contributions paid to social security system during the working life of the pensioner: below 16 years of contributions (19 for self-employed), it equals 336 euros; from 16 (19) to 25 (28) years, 420 euros; above 25 (28) years, 504 euros. To avoid cases of re-ranking in the neighborhood of the eligibility income threshold, the benefit amount is adjusted so that the sum of the original income and the benefit does not exceed the threshold itself. BIMic simulation of the measure may potentially overestimate the additional sum attributed to each individual as years of contributions in SHIW database may be over-reported. Missing values are imputed using the average of years of contributions for contributory pensioners with age above 64. In section 6 we discuss the distributive impact of a recently approved change to this program.

Equivalent Financial Situation Index (ISEE - *Indicatore della situazione economica equivalente*). ISEE is an indicator allowing to compare the financial situation of households with different compositions, taking into account not only their several sources of income (included those not subject to the personal income tax) but also their financial and real wealth. The richness of information contained in SHIW allows BIMic to derive ISEE in a realistic way, consistent with the complex rules governing its calculation.

ISEE takes the following form

$$\text{ISEE} = \frac{(\text{Income}) + (20\% \times \text{Wealth})}{\text{Equivalence scale parameter}}$$

where:

- “Income” includes all sources of income, irrespectively of their fiscal status (i.e. scholarships and family allowances are included) and is net of individual-specific deductions (which are related to the income source, such as payroll workers and pensioners) and family-specific deductions (such as rents for the primary residence).

- “Wealth” includes all form of financial and real assets. As for financial assets, households are entitled with a deduction, increasing with the number of children. As for real assets, the value to be considered is the cadastral value, net of the share of mortgage still to be paid. Households owner of their primary residence can deduct a share of their value that increases with the number of children.

- “Equivalence scale parameter” is needed to make meaningful comparison across households of different size, in order to take into account economies of scale of certain consumption items. It is composed by two parts: a part related to the household size (for example, equal to 1.57 for 2 components, to 2.04 for 3, and so on) and a part giving extra weight for households with some specific characteristics (for example extra 0.2 for households with children aged less than 18 years old, increased to 0.3 if at least one is aged less than 3).

5 Weights post-stratification and validation

In order to assess BIMic ability to produce estimates of fiscal aggregates consistent with official data, sample weights should be used. The weighting procedure is particularly important when redistributive considerations are on the ground.

SHIW data are diffused together with official weights that are inversely related to the probability of individuals’ inclusion in the survey. Moreover, they are corrected to account for rates of non-responses at municipal levels and are finally post-stratified to guarantee that final sample matches population characteristics such as gender, age groups (four categories: less than 26, 26-45, 46-65, over 65), macro-regions (North, Center, South and Islands), municipal dimension (up to 20,000 inhabitants; 20,000-40,000; 40,000-500,000; more than 500,000) (Bank of Italy, 2015).

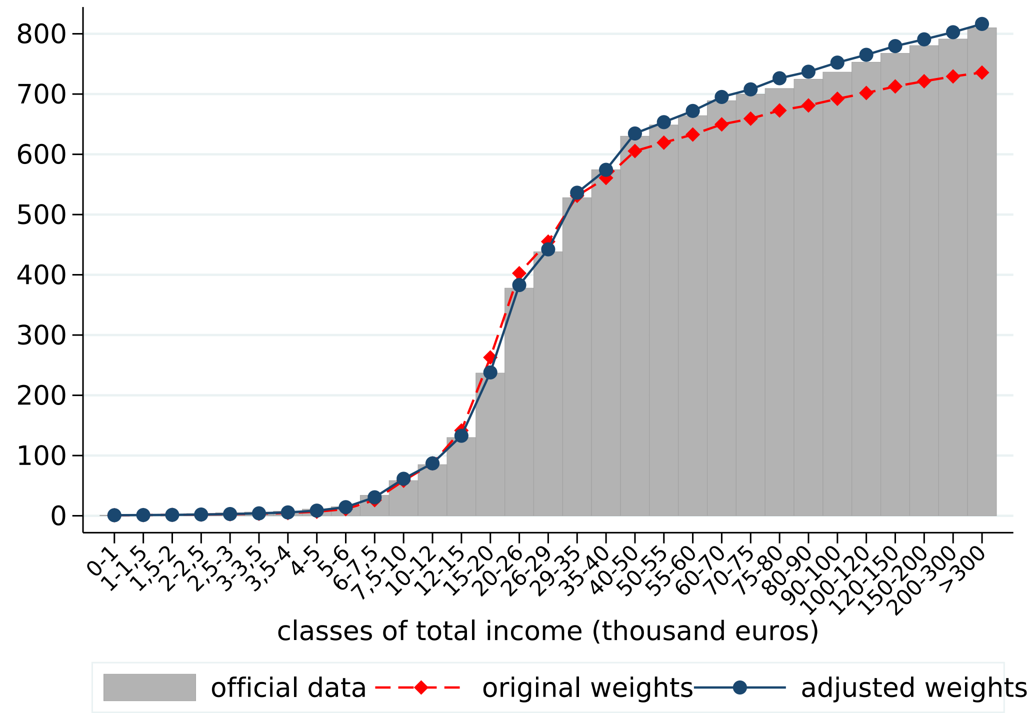
Table 5: Population totals by socio-demographics characteristics (year 2014). Count.

