



Ca' Foscari  
University  
of Venice

**Department  
of Economics**

**Working Paper**

**Cinzia Di Novi, Anna  
Marenzi, and Dino Rizzi**

**Do healthcare tax credits  
help poor healthy  
individuals on low incomes?**

ISSN: 1827-3580  
No. 16/WP/2016





## Do healthcare tax credits help poor healthy individuals on low incomes?

**Cinzia Di Novi**

*University of Pavia, Department of Economics and Management*

**Anna Marenzi**

**Dino Rizzi**

*Ca' Foscari University of Venice, Department of Economics*

### Abstract

In several countries, personal income tax permits tax credits for out-of-pocket healthcare expenditures. Tax credits produce two effects on taxpayers' disposable income. On the one hand, they benefit taxpayers at all income levels by reducing their net tax liability; on the other hand, they modify the price of out-of-pocket expenditure and, 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 two effects influence, in turn, income redistribution and may affect 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 ensure a more equitable distribution of healthcare expenditure and, consequently, to alleviate health inequality. In this paper, we study the potential effects that tax credits for health expenses may have on health-related inequality with reference to the Italian institutional setting. The analysis is performed using a tax-benefit microsimulation model which reproduces the personal income tax and incorporates taxpayers' behavioural responses to changes in tax credit rate. Our results suggest that a healthcare tax credit design that does not rely on income, like the one implemented in the Italian personal income tax, is not effective in improving equity in health and tends to favour the richest part of the population.

**Keywords:** personal income tax, health-related tax credit, health inequality

**JEL Codes:** I10, I14, H24

*Address for correspondence:*

**Cinzia Di Novi**

University of Pavia  
Department of Economics and Management  
via San Felice, 5  
2700 Pavia

E-mail: [cinzia.dinovi@unipv.it](mailto:cinzia.dinovi@unipv.it)

*This Working Paper is published under the auspices of the Department of Economics of the Ca' Foscari University of Venice. Opinions expressed herein are those of the authors and not those of the Department. The Working Paper series is designed to divulge preliminary or incomplete work, circulated to favour discussion and comments. Citation of this paper should consider its provisional character.*

## 1. 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 which have characterised 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 (Mackenbach, 2012). 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 (Crivelli and Salari, 2014).

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 (Deaton, 2003; Wilkinson and Pickett, 2006). Income level is the key socioeconomic indicator: “Income provides the prerequisites for health, 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” (Benzeval et al., 1995, p. xxi). The slope of the socioeconomic gradient in health appears to be fixed by 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 (Jakobsson, 1976; Prasad, 2008). Policymakers have a variety of instruments at their disposal for influencing the progressivity of the personal income tax; such instruments include the exemption of

---

\* The authors wish to thank Andrea Albarea for his assistance in gathering and processing the data. The paper benefitted from comments from Michele Bernasconi, Enrica Croda and Francesca Zantomio.

certain types of income from taxation, allowances, deductions and tax credits (Wagstaff and Van Doorslaer, 2001).

In several countries, personal income tax laws permit tax credits for out-of-pocket healthcare expenditures. Although the main purpose of the tax credit is not to redistribute wealth, but rather to encourage and support individuals' behaviours that have a particular social relevance, 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, Toder and Baneman 2012). 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 (Burman, 2003; Poterba, 2011); however, little is known about the ability of healthcare tax credits to ensure a more equitable distribution of healthcare expenditure and, consequently, to alleviate health inequality.

Tax credits on eligible health expenses produce two effects on taxpayers' disposable income: they reduce net tax liabilities and modify the price of out-of-pocket expenditure; hence, 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 two effects may influence, in turn, income distribution and taxpayers' health status and, potentially, health inequality.

In Italy, the personal income tax (Imposta sui Redditi delle Persone Fisiche – IRPEF), a progressive tax, 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, general costs, specialist's fees, surgery costs, pharmaceutical costs, etc.) qualify for a 19% tax credit.

The aim of this paper is to test the potential effect that tax credits for health expenses may have on health-related inequality. For this purpose, we use a tax-benefit microsimulation model which reproduces IRPEF taxation while also incorporating information on taxpayers' behavioural responses to tax credits and their impact on health expenditure.

Most studies do not incorporate this aspect, since sufficient data on behavioural responses is often unavailable.

We simulate two different tax credit scheme scenarios: the first one in which the tax credit rate for health expenses is higher than the current baseline scenario (19% tax credit) and the second one in which health costs do not qualify for a tax credit. 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 effects of an increase/decrease in 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, Section 2 presents the institutional background of healthcare expenditure. Section 3 describes the mechanisms that underlie income tax credit, data and the empirical model. Section 4 presents the results. Concluding comments are given in Section 5.

