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Do healthcare tax credits help poor-health individuals on low incomes?

Cinzia Di Novi[1,3,4] · Anna Marenzi[2] · Dino Rizzi[2]

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Abstract In several countries, personal income tax permits tax credits for out-of-pocket healthcare expenditure. Tax credits benefit taxpayers at all income levels by reducing their net tax liability and modify the price of out-of-pocket expenditure. To the extent that consumer demand is price elastic, they may influence the amount of eligible healthcare expenditure for which taxpayers may claim a credit. These effects influence, in turn, income distributions and taxpayers' health status and therefore income-related inequality in health. Redistributive consequences of tax credits have been widely investigated. However, little is known about the ability of tax credits to alleviate health inequality. In this paper, we study the potential effects that tax credits for health expenses may have on income-related inequality in health status with reference to the Italian institutional setting. The analysis is performed using a tax-benefit microsimulation model that reproduces the personal income tax and incorporates taxpayers' behavioral responses to changes in tax credit rate. Our results suggest that the current healthcare tax credit design tends to favor the richest part of the population.

Keywords Personal income tax · Health-related tax credit · Health inequality

JEL Classification I10 · I14 · H24

Introduction

Socioeconomic inequality and its impact on health is a growing concern in the European public health debate. Indeed, despite improvements in some health measures and increases in life expectancy that have characterized recent decades, these improvements have not occurred consistently across all segments of the population. Inequalities continue to persist across groups with a lower socioeconomic position (as indicated by education, occupation, income, or wealth) who have less access to healthcare services, as well as poorer health outcomes than their counterparts. In many countries, including those that rank high on indices of economic prosperity and human development, health inequality remains a pressing policy issue [36]. The interest of policymakers is now shifting towards the identification of the determinants of observed inequalities, with the aim of developing policy measures targeted at promoting forms of solidarity, not only between sick and healthy individuals, which is implicit in any health insurance system, but also solidarity between rich and poor [15].

Socioeconomic factors are widely acknowledged as important determinants of health: low socioeconomic status has been repeatedly linked to a great burden of disease and death [17, 54]. Income level is the key socioeconomic indicator: "Income provides the prerequisites for health,

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✉ Cinzia Di Novi
cinzia.dinovi@unipv.it

1 Department of Economics and Management, University of Pavia, via San Felice, 5/7, 27100 Pavia, Italy

2 Department of Economics, Ca' Foscari University of Venice, Venice, Italy

3 Health, Econometrics and Data Group, University of York, York, UK

4 LCSR, National Research University Higher School of Economics, Moscow, Russian Federation

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such as shelter, food, warmth, and the ability to participate in society; living in poverty can cause stress and anxiety, which can damage people's health; and low income limits peoples' choices and militates against desirable changes in behavior" ([7] p. xxi). The slope of the socioeconomic gradient in health appears to be correlated to the level of income inequality in a society: the more unequal a society is in economic terms, the more unequal it is in health terms.

There is considerable debate about the extent to which taxes should be used more actively to redistribute income. The debate focuses, in particular, on progressive taxation, which is often suggested as a way to mitigate societal income inequality [30, 41]. Policymakers have a variety of instruments at their disposal for influencing the progressivity of the personal income tax; such instruments include the exemption of certain types of income from taxation, allowances, deductions, and tax credits [53].

In several countries, personal income tax laws permit tax credits for out-of-pocket healthcare expenditure. The main aim of tax incentives is to encourage and support individuals' behaviors that have social relevance. In countries where the private sector is involved as the major provider of health coverage to citizens, tax credits are used as a mechanism for extending insurance coverage to the uninsured [31]. The use of tax incentives in tax-funded universal health systems, where all citizens are granted free access to healthcare and equal standards of healthcare, is not purely justified on the ground of horizontal equity. Other motivations, such as providing patients with more freedom to get the treatment from a private provider, especially when public sector is congested by longer waiting time, or granting an incentive to ask for the receipt of the transaction (making it difficult for the private provider to evade taxes) seem to be more suitable [19].

Although the main purpose of the tax credit is not to redistribute income, its distributional effects may be relevant. Overall, tax credits benefit taxpayers at all income levels, but they raise the after-tax incomes of higher-income taxpayers more than that of lower-income taxpayers to the extent that high-income taxpayers are more likely to participate in the subsidised activities (see, for example, [47]). Moreover, when tax credits are non-refundable, low-income taxpayers are often unable to receive the full benefit of the credits for which they qualify.

Redistributive consequences of tax credits have been widely investigated [9, 42] however, little is known about the ability of healthcare tax credits to alleviate health inequality. Actually, tax credits influence the level of healthcare expenses and taxpayers' disposable income and may potentially affect taxpayers' 'health status and health inequality since income and healthcare consumption enter directly the individual health production function. Indeed, tax credits modify the price of out-of-pocket expenditure and, to the extent that consumer demand is price elastic, influence the amount of eligible healthcare expenditure. A variation in the amount of eligible healthcare expenditure modifies in turn the net tax liability and consequently the taxpayers' disposable income. These two effects may influence the taxpayers' health status and income-related inequality in health.

The aim of this paper is to test the potential effect that tax credits for health expenses may have on income-related inequality in health. For this purpose, we use a tax-benefit microsimulation model that reproduces Italian personal income taxation (Imposta sui Redditi delle Persone Fisiche—IRPEF), while also incorporating information on taxpayers' behavioral responses to tax credits and their impact on health expenditure. Most studies do not incorporate this aspect, since sufficient data on behavioral responses are often unavailable.

We simulate the taxpayers' behavioral responses with reference to different scenarios in which we modify the tax credit rate design. Actually, we analyze five scenarios: the current baseline scenario in which the tax credit is fixed at 19%; a second scenario in which health costs do not qualify for a tax credit; a third scenario in which the tax credit rate is higher than the current baseline scenario; a fourth scenario in which we introduce an upper threshold to the tax credit and, finally, a fifth scenario in which the tax relief is a decreasing function of income. The basic idea is to understand whether any of the policy scenarios we examine could result in variation in health inequality among taxpayers compared to the reference situation.

To the best of our knowledge, there are no studies about the effect of personal income tax credits on health inequalities, either for Italy or for other countries.

The layout of the paper is as follows. Following this introduction, "The Italian healthcare system and income tax credits" presents the institutional background of healthcare expenditure. "Empirical approach" describes the mechanisms that underlie income tax credit, data and the empirical model. "Results" presents the results. Concluding comments are given in "Conclusion".