Group	Original weights	Adjusted weights
males	29,404,000	29,350,036
females	31,079,295	31,133,260
less than 14	7,688,545	7,762,305
age 14-21	4,066,334	4,009,883
age 21-30	6,449,779	6,436,456
age 31-40	7,823,168	8,096,382
age 41-50	9,786,846	9,801,197
age 51-65	11,376,113	11,225,907
more than 65	13,292,510	13,151,166
less than 20,000 inhabitants	28,426,437	28,304,424
20,000 - 40,000 inhabitants	8,785,192	8,704,160
40,000 - 500,0000 inhabitants	16,354,023	16,172,709
more than 500,000 inhabitants	6,917,643	7,302,003
North	27,953,171	27,656,990
Center	11,608,432	12,028,525
South and Islands	20,921,692	20,797,781

Note: Total population derives from the National Demographic Balance at December 31, 2014 and refers only to individuals living in private households (the same population from which SHIW data are sampled). However, the National Demographic Balance does not report the classification by socio-demographic characteristics, apart the one by municipal size. Consequently, for the other classifications we calculate the shares using the Resident Population (which also includes institutionalised individuals) at January 1, 2015 and apply them to the total population by the National Demographic Balance.

Official weights do not control for SHIW sample being able to reproduce official fiscal aggregates, a crucial aspect for BIMic's purposes. For this reason, we estimate new sample weights able to replicate the distribution of incomes declared to fiscal authorities and being *as close as possible* to the original weights (Creedy and Tuckwell, 2004; Pacifico, 2014). In particular we adjust sample weights so that the number of individuals by deciles of total gross income in BIMic match those of tax filing declarations data, for both the population as a whole and the most

Figure 5: Cumulated total gross income (billion euros). Fiscal year 2014.



relevant subpopulations by main income source (payroll employees, pensioners and so on).

Table 5 shows that the new weighting scheme does not alter significantly the original sample design in terms of the most relevant socio-demographic characteristics. For example, the number of males is only 50,000 lower using the adjusted weights rather than the original ones. The small cost of slightly distorting the sample design is more than compensated by the benefit of a much higher similarity with tax filing declarations data.

Figure 5 reports the cumulated gross total income by classes of total gross income, according to official data and to the two weighting schemes. The adoption of the adjusted weights allows an almost perfect estimation of the total gross income (806,5 billion euros for fiscal year 2014; 808 according to official data), almost 70 billion euros more than the estimate with the original weights.

Application of adjusted weights naturally results in a better estimation of the main tax and benefit variables. The comparison between BIMic estimates and official data about total tax base and other PIT aggregates are reported in Table 6;

Table 6: Validation of BIMic: main tax-benefit aggregates (billion euros and ratios). Fiscal year 2014.

	Official	BIMic estimates			
	data*	adj. weights		orig. weights	
	(*a*)	(*b*)	(b)/(a)	(*c*)	(c)/(a)
Gross income	808.0	806.5	0.998	735.6	0.910
Deductions	33.4	37.0	1.107	36.2	1.083
Taxable income	777.5	769.8	0.990	699.7	0.900
Gross tax	210.1	207.1	0.985	183.8	0.875
Tax credits	66.2	69.0	1.043	67.5	1.021
Net tax	151.2	142.4	0.942	118.6	0.784
Net tax plus local surcharges	167.1	157.3	0.941	131.9	0.789
Family allowance	6.4	6.8	1.057	7.0	1.092

* Official data for the personal income tax variables refer to the statistics produced by the Ministry Minister of Economy and Finance (http://www1.finanze.gov.it/finanze2/analisi_stat/index.php?tree=2015). Those for family allowances refer to the statistics produced by ISTAT (*Conti economici protezione sociale*; http://dati.istat.it/Index.aspx?DataSetCode=DCCN_PROTSOC).

as a term of reference we also report the estimation using original weights. Gross incomes are almost perfectly matched. A 10% overestimation of tax deductions results however in a small underestimation of taxable incomes (769.8 billion euros instead of 777.5). Final tax liability is understimated by about 5% (142.4 versus 151.2 billion euros), reflecting both lower tax liabilities (before deducting tax credits) and higher tax credits than those reported in tax filing declarations statistics. Finally, family allowances are slightly overestimated.