## **2. 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.

Since its inception, the NHS has been heavily reformed: as healthcare expenditure increased steadily over time, the Central Government repeatedly introduced policy reforms aimed at controlling such growth. In particular, in the last 20 years major reforms have transformed the centralised structure of the Italian NHS through a process of decentralisation, with a progressive shift in responsibilities, management and funding from central to regional jurisdictions (Canta et al., 2006).

Despite these major reforms, public healthcare spending has undergone strong growth, which has exceeded economic growth in recent decades (de Belvis et al., 2012). 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% (ISTAT, 2015). According to the OECD's Health Statistics (2015), 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.

The financial crisis and austerity spending policies have imposed a tight budget constraint on Italian public healthcare spending, putting great emphasis on the need to consider a rationalisation effort aimed at controlling or even cutting selected health expenditures. The fear that the universal public healthcare system may collapse in the future is strengthening the argument for a shift to a more mixed financing system, with a greater level of private payment (Gabriele et al., 2006).

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 (France et al., 2005).

The Italian personal income tax currently offers a non-refundable income tax credit for eligible out-of-pocket health expenses (i.e. doctor's fees, specialist's fees, surgery costs, pharmaceutical costs, etc.) and co-payments on doctors' and specialists' fees and pharmaceutical costs.<sup>1</sup> Since 2010, 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).<sup>2</sup>

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. The application rate increased in the wake of the Great Recession and continued to increase rather than decline as the economy improved.

---

<sup>1</sup> The broad list of eligible health expenses is prescribed in the legislation.

<sup>2</sup> 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 payment to medical care providers for private medical services.

*Table 1. Public and private healthcare expenditures in Italy, 2003–2013*

	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

*Source:* Health for All, ISTAT (Italian Bureau of Statistics), 2015.

*Table 2. Healthcare expenses for which taxpayers have claimed a tax credit (€ million) and number of applicants, 2003–2013*

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Healthcare expenses for which taxpayers have claimed a tax credit	9,491	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

*Source:* Ministry of Economy and Finance, 2015.

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 showed in Table 1. The discrepancy may be explained by the fact that taxpayers could only receive the 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.<sup>3</sup> 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.

### 3. EMPIRICAL APPROACH

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

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

Following the Grossman model (1972),  $H$  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.

---

<sup>3</sup> 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: €8,000 per year for subordinate workers; €7,500 for pensioners under 75 years of age; €7,750 for pensioners aged 75 or older; €4,800 for the self-employed. Furthermore, the no-tax hurdle increases further if there are dependent family members.



The individual aims to maximise 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:

$$y - \bar{T} = X + p_h(1-d)q_h \quad (2)$$

$$X, q_h \geq 0 \quad (3)$$

where  $y$  is the gross personal income,  $\bar{T}$  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 normalised to one. The tax credits act as a subsidy to out-of-pocket health expenditures, reducing the price of eligible expenditures at the rate  $d$ , so that the after-tax price is  $p_h(1-d)$ . Expression (3) shows the non-negativity conditions on consumption and on healthcare services.

The tax credit produces two effects on taxpayers' disposable income. First, a tax credit reduces the net tax liability. Secondly, as Equation (2) demonstrates, it modifies the price of out-of-pocket expenditures relative to other goods and, to the extent that consumer demand is price elastic, the amount of eligible healthcare expenditure for which taxpayers may claim a credit.<sup>4</sup> The total effect may influence income redistribution and the taxpayers' health status and, therefore, income-related inequality in health.

We therefore proceed in the following way. First, we estimate the price elasticity of healthcare expenditure and the taxpayers' health status 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 net tax liability as a result of varying the tax credit rate and healthcare expenditure and, consequently, the new level of personal income. Finally, we check whether this final effect 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.

---

<sup>4</sup> Typically, the individual demand for health care services under full insurance coverage regime tends to be inelastic (for details, see Newhouse and Phelps, 1974; Wagstaff, 1986; Getzen, 2000).

To measure inequality in health, we employ the concentration index  $C(H)$  proposed by Wagstaff et al. (1991) and Wagstaff and Van Doorslaer (2000):

$$C(H) = \frac{2}{n\mu} \sum_{i=1}^n H_i r_i - 1 = \frac{2}{\mu} \text{cov}(H, r) \quad (4)$$

where  $\mu$  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.

### 3.1 Data

To perform our simulation, we use a tax-benefit microsimulation model (BETAMOD) developed recently by Albarea et al. (2015). BETAMOD is a static model that reproduces the Italian personal income tax (IRPEF), building on a detailed reconstruction of tax legislation. However, BETAMOD does not include a simulation of individuals' behaviour, 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 behavioural equation to estimate the tax price elasticity of demand for eligible healthcare expenditures (see Section 3.2); the second one introduces a health status equation (see Section 3.3). The two new modules are integrated in BETAMOD, as shown in Figure A.1 in Appendix A.

