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EVALUATING THE DISTRIBUTIONAL EFFECTS OF THE ITALIAN FISCAL POLICIES USING QUANTILE REGRESSIONS

Giorgia Casalone
Daniela Sonedda

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CRENoS - SASSARI
VIA TORRE TONDA 34, I-07100 SASSARI, ITALIA
TEL. +39-079-2017301; FAX +39-079-2017312

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EVALUATING THE DISTRIBUTIONAL EFFECTS OF THE ITALIAN FISCAL POLICIES USING QUANTILE REGRESSIONS

Giorgia Casalone*
SEMeQ, Università del Piemonte Orientale

Daniela Sonedda
SEMeQ, Università del Piemonte Orientale and CRENoS

This paper aims to evaluate the distributional impact of both income taxation and noncash income transfers in Italy, where the latter are related to health and educational services. By definition, a tax (in-kind income transfers) system is progressive (regressive) if the tax liabilities (the non cash benefits) are distributed more unequally than the income to which they apply. The econometric tool adopted in the paper is represented by quantile regression methodology which allows the evaluation of whether the investigated policies have either homogeneous or heterogeneous effects on different income quantiles. Indeed, our estimates suggest that both non cash transfers and direct taxation have heterogeneous effects on different gross income quantiles. However, although heterogeneous, the distributional effects of the potential fiscal reforms are quite small and are not able to modify the winner-loser position in the post-tax (post-benefit) income distribution of the Italian households.

KEYWORDS: In-kind transfers, Taxation, Income Redistribution, Quantile Regressions
JEL Classification: H42, H24, D31, C21

*Corresponding author: Dipartimento di Scienze Economiche e Metodi Quantitativi, Università del Piemonte Orientale, Via Perrone 18, 28100 Novara (Italy). Tel: +390321375330, fax: +390321375305, email: giorgia.casalone@eco.unipmn.it.

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1. Introduction

Redistribution in developed countries is the result of several policies, from both the public revenue and expenditure sides, ranging from taxation to cash and non cash transfers. Such policies are generally implemented all together and their effects are interdependent. As a consequence, evaluating the redistributive effect of each mechanism without taking into account the effects of the others can be misleading. Let's suppose, for instance, that in a certain country publicly provided services, such as health care or education, mainly benefit the rich. If these expenditures are financed by a flat rate tax system this can certainly be interpreted as a form of redistribution from the poor to the rich. But, if the tax system is highly progressive, the previous conclusion could be reversed as long as the net effect of the fiscal system is considered. The redistributive power of a progressive tax system also depends on the distributional policies implemented by those expenditures financed by taxation. On the other hand, the redistributive impact of public expenditures that mainly benefit the poor can be definitively established only if one considers how the resources needed to finance them are collected.

The necessity to provide a joint analysis of optimal taxation and public provision issues emerges from several theoretical contributions[1]. The studies analyzing the optimal structure of non linear taxes in asymmetric context (Cremer and Gahvari, 1993; Boadway and Marchand, 1995; Blomquist and Christiansen, 1995; Boadway, Marchand and Sato, 1998; Pirrtila and Tuomala, 2002) in particular emphasize the role of non cash transfers as mechanisms through which the self-selection constraints for the rich is relaxed, allowing thus to achieve redistributive goals. In this context, public expenditure in terms of non cash transfers represents a main redistributive device and its "desiderability" does not depend on the effect on tax revenues. Furthermore, Arrow's (1971) finding on the regressivity of public provision of education, reaffirmed in a different framework by Dur and Teulings (2001), has been contrasted by recent analyses developed in a general equilibrium framework. Lans Bovemberg and Jacobs (2005) in a paper which extends earlier works by Ulph (1977) and Hare and Ulph (1979) argue that, although the more able benefit more than proportionally from education provision, public expenditures in education can be justified on the basis of the role played in reducing the

[1] For a complete overview of this literature, see Balestrino (1999).

tax distortions in human capital accumulation induced by redistributive policies. This result also provides a theoretical justification for the positive correlation between public education expenditures and income tax progressivity emerging in many OECD countries[2].