Overall, BIMic appears able to replicate the main fiscal aggregates, considering also that the model needs to estimate gross from net incomes, differently from other models based on EU-Silc database (see Section 3).

6 A policy evaluation exercise: the reform of the additional sum to pensioners

In this section we show how BIMic can be applied to evaluate the effects of a policy change. More specifically, we show the distributional effects of a legislative innovation to the additional sum to pensioners (known as the *quattordicesima ai pensionati*).[26]

In order to improve conditions of low-income pensioners, the Budget Law for 2017 raised the amount of the benefit paid to those pensioners already receiving the *quattordicesima* and relaxed income requirements for eligibility, thus increasing the number of beneficiaries. As before, the amount of the benefit depends on whether the worker was an employee or a self-employed and on years of contributions. Eligibility rules and amounts of the benefit were modified as reported in Table 7.

Table 7: The legislative innovation to *quattordicesima ai pensionati*

Years of contributions		Additional sum (euros)	
Employees	Self-employed	until 2016	from 2017
Total income below 9,786.86 euros[a]			
≤ 15	≤ 18	336	437
16 to 25	19 to 28	420	546
≥ 26	≥ 28	504	655
Total income between 9,786.86 and 13,049.14 euros[b]			
≤ 15	≤ 18	0	336
16 to 25	19 to 28	0	420
≥ 26	≥ 28	0	504

[a] 9,786.86 euros correspond to 1.5 times the minimum pension level.
[b] 9,786.86 and 13,049.14 euros correspond to 1.5 and 2 times the minimum pension level, respectively.

In particular, those already entitled to receive the benefit (pensioners whose total income does not exceed 1.5 times the minimum pension level, i.e 9,786.86 euros) receive in 2017 a *quattordicesima* that is 30% higher than in 2016. Furthermore, an

[26]For a detailed explanation of the rules governing this benefit, see Section 4.4.

additional group of pensioners start benefiting from the measure: those with total income between 1.5 to 2 times the minimum pension level (13,049.14 euros) now receive a transfer equal to the one granted until 2016 to those with income lower 1.5 times the minimum pension level. No further modifications to the rules were decided.

In order to evaluate this change from a distributive point of view, a preliminary step involves the definition of unit of analysis: natural candidates are individuals or households. Following the relevant literature, we choose households as unit of analysis, acknowledging the role of within-family resource pooling on individuals' living conditions. Moreover, in order to compare the financial well-being of individuals belonging to households of different sizes, family incomes have to be expressed in equivalent terms. Per capita income would be a possible and easy choice, but it neglects the role of economies of scale within households. For example, the financial well-being of a couple with total income of 20,000 euros is probably higher than the one of a single with income of 10,000 euros, thanks to economies in some expenditures (i.e. renting and heating an apartment, etc.) that can be split among members. Therefore equivalence scales need to be adopted to correct household incomes and properly compare the two situations. There are several equivalence scales differing in the way they translate the extent of such economies of scale into a single index. In our example, in order to have the same well-being as a couple with 20,000 euros, a single should have an income equal to $\frac{20{,}000}{1.5} \approx 13,333.3$ euros according to the "OECD-modified" scale[27], or to $\frac{20{,}000}{\sqrt{2}} \approx 14,142.1$ euros according to the "square root scale", and so on. A further step is whether to consider wealth or not in measuring households' well-being. Following the relevant literature (Brandolini et al., 2010) we choose a definition of well-being comprehensive of household's wealth, as it acts as insurance against unexpected shocks to income and provides means to increase future incomes (for example, by investing in human capital or by starting a new business). Therefore, we adopt ISEE as our indicator of well-being, as it is family-based, it adjusts family means by proper equivalence scale and it accounts also for wealth (see the discussion about ISEE in Section 4.4).