BETAMOD mainly runs on data from the 2011 Italian Statistics on Income and Living Conditions Survey (IT-SILC), and includes lagged information from the 2009 and 2010 wave of the same survey. IT-SILC provides multi-dimensional data on income and living conditions. It is characterised 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 expenditures to evaluate the redistributive effects of tax credits in the healthcare sector.

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

incurred by a dependent relative. Indeed, eligible medical expenditures 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 referent person and who have a personal gross income (before deductions) below €2,840. However, the available data does 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 1,572 individuals who have incurred healthcare expenses in excess of a deductible of €129.11.

### *3.2 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) using a linear regression model. We adopt the standard log-log formulation, which allows us to calculate (assumed constant) price and income elasticities directly.

As the dependent variable, we use the amount of healthcare expenditure for which taxpayers have claimed a credit, which is available from the BETAMOD microsimulation model.<sup>5</sup> 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 Albarea et al., 2015).

Among regressors, the key explanatory variables for our analysis are after-tax price, income and health status.

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 2010

---

<sup>5</sup> 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.

ISTAT database.<sup>6</sup> 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 (ISTAT, 2010).

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 labour, 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.). 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. Again, in order to avoid potential simultaneity problems with healthcare expenditure, income was included at time t-1 and expressed in log.

The measure of health combines self-assessed health (SAH) with activities of daily living (ADL) and chronic condition indicators using a multiple correspondence analysis (MCA) following Kohn (2012). A health indicator is included as a lagged variable at time t-1 to avoid endogeneity problems in the healthcare expenditure equation (for details about the construction of the health index, see Appendix B).

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

---

<sup>6</sup> 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.

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, other (student, housewife, unable to work).

### *3.3 The health equation and health-related inequality*

Since the health index has a continuous distribution over the interval 0 and 1 (see Appendix B), we estimate the determinants of health using a Tobit model, which is relatively common when data is censored at one and/or zero (Ramalho et al., 2010). Then, we compute the inequality index employing the concentration index.

In the Tobit regression model, we included a set of demographic and socioeconomic variables: age, sex, marital status, education, occupation, income, living standards and regional dummies. Reflecting the structure of the Italian fiscal system, where incomes earned in the calendar year  $t$  are taxed in the following  $(t+1)$ , the reference period in income-related questions is the previous fiscal year, that is, 2010. Demographics and the other socioeconomic characteristics as well as information on the respondents' health status reflect the situation of individuals at the time when the fieldwork was carried out (i.e. March and April 2011).

We also include an indicator of standard of living in the socioeconomic variables, which is considered a powerful determinant of health and health inequality (see Marmot et al., 2008). From information regarding assets, housing (water, electricity, and gas bills), fuel, clothing and shoes, medical and healthcare expenses and other standard-of-living information collected during the interviews, we derive a one-dimensional index using principal component analysis (PCA)<sup>7</sup>. 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.<sup>8,9</sup>

---

<sup>7</sup> By "other standard-of-living information" we mean whether the home is owned, number of rooms per household member, overall size of dwelling (i.e. the number of square metres 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 (Vyas and Kumaranayake, 2006; O'Donnell et al., 2008). 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 Balestra and Sultan, 2013).

<sup>8</sup> For a detailed discussion on how to construct asset indices, see Vyas and Kumaranayake (2006).

Since the variable that measures health status is distributed between 0 and 1, as suggested by Erreygers (2009), we use a corrected version of the concentration index to compute income-related inequality in health. This index is defined as:

$$E(H) = \frac{4\mu}{(b_n - a_n)} C(H) \quad (5)$$

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).<sup>10</sup> 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 standardised concentration index was computed. Health status  $H$  has been standardised by age, gender and region of residence to obtain an estimate of potentially avoidable inequality (see also O'Donnell et al., 2008). The standardisation provides the possibility to understand whether higher income groups are more likely to enjoy good health than lower income groups, keeping demographics constant. After standardisation, any residual inequality in health may be interpreted as horizontal inequality (which could be pro-rich or pro-poor). Indirectly standardised health status  $\hat{H}_i^{IS}$  can then be obtained by calculating the difference between actual health ( $H_i$ ) and standardised health status ( $\hat{H}_i^X$ ), plus the sample mean ( $\bar{H}$ ):

$$\hat{H}_i^{IS} = H_i - \hat{H}_i^X + \bar{H} \quad (6)$$

Equation (6) indicates that standardisation will subtract the variation in health driven by demographic factors from actual health. Therefore, the distribution of  $\hat{H}_i^{IS}$  across income

<sup>9</sup> 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.

<sup>10</sup> 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 (Costa-Font et al., 2014).

can be interpreted as the health status we expect to observe in an individual, irrespective of differences in the distribution of demographic characteristics.