The Italian healthcare system and income tax credits

The Italian National Health Service (NHS) is a Beveridge-like healthcare system. It was established in 1978 to replace a Bismarckian system of health insurance funds with the declared goal of providing uniform and comprehensive healthcare services across the country. Indeed, in Italy, most of the healthcare costs incurred are covered by publicly funded health insurance, which provides universal coverage free of charge.

Despite these major reforms, public healthcare spending has undergone strong growth, which has exceeded economic growth in recent decades [16]. Especially in the years preceding the economic crisis, public health spending outpaced the rest of the economy, with an annual average growth of 5.3% [29]. According to the OECD's Health Statistics [40], the Italian healthcare sector now accounts for over 8.8% of GDP, whereas other advanced countries with modern healthcare systems spend 9% or more. However, the ageing of the population and the development of potentially valuable, but expensive, innovations are likely to put continuing upward pressure on health spending, especially on the public side.

Up until now, public healthcare has been largely financed by national and regional taxes and only supplemented by co-payments for pharmaceuticals and outpatient care determined according to income, age, health conditions, and other individual characteristics, with a certain level of regional discretion [23].

The Italian personal income tax currently offers a non-refundable income tax credit for eligible out-of-pocket health expenses.[1] There are two categories of out-of-pocket payments: the first category is cost-sharing instruments (co-payments for pharmaceuticals, diagnostic procedures, and visits to a specialist); the second category is patients' direct payments to medical care providers for private medical services.[2] Since 2009, out-of-pocket spending has recorded much higher average growth as share of GDP, while before the crisis the average growth rate was less pronounced (see Table 1).

The number of applicants who claimed income tax credits for eligible out-of-pocket health expenses relative to the number of taxpayers overall has also increased over time. Table 2 presents trends for the 2003–2013 period; the jump in the application rate between 2003 and 2013 was dramatic: from 27.8% in 2003 to 41.4% in 2013.

Several factors may have contributed to this increase. Because of cost-containment policies in the public sector, patients have been forced to pay higher co-payments for outpatient/ambulatory care, diagnostics, and drugs. In particular, from 2011, regions have introduced additional co-payment to existing tariffs for visits to public and private accredited specialists and also a charge for visits by patients aged 14 or older to hospital emergency departments when they are evaluated in the lowest priority class [16]. Longer waiting lists for NHS treatment may have also contributed to greater out-of-pocket healthcare expenditure and consequently to a higher tax credit application rate. Indeed, in Italy waiting time is a critical issue, especially for out-patient specialist care and diagnostic service [20, 22]. The longer waiting lists that have affected these services in the last decades may have led patients to some migration towards the private sector, which imply higher healthcare expenses compared to the public health care sector [8].

As Table 2 indicates, the amount of healthcare expenses for which taxpayers have claimed a tax credit is lower than the amount of out-of-pocket expenditure shown in Table 1. The discrepancy may be explained by the fact that taxpayers could only receive a 19% deduction for health expenses in excess of an initial deductible of €129.11 per year, and claims must always be accompanied by receipts. The need to provide receipts may discourage applicants to take the necessary steps to claim the credit. Moreover, taxpayers are sometimes unable to provide receipts when payments are informal because of tax evasion during visits to a specialist. In addition, taxpayers with income below a certain threshold are exempt from IRPEF and are consequently unable to claim the tax credit.[3] Nevertheless, in the last decade, the share of healthcare expenses for which taxpayers have claimed tax credits for private healthcare expenditure increased from 37% in 2003 to 49% in 2013.

With reference to fiscal year 2013, Table 3 shows the distributional patterns of applicants and eligible healthcare expenditure (total and average). Both the number of applicants and the average eligible expenses are increasing by classes of reported income: tax credits tend to benefit more upper-income taxpayers while those in lower-income classes partly loss tax credits because of their low level of taxable income/gross tax liability and the non-refundable nature of these tax credits (see [1]).

Empirical approach

We assume that taxpayers maximize a utility function that depends on health H and on a composite "numeraire" good X that yields direct satisfaction, but does not affect health:

$$U = U(X, H). \tag{1}$$

[1] IRPEF is currently the main tool for income redistribution policies. IRPEF accounts for around one-third of overall government tax revenues. IRPEF tax relief is provided for costs with a particular social relevance, such as those paid by taxpayers for health reasons: health costs of any type (doctor's fees, specialist's fees, surgery costs, pharmaceutical costs, prescription medications, and appliances such as glasses, hearing aids, etc.) qualify for a 19% tax credit.

[2] The broad list of eligible health expenses is prescribed in the legislation.

[3] Exemption from IRPEF is determined by a universal tax credit granted for specific income sources: the tax credit is applicable for either employment income or self-employment income, or pension income, with a withdrawal rate resulting in a decreasing credit as gross income increases. This tax credit contributes to the income tax progressivity design, even more so given the absence of a legal zero rate tax bracket. The no-tax hurdle is: €8000 per year for subordinate workers; €7500 for pensioners under 75 years of age; €7750 for pensioners aged 75 or older; €4800 for the self-employed. Furthermore, the no-tax hurdle increases further if there are dependent family members.

Table 1 Public and private healthcare expenditures in Italy from 2003 to 2013. Source: Health for All, ISTAT (Italian Bureau of Statistics) [29]

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Public healthcare expenditure (€ million)	81,332	89,361	95,316	100,554	101,342	108,077	109,739	112,588	111,715	109,849	109,378
% of GDP	6.09	6.42	6.67	6.77	6.52	6.86	8.03	7.01	6.82	6.80	6.81
Private healthcare expenditure (€ million)	25,981	26,613	27,285	27,841	26,202	27,231	26,734	30,954	33,254	32,765	31,884
% of GDP	1.95	1.91	1.91	1.87	1.69	1.73	1.96	1.93	2.03	2.03	1.98
Total healthcare expenditure (€ million)	107,313	115,974	122,601	128,395	127,544	135,308	136,473	143,542	144,969	142,614	141,262
% of GDP	8.04	8.33	8.58	8.64	8.21	8.59	9.99	8.94	8.85	8.83	8.79

Following the Grossman model [25], H has both consumption and investment aspects, as it enters the utility function directly and determines the amount of healthy time available for market and non-market activities. The marginal utility of consuming H is assumed to be non-negative. The stock of health capital is determined by the production function

$$H = h(y, k, q_{\mathrm{h}}), \tag{2}$$

where y is the personal income, q_{h} healthcare consumption, and k individual characteristics and actions such as age, sex, work, education.