The last row of table 8 shows that 16.2% of Italian households are benefiting from the reform, because either one (or more) of the components is receiving the

[27]This scale attributes weight 1 to the first adult, 0.5 to any remaining individual aged at least 14 years old, and 0.3 to others.

increased amount or (s)he is now among the new recipients: for these households, the average gain is 245 euros, 1.68% of disposable income. Notice that the gain is calculated as the difference between before- and after-reform disposable income for each individual and then aggregated at the household level..

The analysis of the gain by ISEE deciles reveals that most of the household recipients belong to the bottom part of distribution, confirming that the measure is generally able to target households with lower than average means. However, even for these households, the gain does not exceed 2.4% of disposable income, relatively small to effectively improve living conditions of the least affluent segment of pensioners. Moreover, although the share of recipients decreases for higher deciles, a significant number of relatively well-off households still gain from the reform, essentially because eligibility depends on individual rather than household income.

Table 8: Innovation to *quattordicesima ai pensionati*: share of recipients and average additional gain by ISEE deciles

	ISEE[a]			Average additional gain[b,c]	
Decile	Min.	Max.	Recipients (%)	Value (euros)	Share of disposable income
1		4252	7.1	158	1.73
2	4258	6965	27.0	190	1.88
3	6968	10130	31.8	224	1.89
4	10130	13957	25.0	307	2.39
5	13961	18127	21.4	236	1.50
6	18133	22887	16.0	275	1.18
7	22896	29578	9.7	260	1.39
8	29586	39496	8.2	248	0.92
9	39496	61479	8.4	226	0.93
10	61479		7.3	378	1.35
Total			16.2	245	1.68

[a] All households.
[b] Computed as difference between disposable income after and before the policy change.
[c] Averages are calculated over only households who benefit from the policy change.

Concentration curves can help illustrating this phenomenon. They display the cumulated $q\%$ of the benefit accruing to the poorest $p\%$ of the population, in a diagram reporting households ranked by a measure of their financial well-being on the x-axis and the cumulated share of the benefit on the y-axis; the 45-degree line would be the concentration curve of a given hypothetical transfer evenly distributed over the population. Social benefits generally exhibit curves lying above the 45-degree line, as - say - the poorest 30% of the population receive more than 30% of the total amount of that benefit.[28]

Figure 6 plots the concentration curve of gains generated by the reform of *quattordicesima ai pensionati* for households ranked by their ISEE (blue solid line); as a term of reference, we also show the analogous figure for family allowances, which is an example of benefit conditioned on household's total income (red dot-dashed line). The comparison between the two benefits shows that poorer households attract a relatively lower share of the gains from the reform with respect to family allowances: for example, 34% versus 72% for the poorest 30% of the population. Consistently, a substantial share of the new measure is attracted by relatively well-off households: almost 35% of the resources devoted to the additional sum to pensioners are collected by the richest half of the population, versus only 11% for family allowances.

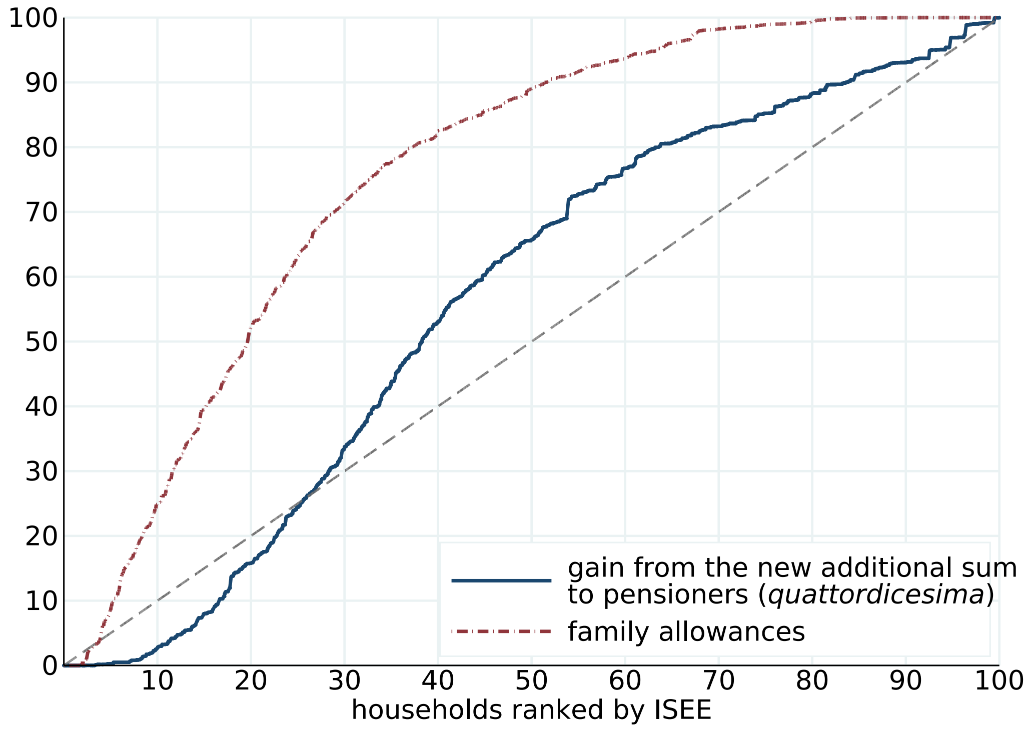
The progressivity of the gains associated with the new *quattordicesima* (although to a smaller extent compared with family allowances) is confirmed by some synthetic measures widely used in the literature. For example, the Kakwani index takes value of -0.6157 for the extra transfer to pensioners and -0.9145 for family allowances[29] (Table 9). This last benefit is also characterized by a larger redistributive effect (the ability to reduce income inequality) as measured by the Reynold-Smolensky index[30] (0.0064 versus 0.0010): the redistributive effect, in fact, combines