Drawing on these theoretical contributions, the aim of the paper is to evaluate the distributional impact of the net fiscal system, identified by income taxation and noncash income transfers, where the latter are related to health and educational services, in Italy for the years 2000 and 2004. By definition, a tax (in-kind income transfers) system is progressive (regressive) if the tax liabilities (the non cash benefits) are distributed more unequally than the income to which they apply. In other words, any progressive income tax (regressive in-kind income transfer) is equivalent to a flat tax (in-kind benefit) with the same yield but with a rich to poor transfer (a higher tax rate (a lower in-kind transfer) for the rich)[3].

The econometric tool adopted in the paper consists of using quantile regressions (Koenker and Basset, 1978) which seems particularly suitable to investigate this issue. The conventional linear regression presents a patent limit when one suspects that the behavior of observations is affected by exogenous covariates in different ways according to where they rank in the response variable distribution. Since we assume that the analyzed policies may be redistributive only if they produce different effects on the quantiles of various household gross incomes, the superiority of the quantile regression, as compared with linear estimates that provide a mean treatment view of the effect, is a necessary (but not sufficient) condition to argue the redistributive power of the investigated mechanisms. In other words, recognizing the heterogeneity in the potential effect implies that a more disaggregated estimation of the fiscal policies must be preferred to standard least-squares methods. To the best of our knowledge, the current paper is the first attempt to evaluate the heterogeneity in the potential effects of the two fiscal policies of interest on the gross income distribution using quantile regressions. We consider the structural quantile treatment effect as suggested by Ma and Koenker (2006) in order to explore the potential heterogeneity in the effects of the two policy measures over both the

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[2] Lans Bovemberg and Jacobs (2005), p. 2007.

[3] In-kind transfer benefits that are allocated in proportion to income do not have distributional effect while benefits that are regressively distributed exert an equalizing effect on income distribution.

distribution of gross income as well as the distribution of the two policy variables. More specifically, the Ma and Koenker (2006) methodology allows us to provide the broadest view for evaluating the effects of fiscal policies in Italy in 2000 and 2004 and, therefore, to be able to constructively contribute to the policy debate on these issues.

The paper is organized as follows. Paragraph 2 presents background and motivation for the analysis. Paragraph 3 describes the empirical strategy used to identify the distributional impact of fiscal policies. Paragraph 4 describes the data set and provides descriptive statistics. Paragraph 5 presents the results of the analysis. Finally paragraph 6 concludes.

2. Background and Motivation

According to standard public finance textbooks, two main rationales for progressive income taxation can be identified. On the one hand, as stated by Musgrave and Musgrave (1984), "[…].Yet, actual tax policy is largely determined independently of the expenditure side and an equity rule is needed to provide guidance. The ability to pay principle is widely accepted as this guide" (Musgrave and Musgrave, 1984, p.228). On the other hand, using Head's (1964) words, "[…]for each individual the utility to him of the last unit of public good is equal to the sacrifice represented by the tax-price he must pay for that unit […]" (Head, 1964, p.423). Therefore on the basis of the benefit principle that explicitly takes into account the expenditure side, income tax progression is justified as long as the demand of pure public good exerted by upper income units is higher than that wielded by lower income units.

As shown, starting from the seminal papers by Blackorby and Donaldson (1988) and by Besley and Coate (1991), the universal provision of private goods such as health or education, can be interpreted as a (optimal) device to redistribute income from the rich to the poor.

The aim of the current paper is to examine empirically the distributional effects of private goods publicly provided such as education and health. In other words, we evaluate whether the benefit principle can be applied to publicly provided private goods against the alternative of an equity rule that guarantees equal opportunities to all individuals through education and health services.

By definition, a tax (in-kind income transfers) system is progressive (regressive) if the tax liabilities (the income in-kind transfer benefits) are distributed more unequally than the income to which they apply. In other words, any progressive (regressive) income tax (in-kind income transfer) is equivalent to a flat tax (uniform in-kind benefit system) with the same yield but with a rich to poor transfer (a higher tax rate (a lower in-kind transfer) for the rich). That is to say that there must be a single crossing between the hypothetical proportional taxation system (in-kind income benefit system) and the system observed in reality[4].