The individual aims to maximize her utility subject to a budget constraint. We assume that the taxpayer allocates her income between spending on health goods q_{h}, and consumption goods X, according to the following budget constraint:

$$y - \overline{T} = X + p_{\mathrm{h}}(1 - d)q_{\mathrm{h}}, \tag{3}$$

$$X, q_{\mathrm{h}} \geq 0, \tag{4}$$

where y is the gross personal income, $\overline{T}$ is the net tax liability before subtracting the tax credit for healthcare expenses, and p_{h} is the price of the healthcare services incurred by the individual, while the price of non-healthcare consumption goods is normalized to one. The tax credits act as a subsidy to out-of-pocket health expenditure, reducing the price of eligible expenditure at the rate d, so that the after-tax price is $p_{\mathrm{h}}(1 - d)$. Expression (4) shows the non-negativity conditions on consumption and on healthcare services.

The tax credit produces two effects. Firstly, it reduces the net tax liability. Secondly, as Eq. (3) demonstrates, it modifies the price of out-of-pocket expenditure relative to other goods and the amount of eligible healthcare expenditure for which taxpayers may claim a credit.[4] The two effects may influence the taxpayers' health status and income-related inequality in health through the variation in disposable income and healthcare expenditure.

Data

To perform our analysis, we use a tax-benefit microsimulation model (BETAMOD) developed recently by [1]. BETAMOD is a static model that reproduces IRPEF taxation, building on a detailed reconstruction of tax legislation. However, BETAMOD does not include a simulation of individuals' behavior, so any analysis of changes in tax-benefit policies is limited to first-order effects. In order to evaluate the response of taxpayers to the tax credit and its impact on individuals' health status, we need to complement BETAMOD with two new modules. The first one introduces a behavioral equation to estimate the tax price elasticity of demand for eligible healthcare expenditure (see "The price elasticity of healthcare expenditure"); the second one introduces a health status equation (see "The health equation and health inequality"). The two new modules are integrated in BETAMOD, as shown in Fig. 1 in "Appendix A".

BETAMOD mainly runs on data from the 2011 Italian Statistics on Income and Living Conditions Survey (IT-SILC). IT-SILC provides multi-dimensional data on income and living conditions. It is characterized by a rather large sample size (comprising 19,399 households and 47,841 individuals). Information about health and other individual characteristics, such as occupational status and education, in addition to demographic variables, refers to individuals aged 16 and over. BETAMOD uses health-related indicators and a detailed set of health expenses to evaluate the redistributive effects of tax credits in the healthcare sector. We use for our analysis, in conjunction with BETAMOD, the 2011 IT-SILC cross-sectional data and also include lagged information on the same individuals from the 2009 and 2010 wave of the same survey.

Concerning the selection of the sample, we have taken into account that the amount of health expenses for which the taxpayer can claim a tax credit can also include those

[4] Typically, the individual demand for health care services under full insurance coverage regime tends to be inelastic (for details, see [38, 50, 24]).

Table 2 Healthcare expenses for which taxpayers have claimed a tax credit (€ million) and number of applicants from 2003 to 2013. Source: Ministry of Economy and Finance [37]

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Healthcare expenses for which taxpayers have claimed a tax credit	9491	10,377	11,015	11,684	12,719	11,951	12,678	13,606	14,383	15,205	15,581
% of GDP	0.71	0.75	0.77	0.79	0.82	0.76	0.93	0.85	0.88	0.94	0.97
% of private healthcare expenditure	36.53	38.99	40.37	41.97	48.54	43.89	47.42	43.96	43.25	46.41	48.87
Number of applicants	11,311,757	11,865,536	12,231,361	12,570,151	13,493,934	13,361,823	14,172,055	15,002,250	15,684,283	16,400,628	16,731,808
% of total taxpayers	27.87	29.30	30.02	30.84	32.39	32.22	34.43	36.44	38.32	40.46	41.42

Table 3 Number of applicants and health care expenses by classes of reported income. Source: Italian Ministry of Economy and Finance, 2013

Classes of reported income	Number of applicants as % of total taxpayers	Health care expenses for which taxpayers have claimed a tax credit	
		Total amount (€ million)	Mean value (€)
Under 5000	7.17	288,945	607
5000–7500	11.07	241,048	588
7500–10,000	25.31	464,102	642
10,000–12,000	34.07	585,960	696
12,000–15,000	40.36	1,041,391	755
15,000–20,000	47.36	2,429,972	817
20,000–26,000	56.85	3,105,058	886
26,000–29,000	63.01	1,320,792	955
29,000–35,000	66.71	1,888,748	1,013
35,000–40,000	69.77	940,773	1088
40,000–50,000	71.22	1,053,074	1194
50,000–75,000	71.84	1,141,973	1385
Above 75,000	71.47	1,078,968	1789
Total	40.82	15,580,804	931

incurred by a dependent relative. Indeed, eligible medical expenses can be paid by or on behalf of the taxpayer and dependent family members. According to personal income tax law, dependent family members include the spouse, children, and other relatives living with the reference person and who have a personal gross income (before deductions) of below €2840. However, the available data do not allow us to distinguish between individual expenses and those of relatives. In our sample, therefore, we have included only taxpayers without dependent family members. The final sample, after correcting for the missing values, identifies 1572 individuals who have incurred healthcare expenses in excess of a deductible of €129.11.

Table 4 shows a simple descriptive analysis that presents sample means and standard deviations for the variables used in the models.

First of all, from the descriptive statistics concerning the health index, in 2011, it emerges that individuals seem to have suffered from a deterioration in their health status with respect to the previous years considered in our analysis. These data are also confirmed by previous literature, also based on IT-SILC (see [2]), which shows a similar deterioration that is particularly relevant among the elderly.[5]

[5] It is worth noting that our sample (which is 39% male) also consists of individuals whose average age is quite high: 60 years old. This is not surprising, since we only considered individuals without dependent relatives.