#### 4. RESULTS

A simple descriptive analysis, which presents sample means and standard deviations for the variables used in the models is shown in Table C.1 in Appendix C.

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. This phenomenon seems to be mainly related to an increase in chronic illness prevalence. This data is also confirmed by previous literature, also based on IT-SILC (see Atella et al., 2015), which shows a similar deterioration that is particularly relevant among the elderly. In fact, 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. The average age when Italian people leave their parents' home is one of the oldest in Europe. Young adults start living independently from their parents at a later age, mainly because of family culture and job insecurity (Schröder, 2008; Carrieri et al., 2014). As a result, individuals without dependent relatives tend to be mainly concentrated among the classes of middle-aged taxpayers. Finally, when looking at socioeconomic indicators, we can also note that a large part of the sample is represented by married individuals, employed or retired, who have, on average, a medium level of education.

Concerning the results of the empirical estimation, Table 3 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,  $p_h(1-d)$ , and the equivalent income, which are included among regressors and expressed in log.

Table 3. The estimated health expenditure equation (t = 2010)

<i>Dependent variable:</i>		Coefficients		Standard errors
Health expenditure				
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
Widowed		0.12841	***	0.03569
Unemployed		-0.37950	*	0.16003
Retired		0.14653	***	0.03514
Other occupation		-0.20599	***	0.04658
Numb. obs.	1,572			
F (13, 1558)	30.15			
Prob > F	0.0000			
R-squared	0.2010			
Root MSE	0.4368			

Note: The dependent variable, equivalent income and after tax price index of health expenditure are in logs. Linear regression model estimated by OLS. \*\*\* p < .001, \*\* p < .01, \* p < .05.

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.<sup>11</sup> In other words, our results suggest that individuals increase their eligible health expenses by 0.7% in response to a 1% reduction in price. Finally, as expected, health expenses are negatively correlated with the health index and a higher socioeconomic status. In particular, 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 zero and 0.2 (Getzen, 2000; Liu and Chollet, 2006).

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 4.

<sup>11</sup> In the Canadian context, Smart and Stabile (2005) 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 Liu and Chollet (2006).



Table 4. Estimated health index equation (t = 2011)

<i>Dependent variable: Health index</i>	<i>Coefficients</i>		<i>Standard errors</i>
Constant	1.05365	***	0.06559
<i>Socioeconomic variables:</i>			
Low education	-0.17570	***	0.02388
High education	0.16558	***	0.02406
Single	-0.15767	***	0.02751
Separated/divorced	-0.04447		0.03033
Widowed	-0.01677		0.02822
Unemployed	-0.27346	***	0.08162
Retired	-0.08985	***	0.02681
Other occupation	-0.15088	***	0.03563
Equivalent income (t-1)	3.12e-06	***	5.83e-07
Living standard index	0.03071	***	0.00546
<i>Demographic variables:</i>			
Age	-0.00843	***	0.00102
Male	-0.08033	***	0.01797
Piedmont	-0.04025		0.03402
Valle d'Aosta	0.33900		0.19949
Bolzano	0.23444		0.15762
Trento	0.13393		0.11267
Veneto	0.09258	***	0.02760
Friuli Venezia Giulia	-0.05488		0.05687
Liguria	-0.09811		0.05883
Emilia Romagna	0.00722		0.02638
Tuscany	-0.09668	*	0.03791
Umbria	0.00394		0.06464
Marche	-0.06877		0.06119
Lazio	-0.03658		0.03513
Abruzzo	0.05605		0.06101
Molise	-0.10079		0.16478
Campania	-0.24907	***	0.06103
Apulia	-0.09605		0.05589
Basilicata	-0.30476		0.22063
Calabria	-0.21537	**	0.07590
Sicily	-0.35863	***	0.06583
Sardinia	-0.05360		0.13640
Numb. obs.	1,572		
LR chi <sup>2</sup>	800.10		
Prob > chi <sup>2</sup>	0.0000		
Pseudo R-squared	0.3191		

Note: Tobit regression model. \*\*\* p < .001, \*\* p < .01, \* p < .05.

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 effects on 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, Contoyannis and Jones, 2004; Balia and Jones, 2008; Di Novi, 2010).

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 4. We predict (indirectly) standardised health and calculate the non-demographic/socioeconomic-related inequality of health by estimating the overall Erreygers Inequality Index (EI) as well as a specific Erreygers Inequality Index which relies on the health equation and is adjusted for demographic variables (Erreygers index adjusted for needs – ENA) respectively. A negative value for either index (EI or ENA) denotes a concentration favouring the poor, while a positive value implies a concentration in favour of high-income groups.

In the current baseline scenario, when the tax credit is equal to 19%, the inequality index is positive and significant, denoting a pro-rich health inequality (see Table 5).