While a progressive income tax is inequality reducing compared to a flat tax rate, the component tax schedules which are based on individual characteristics such as marital status, age and family composition are of course not necessarily overall inequality reducing. Drawing on this, there are no a priori reasons to expect regressive, and thus redistributive from rich to poor, in-kind income transfers. This argument may hold true for the taxation system as well.

We evaluate the redistributive role of public policies by considering a standard tool in the analyses of the distribution and redistribution of income, the Lorenz curves[5].

By definition the Lorenz curve that includes non-cash (in-kind) income dominates the Lorenz curve that does not consider it if:

$$L_j(x, \alpha, c) \geq L_j(x) \quad \forall j = 1 .... n \qquad [1]$$

Where x defines income, α is a parameter that depends on household characteristics and c defines the parameter that measures the average cost (benefit for the individual) for the government to provide health and educational services. According to our imputation rules, α depends on household characteristics such as, for instance, the number of children while the parameter c is calculated on regional basis.

Equation [1] can be rewritten as:

$$\sum_{i=1}^{j} \frac{x_i + \alpha_i c_i}{(\mu + \alpha c)} \geq \sum_{i=1}^{j} \frac{x_i}{\mu} \forall j = 1 .... n \qquad [2]$$

[4] In contrast if the tax (in-kind benefit) schedule double crosses that related to the flat rate, the actual tax (in-kind income) system involves redistribution from the middle to both ends of the post tax (in-kind income transfer) distribution or viceversa.

[5] The following analysis focuses on in-kind income transfer only since standard textbooks may provide guidance for the income tax liability, see for instance Lambert (2001).

Where $\mu = \frac{1}{n}\sum x_i$ defines the average income and $n\alpha c = \sum \alpha_i c_i$ the average non-cash income transfer.

Rewriting equation [2] in terms of total income we have:

$$X_j \mu + \sum_{i=1}^{j} \alpha_i c_i \geq X_j \mu + \frac{X_j}{\mu}\alpha c$$

$$\sum_{i=1}^{j} \frac{\alpha_i c_i}{\alpha c} \geq \frac{X_j}{\mu} \qquad [3]$$

According to equation [3] we can evaluate the distributional and redistributive effects of noncash income by regressing for each decile the ratio between the mean income for the decile over the average income of the whole distribution on the corresponding ratio for the non-cash income. More specifically, an income decile can be considered as "winner" if the ratio between its average in-kind income transfer over the mean of the whole in-kind income distribution is higher than the corresponding ratio for the gross income (i.e. the income decile is receiving a transfer proportionally higher than its income quote).

3. The Empirical Strategy

The key implication discussed above is that in-kind income transfers improve a family's relative position in the gross income distribution if the share, over the sample mean, of in-kind transfers is higher than the family's gross income share. Drawing on this prediction, in the rest of the paper, we submit to empirical investigation the evaluation of the full distributional responses to changes of in-kind transfers and income tax liability using Italian data for two periods 2000 and 2004. We start by defining the following quantile regression model as an approximation of equation (3).

Let y_{gi}, tax_i and $in\text{-}kind_i$ be respectively the gross income, direct tax liabilities and in-kind transfers of household i and μ_{yg}, μ_{tax} and $\mu_{in-kind}$ their average values over the whole population. The empirical equation to be estimated is:

$$\frac{yg_i}{\mu_{yg}} = \alpha(C_i, F_i)\frac{tax_i}{\mu_{tax}} + \beta(A_i, F_i)\frac{inkind_i}{\mu_{inkind}} + C_i + A_i + F_i + \gamma X_i \quad [4]$$

where A_i and C_i represent unobserved household's characteristics, F_i is an idiosyncratic income shock orthogonal with A_i and C_i and X_i is a vector of controls. These controls include both household and head of household's characteristics. As for a family's characteristics, in particular we control for family's size, number of income recipients and macro-area of residence. Concerning head of family, we afterwards control for gender, age, level of education and employment condition.