Table 4 Descriptive statistics

Variable	2009		2010		2011	
	Mean	SD	Mean	SD	Mean	SD
Dependent variables						
Health index	0.737	0.288	0.757	0.274	0.590	0.323
Health expenditure			694	323		
Socio-economic variables						
Low education			0.198	0.399	0.183	0.387
Medium education			0.615	0.487	0.617	0.486
High education			0.187	0.390	0.201	0.401
Single			0.177	0.382	0.168	0.374
Married			0.570	0.495	0.574	0.495
Separated/divorced			0.095	0.293	0.097	0.296
Widow			0.159	0.365	0.162	0.368
Employed			0.440	0.497	0.425	0.495
Unemployed			0.005	0.070	0.010	0.102
Retired			0.452	0.498	0.458	0.498
Other occupation			0.103	0.304	0.107	0.309
Disposable household income	38,862	25,952	38,875	26,091		
Living standard index			4.8	2.0		
Price index of health expenditure			104.4	6.123		
Demographic variables						
Age			59.5	14.3	60.5	14.3
Male					0.390	0.488
Regions						
Piedmont					0.079	0.270
Valle d'Aosta					0.002	0.044
Lombardy					0.269	0.444
Bolzano					0.004	0.061
Trento					0.006	0.076
Veneto					0.154	0.361
Friuli Venezia Giulia					0.024	0.153
Liguria					0.021	0.145
Emilia Romagna					0.166	0.372
Tuscany					0.059	0.235
Umbria					0.018	0.133
Marche					0.021	0.142
Lazio					0.076	0.265
Abruzzo					0.021	0.142
Molise					0.003	0.051
Campania					0.020	0.140
Apulia					0.025	0.155
Basilicata					0.001	0.037
Calabria					0.012	0.109
Sicily					0.017	0.129
Sardinia					0.004	0.064

Our empirical analysis proceeds in the following way. First, we estimate the price elasticity of healthcare expenditure, the taxpayers' health status, and income-related inequality in health referring to the baseline scenario (tax credit rate at 19%). Second, we simulate the effect of the variation of the tax credit rate on healthcare expenditure depending on price elasticity. Then, we compute the individual's new tax liability as a result of varying the tax credit rate and healthcare expenditure and, consequently, the new level of disposable income. Finally, we check whether the variation of healthcare expenditure and disposable income may have an impact on an individual's health as well as his or her position according to income distribution and therefore income-related inequality in health. The procedure is sketched in Fig. 1 in "Appendix A".

The price elasticity of healthcare expenditure

In this subsection, we estimate the taxpayers' elasticity of demand for healthcare with reference to the current baseline scenario (19% tax credit).

We estimate the following equation:

$$\log q_i = \alpha_0 + \alpha_1 \log y_{-1,i} + \alpha_2 \log p_i(1-d) + \alpha_3 H_{-1,i} + \sum\nolimits_k \gamma_k x_{k,i}, \quad (5)$$

where $i = 1,\ldots, N$ is referred to individual taxpayers. As the dependent variable, we use the amount of healthcare expenditure for which taxpayers have claimed a credit (q_i), which is available from the BETAMOD microsimulation model.[6,7] Among regressors, the key explanatory variables for our analysis are after-tax price ($p_i(1-d)$), lagged income ($y_{-1,i}$) and lagged health status ($H_{-1,i}$). $x_{k,i}$ denotes demographic and socioeconomic variables.

The price variable enters the regression model as an after-tax price of eligible outlays. The price schedule for healthcare services in the Italian system is quite complex. The price that a consumer pays for healthcare services depends on co-payments and the deductible. In our paper, we collected data about the consumer price index of healthcare from the [28] ISTAT database.[8] The consumer price index approximates what households spend out-of-pocket on healthcare goods and services used for day-to-day living. ISTAT provides information on prices at the regional level, and thus we calculated consumption prices, expressed in log, according to the region of residence [28].

Income information is based on total annual household income, obtained by adding up its different components assessed in the questionnaire after deductions for income tax and social or national insurance contributions in the year preceding the interview. It mainly comprises cash income from labor, employee income in kind received from the use of a company car for private needs estimated in cash, income earned or losses incurred from self-employment, received pensions and benefits, regular material assistance from other households, profit from interests of deposits, dividends, shares, income received by children aged under 16, income from property rentals, and receipts for tax adjustments from the State Revenue Service (for business activities, eligible costs, education, medical treatment, etc.). We use equivalent household income before the application of the existing 19% tax credit, and, in order to avoid potential simultaneity problems with healthcare expenditure, we included lagged income expressed in log.[9]

The last key variable is a measure of health that combines self-assessed health (SAH) with activities of daily living (ADL) and chronic condition indicators using a multiple correspondence analysis (MCA) following [34]. The health indicator is included as a lagged variable at time -1 to avoid endogeneity problems in the healthcare expenditure equation (for details about the construction of the health index, see "Appendix B").[10]

Finally, we add demographic and socioeconomic variables, which are standard controls in the literature explaining healthcare demand behavior (age, sex, marital status, level of education, and employment status). Age is modeled as a

[6] In order to obtain the expenditure in real terms, we employed a health-care specific deflator. Accordingly, we also deflated the income indicator by using the consumer price index.

[7] BETAMOD estimates, at the individual level, the conditional probability of incurring tax-relevant healthcare expenditures as a function of individual characteristics known to be predictive of health expenses, such as sex, age, health status, geographical region, marital status, income, occupation, and education. Next, BETAMOD uses the probability of healthcare spending together with fiscal data on tax relief (Ministry of Economics and Finance, 2010) to identify beneficiaries of healthcare tax relief, and to impute related amounts of expenditure (for details, see [1]).

[8] The consumer price index concerns goods and services used, such as pharmaceuticals, visits to doctors and specialists, medical services, dentistry, clinical analysis, and diagnostic tests. We assign to each individual in our sample the price index according to her region of residence, so that the price index captures regional variation only and does not account for other aspects.

[9] To obtain the annual "equivalent household income", we divided the household disposable income by its "equivalent size", which is calculated using the "modified OECD" equivalence scale. This scale gives a weight of 1.0 to the first adult, 0.5 to any other household member aged 14 and over, and 0.3 to each child under 14.

[10] We also tried a different specification including quadratic terms in income and health in the right-hand side of healthcare expenditure equation. For health indicator, we found no evidence of a quadratic relationship. The square of income is statistically significant but the inclusion of the square income does not significantly affect the results: the price elasticity coefficient remains very similar to the baseline model.

continuous variable; female is the reference category for sex. Marital status dummy variables include married (reference category), divorced/separated, widowed, and never married. Education is measured by the ISCED-97 classification. Three levels of education are considered: (1) low education (no educational certificates or primary school certificate or lower secondary education); (2) medium education (upper secondary education or high school graduation) (reference category); (3) high education (university or postgraduate degree). Employment status is divided into four groups: employees and self-employed (reference category), unemployed, retired, others (student, housewife, unable to work).