*Table 5. Health inequality index*

Tax credit rate	Erreygers concentration index EI	Need-adjusted Erreygers concentration index ENA
0%	0.27677*** (0.01275)	0.25333*** (0.01916)
19% (baseline scenario)	0.27745*** (0.01272)	0.25406*** (0.02165)
50%	0.27876*** (0.01293)	0.25575*** (0.01981)
Decreasing tax credit rate	0.27660*** (0.0136)	0.25323*** (0.0227)

*Note:* \*\*\*  $p < .001$ ; standard error in brackets.

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 two tax credit scheme scenarios.

Firstly, as a new tax credit rate we chose 50% of eligible healthcare expenses. Thanks to the estimated elasticity of the demand for care with respect to the after-tax price, we simulate, using BETAMOD, the new level of individual's healthcare expenditure and consequently her new tax liability. In fact, both the variation of the tax credit rate and the healthcare expenditure produces a reduction in the taxpayer's tax burden. This reduction, in turn, leads to an increase in an individual's disposable income while the individual's health index remains relatively constant (see Table 6).

The new income distribution influences the health income-related inequality, with a slightly increase of pro-rich inequality ( see Table 5).

*Table 6.* Health index, disposable income and healthcare expenditures (mean values)

Tax credit rate	Health index	Disposable income	Healthcare expenditures
0%	0.5898 (0.3228)	28,794.09 (17,268.32)	580.80 (278.28)
19% (status quo)	0.5901 (0.3229)	28,934.08 (17,309.40)	694.21 (322.74)
50%	0.5907 (0.3226)	29,330.11 (17,427.75)	1,026.80 (453.12)
Decreasing tax credit rate	0.5900 (0.3226)	28,944.08 (17,249.16)	707.15 (288.88)

*Note:* standard error in brackets.

The second simulation does not allow health costs to qualify for a tax credit, i.e. a tax credit rate equal to 0%. Obviously, with a tax credit rate at 0%, the price of healthcare services increases and, according to our empirical model, the taxpayer reduces her healthcare expenditure (see Table 6). In this case, however, the lack of a tax credit for eligible healthcare expenses also produces an increase in the net tax liability and therefore leads to a reduction in the individual's disposable income, potentially influencing the health income-related inequality even more. Table 5 shows that a reduction in the tax credit rate with respect to the benchmark scenario produces a slight reduction in pro-rich inequality.

Our results suggest that the design of the healthcare tax credit embedded in the Italian personal income tax is not effective in improving equity in health and tends to favour the richest part of the population. This effect may be in part due to the fact that 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. This means that high-income taxpayers benefit more than low-income taxpayers. Indeed, there is some evidence that lower income groups face barriers to specialist care, which are a more expensive component of healthcare expenditures in Italy (France et al., 2005). Moreover, the tax credit is partly lost by taxpayers in the bottom income class, due to their low level of the tax liability, and to the non-refundable nature of this tax credit.

For these reasons, we simulate a new tax credit scheme in which the tax relief is a function of income. In particular, in order to ensure a constant tax revenue, we fix the rate of the tax credit 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 linear decreasing function of income and becomes zero above €75,000 (the highest personal income tax bracket).<sup>12</sup> This simple exercise shows a reduction in income-related inequality in health: the need-adjusted inequality index (ENA) is 0.3% lower than in the status quo (see Tables 5 and 6). Despite the slight variation of the health inequality index, the simulation shows that a tax credit scheme dependent on income is conducive to reducing health inequality and also presents a better redistributive effect with respect to the status quo: indeed, the Reynolds-Smolensky index is 2.3% higher than the current tax credit design characterised by a fixed rate for the tax credit.

## 5. CONCLUSION

Inequality can be addressed through a combination of social service provision, social transfers and taxation. 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 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 redistribution. We tested whether the IRPEF rate of the tax credit for health expenses influences health-related inequality via the price elasticity of healthcare expenditure. Indeed, our results suggest that individuals increase their eligible health expenses in response to a reduction of the tax price. However, the reduction tends to favour the richest part of the population, partially eroding the redistributive impact of the personal income tax. Indeed, the effect on health inequality index, albeit relatively small, is positive and pro-rich.

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

---

<sup>12</sup> 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.

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 (Mackenbach, 2012). As a result, care needs to be taken when using the tax instrument to encourage access to healthcare. According to Boadway and Keen (2000), where redistribution is concerned, the design of the tax credit is important 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.

As an example, we have simulated a new tax credit design that varies with income, and the results suggest that this might make tax policy more effective in improving equity in health. Taxes should be used more actively to redistribute income in a bid to improve access to health-inducing material goods and healthcare services, particularly among the poor, reducing their exposure and susceptibility to ill health.