Quantile regression models (Koenker and Basset, 1978) estimate a family of conditional quantile functions, namely of the median and of other relevant quantiles of the distribution. By this technique each quantile of the conditional distribution of the dependent variable is expressed as a function of a set of regressors, and it is thus possible to evaluate whether regressors' coefficients change when moving from the bottom to the top of the response variable's distribution. As an alternative, the conventional linear regression model (OLS) based on the minimization of the sums of squared residuals provides estimations of the covariates' effect only on the mean of the distribution. This OLS technique presents a patent limit when one suspects that the behaviour of observations could be affected by exogenous covariates in different ways according to where they rank in the response variable distribution. As previously noticed, in our case we assume that the analysed policies are redistributive if they produce different effects on different household gross income's quantiles. As a consequence, the superiority of the quantile regression - compared with OLS estimates - is a necessary (but not sufficient) condition to argue the redistributive power of the investigated mechanisms.

Moreover, even after conditioning for the influence of the head of family's and family controls, the relationship between the gross income share and the two policy variables of interest can be further plagued by two main factors.

First, since our variables are the results of a microsimulation, measurement errors related to both in-kind and taxation income can generate a spurious correlation between the variables of interest.

Second, reverse causality, running from the gross income share to the two policy variables, implies that the tax liability and the in-kind income share in model (4) are endogenous.

As regards non cash benefits since primary school is compulsory and in-kind income transfers related to the national health service by construction depend on the individual's age and on the region of residence, we conceive as potentially endogenous only in-kind transfers related to secondary and tertiary education. Indeed, the family's educational choices may depend on the family's gross income as well as on unobserved characteristics A_i.

We address these problems using the control variate methodology suggested by Ma and Koenker (2006). Consistent estimates can be obtained if there exists, for each endogenous fiscal policy, at least one variable correlated with them but not with household income. Denoting by W and Z these instrumental variables, the auxiliary regressions of tax liabilities and in-kind transfer to be estimated are:

$$\frac{tax_i}{\mu_{tax}} = \gamma_{tax} X_i + \chi W_i + \lambda C_i \quad [5]$$

$$\frac{inkind_i}{\mu_{inkind}} = \gamma_{ik} X_i + \phi Z_i + \varepsilon A_i \quad [6]$$

Let's define $\tau_C = G_C(C_{\tau C})$, $\tau_A = G_A(A_{\tau A})$ and $\tau_F = G_F(F_{\tau F})$, where $C_{\tau C}$, $A_{\tau A}$ and $F_{\tau F}$ are the τ-quantiles of distribution of C_i, A_i and F_i respectively. Following Ma and Koenker (2006), we define the conditional quantile equations of the gross income, direct taxation and in kind provision respectively as $Q_y[\tau_F \mid tax, inkind, X]$, $Q_{tax}[\tau_C \mid X, W]$ and $Q_{ik}[\tau_A \mid X, Z]$, corresponding to equation [4], [5] and [6] are:

$$\begin{aligned} & Q_y[\tau_F \mid Q_{tax}(\tau_C \mid X,W), Q_{ik}(\tau_A \mid X,Z), X] = \\ & Q_{tax}(\tau_C \mid X,W)\pi_1(\tau_F,\tau_C) + Q_{ik}(\tau_A \mid X,Z)\pi_2(\tau_F,\tau_A) + \quad [7] \\ & \gamma_y X + G_C^{-1}(\tau_C) + G_A^{-1}(\tau_A) + G_F^{-1}(\tau_F) \end{aligned}$$

$$Q_{tax}(\tau_C \mid X,W) = \gamma_{tax} X + \pi_1 W + \zeta G_C^{-1}(\tau_C) \quad [8]$$

$$Q_{ik}(\tau_A \mid X,Z) = \gamma_{ik} X + \pi_2 Z + \upsilon G_A^{-1}(\tau_A) \quad [9]$$

Since the distribution of taxation and of in kind provision, conditional on controls X and on instruments W and Z respectively, are affected by the distribution of unobservables C_i and A_i, expressions [7], [8] and [9] represent the effects of these unobserved characteristics on the various quantile of the distribution of gross income. We then study how various quantiles Q_y of the gross income distribution are affected by endogenously determined Q_{tax} and Q_{ik} quantiles of direct taxation and in kind transfers. That is, we evaluate what the consequences are on various quantiles of the gross income distribution of a perturbation of the prevailing distribution of both in-kind income transfers and income taxation. The function $\pi_1(\tau_F, \tau_C)$ and $\pi_2(\tau_F, \tau_A)$ are the quantile effects of a change in the direct taxation and in the publicly provided goods on gross income, respectively. When the distributional effects are more heterogeneous, as assumed in this location-scale shift model, the structural quantile treatment effects $\pi_1(\tau_F, \tau_C)$ and $\pi_2(\tau_F, \tau_A)$ represent a deconstruction of the mean effect (estimated by the two-stage least squares estimator in the pure location shift model) into its elementary components. In the pure location shift form of the model the structural effect of the fiscal policies has to be interpreted instead as the shift in location of gross income induced by a change in the fiscal policies that describes the effect at all quantiles of the gross income distribution and at all quantiles of the fiscal policies variables distribution.