Regarding the dependent variable, we only observe expenditure from individuals whose healthcare expenses exceed the deductible of €129.11. For people who do not exceed the deductible or do not use healthcare services, the expenditure level reported in the data is zero. However, this situation does not necessarily mean that those people do not need healthcare or need a low level of healthcare. It may also indicate that market prices of these services are higher than the levels they are willing to pay. We also have to take into account that other individuals may undertake healthcare expenses, but then fail to claim the tax relief. As a result, the true health expenditure under this situation may actually be unreported, and this absence of data may be not random. One standard parametric approach that deals with this problem is using a Heckman correction for sample selection [26]. Therefore, we have started by estimating a Heckman sample selection model. Since from our results it arises that the inverse Mill's ratio is not statistically significant, the use of Heckman two-step estimation is not justified. Hence, we have re-estimated the model for healthcare expenditure using a linear regression model without sample selection correction.[11]

The health equation and health inequality

In order to estimate the health equation we employ, as a dependent variable, the above-described measure of health, which combines self-assessed health (SAH) with activities of daily living (ADL) and chronic condition indicators (see "Appendix B"). Since the health index has a continuous distribution over the interval 0 and 1, we estimate the determinants of health using a Tobit model, which is relatively common when data is censored at 1 and/or 0 [43]:

$$H_i = \beta_0 + \beta_1 H_{-1,i} + \beta_2 y_{-1,i} + \beta_3 \mathrm{LS}_{-1,i} + \sum\nolimits_k \beta_k x_{k,i} + \sum\nolimits_r \beta_r R_{r,i}. \tag{6}$$

Among the regressors, we consider health ($H_{-1,i}$), income ($y_{-1,i}$) and living standard ($\mathrm{LS}_{-1,i}$) included as a lagging variable in order to mitigate simultaneity. We construct the living standard indicator from information regarding medical and healthcare expenses and other standard-of-living information collected during the interviews.[12] Moreover, to avoid collinearity problems, we derive a one-dimensional index using principal component analysis (PCA).[13,14] Finally, we include a set of demographics and socioeconomic variables: age, sex, marital status, education, occupation ($x_{k,i}$), and regional dummies ($R_{r,i}$).

To measure inequality in health, we employ the concentration index *C(H)* proposed by Wagstaff et al. [51] and Wagstaff and van Doorslaer [52]:

$$C(H) = \frac{2}{n\mu}\sum_{i=1}^{n} H_i r_i - 1 = \frac{2}{\mu}\mathrm{cov}(H, r), \tag{7}$$

where μ is the average health status in the sample, n is the sample size, H_i is the health status of the i-th individual and r_i signifies the i-th individual's rank within the income distribution. The concentration index (CI) provides a summary measure of the magnitude of income-related inequality in a health variable of interest. Since the variable that measures health status is distributed between 0 and 1, as suggested by Erreygers [21], we use a corrected version of the concentration index to compute income-related inequality in health. This index is defined as:

$$E(H) = \frac{4\mu}{(b_n - a_n)} C(H), \tag{8}$$

[11] For a Heckman model to work, it requires exclusion restrictions, i.e., regressors that enter the selection part, but not the second part of the model. We have included in the reduced form a proxy of barriers to access health care services. We have constructed an interaction term between a dummy variable that takes a value of 1 if the respondent lives in the south of Italy and a dummy variable, which indicates whether the respondent lives in a thinly populated area. In the south of Italy, in particular, the lack of financial means is one of the most relevant barriers to healthcare access [11]. For the sake of brevity, we do not include the results of the Heckman two-step estimation in the paper, but they are available upon request.

[12] By "other standard-of-living information" we mean assets, housing (water, electricity, and gas bills), fuel, clothing, whether the home is owned, number of rooms per household member, overall size of dwelling (i.e., the number of square meters per person) and a battery of items on possessions in the home. These possessions include household items such as a television, satellite dish, mobile phone, computer, Internet access, hi-fi stereo, camera, washing machine, dishwasher, air conditioning, and a car [49, [39]. According to the previous literature, housing in particular is a core element of people's material living standards. Housing conditions may strongly influence people's health and quality of life (see [5]).

[13] PCA transforms the original set of variables into a smaller set of linear combinations that accounts for most of the variance of the original set. For a detailed discussion on how to construct asset indices, see [49].

[14] We also rescaled the index by adding a constant, which was the minimum whole number required to eliminate negative values. This rescaling does not affect the contribution of each variable to the concentration index, since the rank order remains unchanged.

where b_n and a_n represent the maximum and the minimum value, respectively, of the health status index H (in our case 0 and 1) and $C(H)$ represents the standard concentration index specified in (4).[15] The range of the Erreygers concentration index $E(H)$ is from -1 to 1. A negative value indicates a pro-poor inequality, meaning that health is concentrated among the most disadvantaged persons; a positive value indicates a pro-rich inequality, meaning that the health is more concentrated among the better-off. A value of 0 indicates that health is perfectly equally distributed among the population.

In order to measure health inequalities that reflect only non-demographic health differences, an indirectly standardized concentration index was computed. Health status H has been standardized by age, gender, and region of residence to obtain an estimate of potentially avoidable inequality (see also [39]). The standardization provides the possibility of understanding whether higher-income groups are more likely to enjoy good health than lower-income groups, keeping demographics constant. After standardization, any residual inequality in health may be interpreted as horizontal inequality (which could be pro-rich or pro-poor). Indirectly standardized health status $\hat{H}_i^{IS}$ can then be obtained by calculating the difference between actual health (H_i) and standardized health status ($\hat{H}_i^X$), plus the sample mean ($\bar{H}$):

$$\hat{H}_i^{\mathrm{IS}} = H_i - \hat{H}_i^X + \bar{H}. \quad (9)$$

Equation (9) indicates that standardization will subtract the variation in health driven by demographic factors from actual health. Therefore, the distribution of $\hat{H}_i^{\mathrm{IS}}$ across income can be interpreted as the health status we expect to observe in an individual, irrespective of differences in the distribution of demographic characteristics.

Results

Concerning the results of the empirical estimation, Table 5 shows the coefficients relative to the health expenses equation (which relies on the current benchmark scenario characterised by a tax credit rate of 19%). The estimates provide elasticity of demand for healthcare with respect to the after-tax price of eligible expenses, $p_{\mathrm{h}}(1 - d)$, and the equivalent income, which are included among regressors and expressed in log.

According to the previous studies, which show that price elasticity of demand for healthcare ranges between -0.04 and -0.75, we find a negative and statistically significant price elasticity of 0.7.[16] In other words, our results suggest that individuals increase their eligible health expenses by 0.7% in response to a 1% reduction in price.[17] We also find that the demand for healthcare services increases with income, but the coefficient is relatively small: estimated income elasticity is 0.17. This is consistent with past empirical analysis, suggesting that income elasticity ranges between 0 and 0.2 [24, 35]. Finally, as expected, health expenses are negatively correlated with the health index and a higher socioeconomic status.

The second step of our empirical strategy consists of estimating the health equation. Again, we refer to the current benchmark scenario (tax credit rate of 19%). The coefficients of the determinants of individuals' health status are included in Table 6.