## REFERENCES

- Albarea, A., M. Bernasconi, C. Di Novi, A. Marenzi, D. Rizzi, and F. Zantomio, "Accounting for tax evasion profiles and tax expenditures in microsimulation modelling. The BETAMOD model for personal income taxes in Italy", *The International Journal of Microsimulation*, 8, 99-136, 2015.
- Atella, V., E. Borgonovi, C. Collicelli, J. Kopinska, F. Lecci, and F. Maietta, "Crisi economica, diseguaglianze nell'accesso ai servizi sanitari ed effetti sulla salute delle persone in Italia", I Quaderni della Fondazione Farmafactoring, No. 01.2015, 2015.
- Bago d'Uva, T., E. Van Doorslaer, M. Lindeboom, and O. O'Donnell, "Does reporting heterogeneity bias the measurement of health disparities?", *Health Economics*, 17, 351-375, 2008.
- Baker M., M. Stabile, and C. Deri, "What Do Self-Reported, Objective, Measures of Health Measure?", *Journal Human Resources*, 4, 1067-1093, 2004.
- Balestra, C. and J. Sultan, "Home Sweet Home: The Determinants of Residential Satisfaction and Its Relation with Well-Being", OECD Statistics Directorate Working Papers, No.5, 2013.
- Balia, S. and A.M. Jones, "Mortality, Lifestyle and Socio-Economic Status", *Journal of Health Economics*, 27, 1-26, 2008.
- Barbetta, G., S. Pellegrino, and G. Turati, "What Explains the Redistribution Achieved by the Italian Personal Income Tax? Evidence from Administrative Data", *Public Finance Review*, forthcoming.
- Benzeval, M., Judge, K., Whitehead, M., "Tackling inequalities in health: An agenda for Action", London: King's Fund, 1995.
- Boadway, R. and M. Keen, "Redistribution", in A.B. Atkinson and F. Bourguignon, eds., *Handbook of Income Distribution*, 1 (12), 677-789, Elsevier, 2000.
- Burman, L., "Is the Tax Expenditures Concept Still Relevant?", *National Tax Journal*, LVI, 613-627, 2003.
- Canta, C., M. Piacenza, and G. Turati, "Riforme del Servizio Sanitario Nazionale e dinamica dell'efficienza ospedaliera in Piemonte", *Politica Economica*, 22, 157-191, 2006.
- Carrieri, V., C. Di Novi, R. Jacobs, and S. Robone, "Insecure, sick and unhappy? Well-being consequences of temporary employment contracts", in S. W. Polachek and K. Tatsiramos, eds., *Factors Affecting Worker Well-Being. Research in Labor Economics*, 40, 157-193, 2014.
- Contoyannis, P. and A.M. Jones, "Socio-Economic Status, Health and Lifestyle", *Journal of Health Economics*, 23, 965-995, 2004.
- Contoyannis, P., A.M. Jones, and N. Rice, "The dynamics of health in the British Household Panel Survey", *Journal of Applied Econometrics*, 19, 473-503, 2004.

- Costa-Font, J., C. Hernandez-Quevedo, and D. Jimenez-Rubio, "Income inequalities in unhealthy life styles in England and Spain", *Economics and Human Biology*, 13, 66–75, 2014.
- Crivelli, L. and P. Salari, "The inequity of the Swiss health care system financing from a federal state perspective", *International Journal for Equity in Health*, 13, 1-13, 2014.
- de Belvis, A.G., F. Ferrè, M.L. Specchia, L. Valerio, G. Fattore, and W. Ricciardi, "The financial crisis in Italy: implications for the healthcare sector", *Health Policy*, 10, 10-6, 2012.
- Deaton, A., "Health, inequality, and economic development", *Journal of Economic Literature*, 41: 113-158.
- Di Novi, C., "The Influence of Traffic-related Pollution on Individuals' Life-Style: Results from the BRFSS", *Health Economics*, 19, 1318–1344, 2010.
- Erreygers, G., "Correcting the concentration index", *Journal of Health Economics*, 28, 504–515, 2009.
- France, G., F. Taroni, and A. Donatini, "The Italian health-care system", *Health Economics*, 14, 187-202, 2005.
- Gabriele, S., C. Cislighi, F. Costantini, F. Innocenti, V. Lepore, F. Tediosi, M. Valerio, and C. Zocchetti, "Demographic factors and Health Expenditure Profiles by age: the case of Italy", ENEPRI Research Report, No.18, 2006.
- Getzen, T., "Health care is an individual necessity and a national luxury: applying multilevel decision models to the analysis of health care expenditures", *Journal of Health Economics*, 19, 259-270, 2000.
- Grossman, M., "On the Concept of Health Capital and the Demand for Health", *Journal of Political Economy*, 80, 223-255, 1972.
- Idler, E.L. and Y. Benyamini, "Self-rated health and mortality: a review of twenty-seven community studies", *Journal of Health and Social Behavior*, 38, 21–37, 1997.
- ISTAT, "Le differenze nel livello dei prezzi al consumo tra i capoluoghi delle regioni italiane", 2010 ( <http://www.istat.it/it/archivio/6279>).
- ISTAT, "Health for All", 2015 (<http://www.istat.it/it/archivio/14562>).
- Jakobsson, U., "On the measurement of the degree of progression", *Journal of Public Economics*, 5, 161-168, 1976.
- Johnston, D. W., C. Propper, and M.A. Shields, "Comparing subjective and objective measures of health: Evidence from hypertension for the income/health gradient", *Journal of Health Economics*, 28, 540-552, 2009.
- Kenkel, D.S., "The demand for preventive medical care", *Applied Economics*, 26, 313–325, 1994.
- Kennedy, B.P., I. Kawachi, R. Glass, and D. Prothrow-Stith, "Income distribution, socio-economic status, and self-rated health in the United States: Multilevel analysis", *British Medical Journal*, 317, 917-921, 1998.
- Kohn, J.L., "What is health? A multiple correspondence health index", *Eastern Economic Journal*, 38, 223–250, 2012.