[28] A specular argument holds for income taxes, which are generally progressive. As such, their concentration curves lie not only below the 45-degree line but also below the Lorenz curve of before-tax incomes.

[29] The Kakwani index is defined as the difference between the concentration index of the benefit with households ranked by their before-benefit income and the Gini index of the before-benefit income (G_Y). Negative values of Kakwani index denote progressive benefits. The theoretical minimum (i.e. highest progressivity) and the maximum value (i.e. highest regressivity) of such index are $-1 - G_Y$ and $1 - G_Y$ (-1.3550 and 0.6450 in our case, respectively). See also Kakwani (1977).

[30] The Reynold-Smolensky (RS) redistribution index is simply defined as the difference between the Gini index computed on before-benefit income and the one computed on after-benefit income (Reynolds and Smolensky, 1977). The RS index and the Kakwani index are closely related as

Figure 6: Concentration curves: *quattordicesima ai pensionati* versus family allowances



the progressivity of the benefit with its average incidence, and both these indicators are higher for family allowances (see also footnote 30).

In conclusion, the graphical and the statistical analyses performed in this section confirm that the change in the *quattordicesima ai pensionati* is progressive, although a complete revision of such a transfer on the basis of household income (as other social benefits in the Italian system) would make it even more so. Moreover, the ability of such innovation to substantially improve living conditions of low-income households is rather limited.

$RS = -K\frac{b}{1+b} - D$, where K is the Kakwani progressivity index, b the average incidence of the benefit and D a reranking effect (usually negligible in the empirical applications). This relation says that in order to have a substantial redistributive effect, a measure needs to be both relevant (in term on average incidence) and progressive.

Table 9: Progressivity indices of the additional sum to pensioners and of family allowances

Index	Additional sum to pensioners	Family allowances
Kakwani index (K)	−0.6157	−0.9145
Average benefit incidence (b)	−0.0017	−0.0072
Reranking effect (D)	0.0000	0.0001
Reynolds-Smolensky index (RS = -K*b/(1+b)-D)	0.0010	0.0064
Gini index of *original income*[a]	0.3550	0.3550
Gini index of *original income*[a]+ *benefit*	0.3540	0.3486
Concentration index of *benefit*	−0.2607	−0.5595
Concentration index of *original income*[a]+ *benefit*	0.3539	0.3485

[a] Defined as equivalent disposable income net of both additional sum to pensioners and of family allowances.

7 Conclusion

BIMic, the microsimulation model developed at the Banca d'Italia, aimes to deliver a powerful instrument for public policies evaluation of the Italian fiscal and welfare system. Currently, it simulates a large set of tax-benefit programs that will need to be continously updated to reflect policy changes. Even the database will be revised as soon as new waves of SHIW become available, so that socio-demographic changes of the Italian population are properly accounted for.

Besides these updating activities, the model can be enriched along other dimensions. First, as tax evasion may have an impact over the equity profile of the tax-benefit system, our intention is to specifically model it in BIMic. Second, the set of taxes featured can be expanded to include the value added tax levied on households, which is the most relevant tax still not modeled in BIMic. Third, the simulation of some programs, such as tax expenditures, can be ameliorated if related data become available. Finally, BIMic could serve as a basis to model behavioural reactions of labour supply to policy changes in some *ad-hoc* analyses.

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