Starting with socioeconomic variables, our analysis confirms a positive gradient between various indicators of higher socioeconomic status and health. Having a higher education, being married, and being employed have significant and positive associations with individual health status. In particular, individuals who are better off in terms of income and living standard tend to exhibit better health conditions. Consistent with previous empirical findings, the results also show that age and gender are significant predictors of health (see, among others, [12, 6, 18]).

Income-related inequality in health is estimated using a well-established method based on concentration indices. The method involves estimating the model of the determinants of health included in Table 6.

In the baseline scenario, when the tax credit is equal to 19%, the EDA inequality index is significant and positive denoting a pro-rich health inequality (see Table 7).

In order to understand whether a reduction or an increase in the tax credit rate can result in a health inequality variation among taxpayers over the reference situation, we simulate different tax-credit scheme scenarios.

Firstly, we consider a scenario in which health costs do not qualify for a tax credit, i.e., a tax credit rate equal to 0%. Obviously, the price of healthcare services increases

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15 Note that, in contrast to C(H), the Erreygers index does not depend on the mean of health. Moreover, while the standard concentration index may give conflicting information when applied separately to good health and poor health, the Erreygers index satisfies the so-called "mirror property", namely the inequalities in health "mirror" those in poor health [14].

16 In the Canadian context, Smart and Stabile [44] have found price elasticities in the range of –0.27 to –0.9 across different categories of medical care spending. A review of the empirical literature on price and income elasticity of the demand for health insurance and healthcare services is given in [35].

17 In order to check the robustness and the extensibility of our results, we have simulated the tax price elasticity for different family types: singles vs. couples. The elasticity of healthcare expenditure with respect to after-tax price is very similar (respectively -0.71915 and -0.71566) and the difference is not statically significant.

Table 5 The estimated health expenditure equation ($t = 2010$)

Dependent variable: Health expenditure	Coefficients		Standard errors
Constant	3.06739	***	0.86117
Age	0.00184		0.00134
Male	0.08285	***	0.02356
Health index ($t - 1$)	−0.14307	***	0.04377
Equivalent income ($t - 1$)	0.17360	***	0.01723
After tax price index of health expenditure	−0.70331	***	0.18794
Low education	−0.15133	***	0.03146
High education	0.13909	***	0.03001
Single	−0.02749		0.03389
Separated/divorced	−0.02240		0.03920
Widow	0.12841	***	0.03569
Unemployed	−0.37950	*	0.16003
Retired	0.14653	***	0.03514
Other occupation	−0.20599	***	0.04658
Numb. obs.	1572		
$F(13, 1558)$	30.15		
Prob > F	0.0000		
R-squared	0.2010		
Root MSE	0.4368		

The dependent variable, equivalent income, and after-tax price index of health expenditure are in logs. Linear regression model estimated by OLS

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 6 The estimated health index equation ($t = 2011$)

Dependent variable: Health index	Coefficients		Standard errors
Constant	0.54234	***	0.06692
Health index ($t - 1$)	0.49481	***	0.03062
Socio-economic variables			
Low education	−0.14803	***	0.02176
High education	0.14278	***	0.02199
Single	−0.13772	***	0.02505
Separated/divorced	−0.02826		0.02767
Widow	0.00467		0.02571
Unemployed	−0.25407	***	0.07419
Retired	−0.07033	**	0.02445
Other occupation	−0.14906		0.03245
Equivalent income ($t - 1$)	1.93e−06	***	5.33e-07
Living standard index ($t - 1$)	0.02595	***	0.00498
Demographic variables			
Age	−0.00570	***	0.00094
Male	−0.07294	***	0.01636
Piedmont	−0.04506		0.03095
Valle d'Aosta	0.28942		0.18119
Bolzano	0.22651		0.14531
Trento	0.18443		0.10306
Veneto	0.09620	***	0.02511
Friuli Venezia Giulia	−0.02715		0.05179
Liguria	−0.13796	*	0.05344
Emilia Romagna	0.02978		0.02412
Tuscany	−0.10077	**	0.03451
Umbria	−0.01827		0.05877
Marche	−0.05410		0.05583
Lazio	−0.02940		0.03192
Abruzzo	0.02730		0.05543
Molise	−0.11065		0.14994
Campania	−0.22907	***	0.05542
Apulia	−0.11618	*	0.05072
Basilicata	−0.30770		0.20050
Calabria	−0.20323	**	0.06901
Sicily	−0.34428	***	0.05983
Sardinia	−0.04943		0.12548
Numb. obs.	1572		
LR Chi^2	1043.89		
Prob > Chi^2	0.0000		
Pseudo R-squared	0.4163		

Tobit regression model

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

and the taxpayer reduces her healthcare expenditure (to 580€). In this case, however, the lack of a tax credit also produces an increase in the net tax liability and therefore leads to a reduction in the individual's disposable income (to 28,794€), potentially influencing the health income-related inequality even more. Table 7 shows that a reduction in the tax credit rate with respect to the benchmark scenario produces a slight reduction in pro-rich inequality.

In the second simulation, as a new tax credit rate we chose 50% of eligible healthcare expenses. Thanks to the estimated elasticity of healthcare expenditure with respect to the after-tax price, we obtain, using BETAMOD, an increase of individual's healthcare expenditure (1027€ on average with respect to 694€ of the baseline scenario) and an increase of average disposable income (from 28,937 to 29,330€), while the average health index remains relatively constant (see Table 8). The new income distribution influences the health income-related inequality, with a slight increase of pro-rich inequality (see Table 7).

Our results suggest that the design of the healthcare tax credit embedded in the Italian personal income tax tends to favor the richest part of the population. This effect may be due to the fact that high-income taxpayers benefit more than low-income taxpayers: tax credit is partly lost by taxpayers in the bottom income class due to their low level of tax liability and to the non-refundable nature of this tax credit. There is some evidence that lower-income groups face barriers to specialist care, which are a more expensive

Table 7 Health-inequality index

Tax credit rate	Erreygers inequality index (EI)	Erreygers inequality index adjusted for demographics (EDA)
0%	0.27680*** (0.01275)	0.26865*** (0.02079)
19% (current base scenario)	0.27745*** (0.01272)	0.26929*** (0.02299)
50%	0.27879*** (0.01294)	0.27077*** (0.02077)
Upper threshold to tax credit	0. 27729*** (0.01316)	0.26914*** (0.02007)
Decreasing tax credit rate	0.27675*** (0.01365)	0.26858*** (0.01991)

Standard error in brackets

*** $p < 0.001$

Table 8 Health index, disposable income, and healthcare expenditures (mean values)