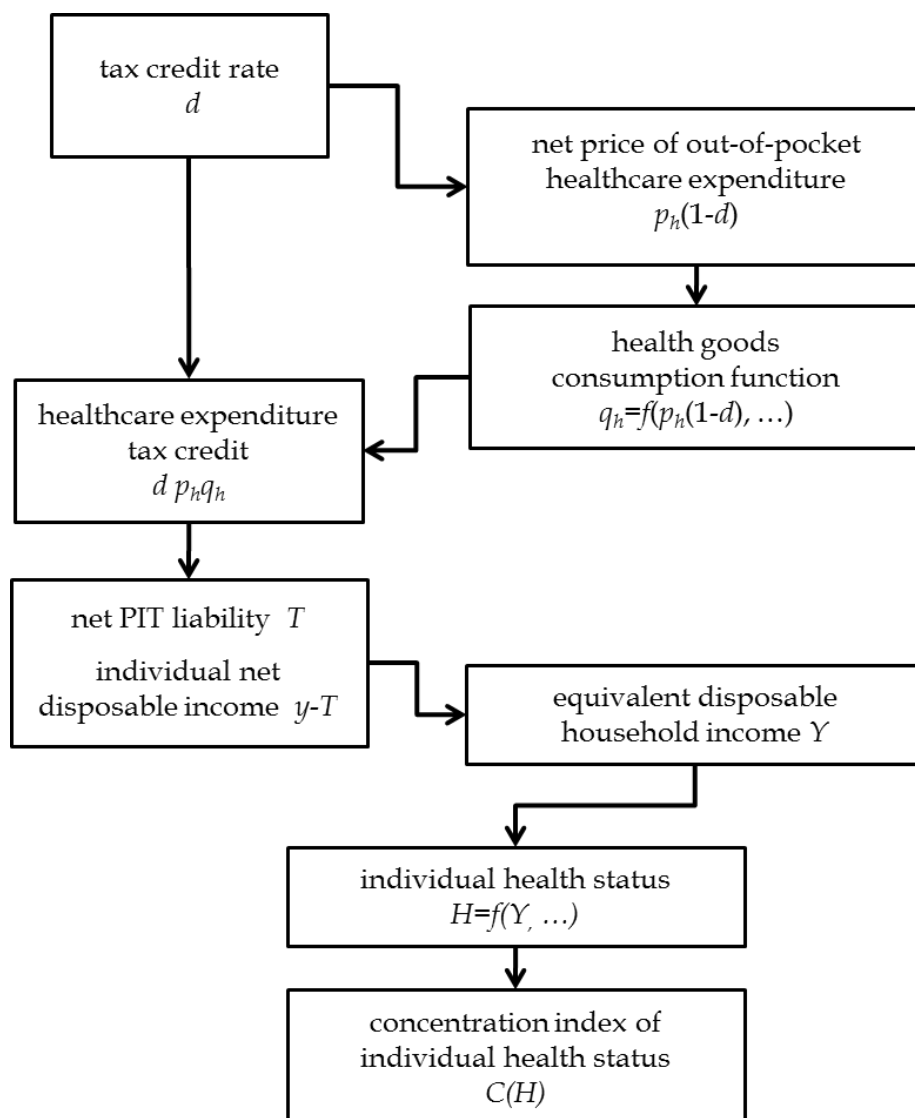
- Liu, S. and D. Chollet, "Price and Income Elasticity of the Demand for Health Insurance and Health Care Services: A Critical Review of the Literature", 2006. Available at <http://www.mathematica-mpr.com/publications/pdfs/priceincome.pdf>
- Mackenbach, J., "The persistence of health inequalities in modern welfare states: the explanation of a paradox", *Social Science and Medicine*, 75, 761–769, 2012.
- Marmot, M., S. Friel, R. Bell, T.A.J. Houweling, and S. Taylor, "Closing the gap in a generation: health equity through action on the social determinants of health", *The Lancet*, 372, 1661–1669, 2008.
- Ministry of Economy and Finance, 2010 and 2015 (<http://www.dt.tesoro.it/en>).
- Newhouse, J.P. and C.E. Phelps, "Price and income elasticities of the demand for medical care services", in M. Perlman, ed., *The Economics of Health and Medical Care*, Macmillan, London, 139-161, 1974.
- O'Donnell, O., E. van Doorslaer, A. Wagstaff, and M. Lindelow, "Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation", World Bank Publications, No. 434, Washington, 2008.
- OECD, Health Statistics, "FOCUS on Health Spending", 2015. Available at <http://www.oecd.org/els/health-systems/health-data.htm>
- Prasad, N., "Policies for redistribution: The use of taxes and social transfers", International Institute for Labour Studies Discussion Paper, No. 194, 2008.
- Poterba, J. M., "Economic Analysis of Tax Expenditures", *National Tax Journal*, 64, 451-458, 2011.
- Ramalho E.A., Ramalho J.J.S., Enriques P.D. "Fractional regression models for second stage DEA efficiency analyses", *Journal of Productivity Analysis*, 34: 239–255, 2010
- Schröder, C., "Economic insecurity and cohabitation strategies in Italy", MPIDR, Working Paper, No. 2008-004, 2008.
- Smart, M. and M. Stabile, "Tax Credits, Insurance, and the Use of Medical Care", *Canadian Journal of Economics*, 38, 345-365, 2005.
- Undén, A.L. and S. Elofsson, "Do different factors explain self-rated health in men and women?", *Gender Medicine*, 3, 295–308, 2006.
- Vyas, S. and L. Kumaranayake, "Constructing socioeconomic status indices: How to use principal components analysis", *Advance Access Publication*, 9, 459-468, 2006.
- Wagstaff, A., "The demand for health: Theory and applications", *Journal of Epidemiology and Community Health*, 40, 1-11, 1986.
- Wagstaff, A. and E. van Doorslaer, "Measuring and Testing for Inequity in the Delivery of Health Care", *Journal of Human Resources*, 35, 716–33, 2000.
- Wagstaff, A., E. van Doorslaer, and P. Paci, "On the Measurement of Horizontal Inequity in the Delivery of Health Care", *Journal of Health Economics*, 10, 169–205, 1991.
- Wagstaff and Vand Doorslaer, "What Makes the Personal Income Tax Progressive? A Comparative Analysis for Fifteen OECD Countries", *International Tax and Public Finance*, 8, 299–315, 2001.



Wilkinson, R. G. and K. E. Pickett, "Income inequality and population health: a review and explanation of the evidence", *Social Science and Medicine*, 62, 1768-1784, 2006.

## APPENDIX A

Figure A.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, the presence of chronic diseases and the presence of conditions limiting daily activities.

SAH has been widely used in previous studies that examined the relationship between health and socioeconomic status (e.g. Kenkel, 1994; Contoyannis and Jones, 2004; Di Novi, 2010). 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 (Idler and Beyamini, 1997; Kennedy et al., 1998). Moreover, SAH correlates strongly with more complex health indices such as functional ability or indicators derived from health service usage (Undén and Elofsson, 2006). The following standard question has been asked: "Would you say that in general your health is: very good, good, fair, bad, very bad".

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 Contoyannis et al., 2004; Bago d'Uva et al., 2008 and Kohn, 2012 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 or condition. The ADL indicator takes three possible values: strongly limited, limited and not limited. The chronic condition indicator is a dummy with a value of 1 if a person mentions a chronic illness and 0 otherwise. 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" (Baker et al., 2004).

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 Kohn, 2012). 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 standardise the index to lie on a continuous scale between 0 (poorest health) to 1 (best health) to aid in interpretation.

## APPENDIX C

Table C.1. Descriptive statistics

Variable	2009		2010		2011	
	mean	sd	mean	sd	mean	sd
<i>Dependent variables:</i>						
Health index	0.737	0.288	0.757	0.274	0.590	0.323
- SAH	1.518	0.842	1.491	0.784	1.732	0.778
- Chronic	0.326	0.469	0.351	0.477	0.600	0.489
- ADL	0.413	0.620	0.346	0.594	0.575	0.621
Health expenditure			694	323		
<i>Socioeconomic variables:</i>						
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
Widowed			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		
<i>Demographic variables:</i>						
Age			59.5	14.3	60.5	14.3
Male					0.390	0.488
<i>Regions:</i>						
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