Tax credit rate	Health index	Disposable income	Healthcare expenditures
0%	0.5898 (0.3228)	28,794 (17,268)	580 (278)
19% (current base scenario)	0.5901 (0.3229)	28,934 (17,309)	694 (322)
50%	0.5905 (0.3227)	29,330 (17,427)	1027 (453)
Decreasing tax credit rate	0.5900 (0.3226)	28,944 (17,249)	707 (288)
Upper threshold to tax credit	0.5900 (0. 3226)	28,942.(17,273)	804 (278)

Standard error in brackets

component of healthcare expenditure in Italy [23]. Moreover, both average expenses and the number of taxpayers claiming this tax credit increase with income and that the tax credit does not have an upper bound. Concerning this last issue, we also investigate the effect that an upper threshold to the tax credit may have on health-related inequality. In order to ensure a constant tax revenue (leaving the tax credit rate at 19% unchanged), the threshold has been fixed at 1100 euros and the deductible of 129.11 euros has been eliminated. Compared to the baseline scenario, this policy would reduce the health inequality index to 0.26924 (see Tables 7 and 8).

Finally, we simulate a more pro-poor tax credit scheme in which the tax relief is decreasing in income. In particular, in order to ensure a constant tax revenue, we fix the tax credit rate on eligible health expenses at 26.5% for those who record a gross income lower or equal to €15,000 (first personal income tax bracket); for those with income higher than €15,000, the tax credit rate is a linearly decreasing function of income and becomes zero above €75,000 (the highest personal income tax bracket).[18] This simple exercise shows a reduction in income-related inequality in health. The demographics-adjusted inequality index (EDA) is 0.26875, about 0.2% lower than in the status quo (see Tables 7 and 8). Despite the slight variation of the health inequality index, the simulation shows that a tax credit scheme dependent on income is conducive in reducing health inequality and also presents a better redistributive effect with respect to the baseline (see Tables 7 and 8).

We acknowledge that the results of our analysis are affected by data limitations. IT-SILC does not include any information on individuals' healthcare expenditure. Ad hoc data were obtained from the Italian Ministry of Economy and Finance, for specific beneficiaries' distribution across income classes and occupational status (employee, self-employed, and pensioner) and imputed to each IT-SILC observation according to the conditional probability of incurring tax-relevant healthcare expenditure as a function of individual characteristics together with fiscal data in tax relief. Moreover, since BETAMOD refers to 2011 as the fiscal year, the design of our study is cross-sectional. Even though we have included lagged information to capture the dynamic structure of the relationship between health, income, and health care use, it is impossible to disentangle the long-term effect of income variation on health and healthcare expenditure and to infer causality.

Conclusions

The Italian NHS provides universal coverage and responds to the need to reduce income-related inequality in health and in access to healthcare services. Public healthcare is supplemented by co-payments as well, but economically disadvantaged individuals, people older than 65 and

[18] IRPEF consists of five brackets, with the lowest rate (23%) applied to personal income up to €15,000 per year and the highest rate (43%) for marginal income above €75,000 per year.

younger than 6, and individuals who suffer from chronic conditions are exempt from co-payments. Furthermore, due to the social relevance of access to healthcare services, the personal income tax operates a tax credit for eligible out-of-pocket health expenses.

In this paper, we have focused our attention on the last mechanism of income redistribution and its possible influence on health inequality. We tested whether the IRPEF rate of the tax credit for health expenses affects income-related inequality in health via the price elasticity of healthcare expenditure. Our results suggest that individuals increase their eligible health expenses in response to a reduction of the tax price. The effect on health inequality index, albeit relatively small, is positive and pro-rich. Hence, healthcare-related tax credits tend to favor the richest part of the population. Despite these results, the social relevance of the demand for healthcare and the related expenses justify the existence of a tax credit which, on the one hand, pursues the principle of social justice as an ethical imperative and, on the other hand, encourages access to healthcare services, reducing its price. Although healthcare access generally contributes little to reducing health inequalities, it is often a primary mechanism for policy implementation [36]. As a result, care needs to be taken when using the tax instrument to encourage access to healthcare. From our results, it arises that the design of the tax credit is important too, and should take into account the taxpayers' level of income as well. In contrast, a fixed rate for the tax credit, such as the one applied in the Italian taxation system, seems to mostly benefit the rich. Accordingly, we have simulated a new tax credit design that decreases with income, and the results suggest that this might make tax policy more effective in improving equity in health.

On an overall basis, tax credit for medical expenses and health is a poor way of contributing to sustained reductions in health inequities. Tax expenditure, in general, tends to provide a disproportionate share of benefits to households higher up the income scale: only tax-paying families can benefit from them, while low-income ones, which do not pay any personal income tax, cannot. A number of studies show that the tax expenses, among which those for healthcare, raise after-tax income proportionally more for higher-income taxpayers than for lower-income taxpayers, making tax expenditure a regressive aspect of the progressive personal income tax [10, 46, 1]. Reforming tax expenditures programs has long been a goal of tax reformers and may offer a promising avenue to improving the equity of tax systems. In Italy, tax expenditures are currently the object of fiscal policy reforms debate and the healthcare tax credit is one that most likely could be replaced by a better targeted expenditure program [45].

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Appendix A

See Fig. 1.

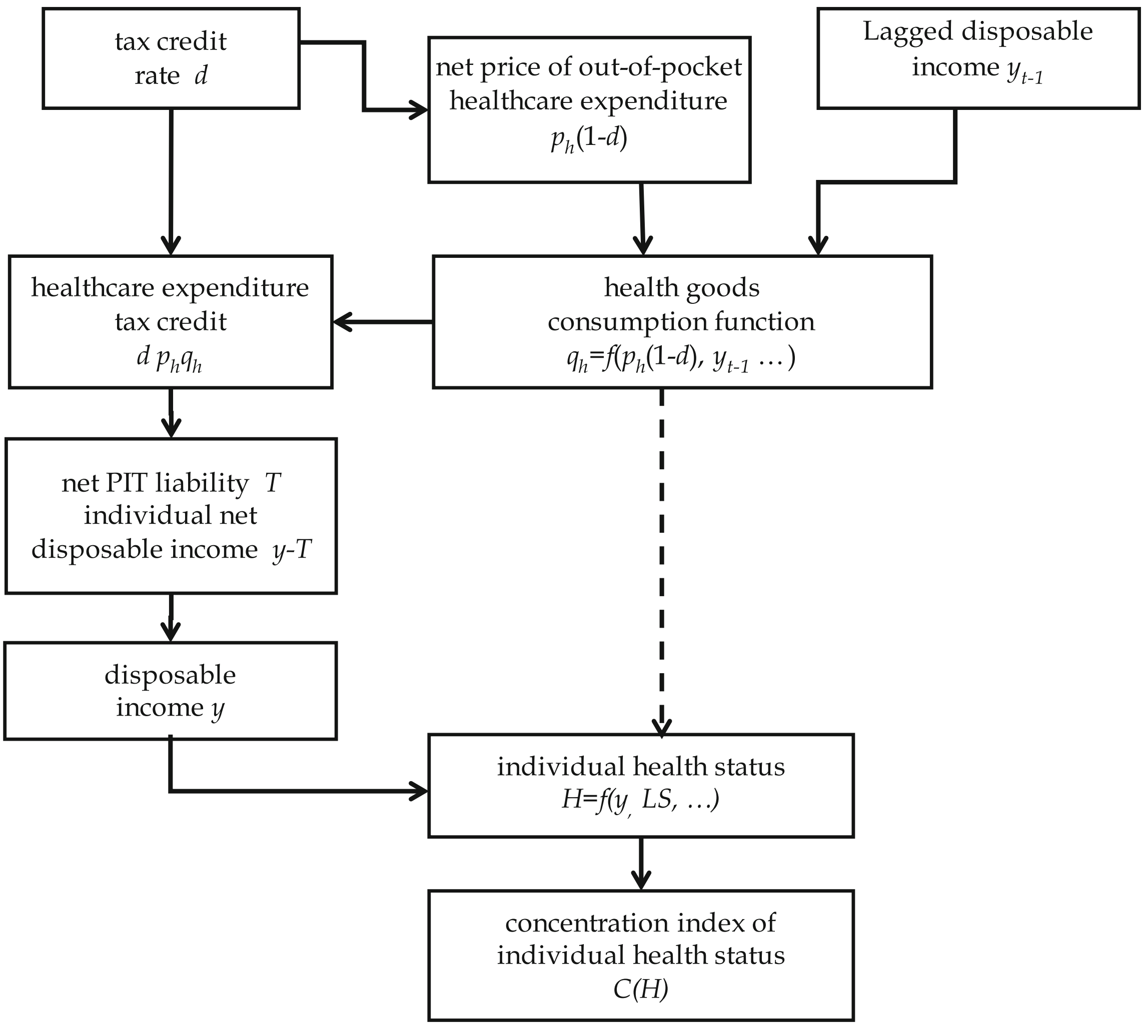

Fig. 1 The assessment of income-related inequality in health using BETAMOD

Appendix B

The health index

IT-SILC provides three different measures of health: self-assessed health (SAH), the presence of chronic diseases, and the presence of conditions limiting daily activities.

SAH is measured with a five-point categorical variable following the conventional levels recommended by the World Health Organization: "very poor", "poor", "fair", "good", and "very good". Hence, the self-assessed health indicator has been included as a five-category ordered variable (ranging from very poor to very good health). SAH has been widely used in previous studies that examined the relationship between health and socioeconomic status (e.g., [32, 12, 18]). SAH is supported by a body of literature that shows a strong predictive relationship between people's self-ratings of their own health and mortality or morbidity [27, 33]. Moreover, SAH correlates strongly with more complex health indices such as functional ability or indicators derived from health service usage [48]. SAH is a subjective measure of health that may involve biases in the measurement of inequalities. Indeed, SAH may be systematically correlated with characteristics such as sex, age, income level, or education. SAH may also be subject to measurement errors caused by the poor design of questionnaires, misunderstood concepts, inadequately trained interviewers, different conceptions of health in general, different expectations for own health or financial incentives to report ill health (see [13, 3, 34] for a discussion of biases associated with self-assessed health).

In order to support the reliability of our measure of health inequality, we also employ two objective (albeit self-reported) functional measures of health: limitations to activities of daily living because of health problems (ADL) and an indicator reporting a chronic (long-standing) illness

Table 9 Health index components (%)

Variable	2009	2010	2011
SAH			
Very poor	2.0	1.5	2.6
Poor	9.1	8.0	12.0
Fair	35.2	36.1	44.3
Good	47.9	48.8	40.1
Very good	5.8	5.6	1.0
Chronic			
Yes	34.4	35.2	60.7
No	65.6	64.8	39.3
ADL			
Strongly limited	7.3	6.2	7.1
Limited	28.2	22.5	43.7
Not limited	64.5	71.3	49.2

or condition. The question about global chronic diseases asked respondents whether they had suffered from or had any chronic (long-standing) illness or conditions in the form of health problems. Answers to this question were kept in its original binary coding ("no" or "yes"). Hence, the chronic condition indicator is a dummy with a value of 1 if a person mentions a chronic illness, and 0 otherwise. Finally, respondents were asked if they had been limited in activities, which people normally do, in the last 6 months due to health problems. The answer categories ranged from "severely limited", "limited but not severely" to "not limited at all". Hence, we use an ordinal scale of 3 points, from 3 (not limited) to 1 (severely limited). Table 9 shows how each indicator is distributed in our sample.

Our choice is explained by the observation that "the specificity of the questions constrains the likelihood that respondents rationalize their own behavior through their answer" [4].

Finally, in order to have a single number that reflects overall health, we constructed a health index through multiple correspondence analysis (MCA), which reduces the multiple discrete indicators described above into a continuous variable. MCA is more appropriate than other techniques such as principal component analysis (PCA) when constructing an index based on ordered categorical variables. Empirical evidence suggests, in fact, that answers to the SAH question, for instance, cannot be scored on a simple scale from 1 to 5 because the true scale will not be equidistant between categories. If PCA was used on an ordered categorical variable such as SAH, or for other discrete or binary indicators of health problems (such as ADL or the presence of chronic illness), the underlying assumption would be that individuals consider the distance between the categories to be equivalent (for details, see [34]). Therefore, the health index has been computed from the weights for each measure of health using row scores based on the indicator matrix of MCA. We also standardize the index to lie on a continuous scale between 0 (poorest health) to 1 (best health) to aid in interpretation.

Table 10 Healthcare expenditure concentration index

Tax credit rate	0%	19%	50%	19% with threshold	Decreasing tax credit rate
Concentration index	0.0723	0.0728	0.0741	0.0625	0.0478

Appendix C

Healthcare expenditure concentration index

Table 10 shows the healthcare expenditure concentration index in the five policy scenarios proposed in our paper.

The results are in line with those presented in the paper, which concerned health inequality. Again, tax relief decreasing in income is conducive to reducing health inequality and also presents a better redistributive effect with respect to the baseline.

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