According to the methodology discussed above for each fiscal policy variable, we then run an auxiliary quantile regression which includes among the regressors all the exogenous variables plus the selected instruments. Next, we compute the residuals from these regressions and run the quantile regression for gross income adding the τ^{th} quantile estimated residuals and their interactions with the fiscal variables to the set of regressors[6]. By this methodology we estimate the effect of each quantile of the analysed mechanisms on each gross income quantiles. Assume that we consider the 10th quantile of the gross income distribution $\tau_F = G_F(F_{\tau F}) = 10$ changes in τ_C and τ_A in $\pi_1(\tau_F, \tau_C)$ and $\pi_2(\tau_F, \tau_A)$ reflect how the distribution of τ_C and τ_A affects the 10th quantile of the response of the gross income. On the other hand, if we fix τ_C and τ_A to 10, we evaluate the effect of the 10th quantile of τ_C and τ_A on the whole distribution of the response of the gross income.

This methodology ensures that the estimates of the key parameters are consistent, and also allows us to test the potential endogeneity of the fiscal policy variables by testing the statistical significance of the estimated coefficients of the residuals and their interaction with the fiscal policies variables[7].

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[6] Table A1 and A2 in appendix report the estimates of the residuals of the auxiliary regressions and of their interactions with fiscal policies in the gross income equation.

[7] In other words, we have selected a model in which the fiscal policies variables are allowed to influence both the location and scale of the gross income distribution.

3.1 The Selection of Instruments

As an identification strategy we adopt two different instruments for education transfers. According to a wide literature on this issue (see for instance Brunello et al. (2007)), we firstly use the number of years of compulsory education for each child living in the household (COMPSCHOOL). The law 20/1999 (so called Legge Berlinguer) raised the compulsory schooling age in Italy from 14 years to 15 years old since the school year 1999/2000, namely for individuals born after 1985[8]. Afterwards, the law 53/2003 (so called Riforma Moratti) restored the compulsory schooling age at 14 years for the cohorts born since 1989 onward. In order to impute to each household the children's number of years of compulsory schooling we proceed as follows. As a first step we identify those children who potentially are enrolled at upper secondary school respectively in 2000 and in 2004. In 2000, for instance, only those born in the years 1981-1985 are potentially enrolled at high school. Among these children, only those born in 1985 have been affected by the 1999 reform which forced them to stay at school one more year, until 2000. In 2004 instead only those born in the years 1985-1989 are potentially enrolled at high school and all of them have been affected by the reform except for those born in 1989 for which the compulsory schooling age reverted to 14 years old. In conclusion, for each household we have three different values of the compulsory years of schooling: zero if there are no children potentially at high school living in the household, eight for those children potentially at high school and not affected by the Berlinguer reform and nine for those children potentially at high school and affected by the reform.

As a second instrument we then use a proxy for the "supply" of higher education in the region of residence of the children who are potentially at college (HESUPPLY). The idea is that, especially for individuals coming from poor backgrounds, the presence of institutions providing higher education close to the household's residence could positively affect children's decision to enrol in college by relaxing household credit constraints[9]. Therefore, we have calculated for each child potentially at college in the years 2000 and 2004 the number of

[8] Since the age at which children normally start compulsory school is 6 years, the 1999 reform raised the number of years of compulsory schooling from 8 to 9.

[9] On the use of education supply indicators to explain educational choices see for instance Card (1999).

degree courses per square kilometres provided in their region of residence in their year of first enrolment. Obviously, for those families who do not have children at all or that do not have children potentially at university in 2000 and 2004, we impute a zero value.

With regards to tax liability, the choice of instruments is a more complex issue as one needs a variable which affects tax liability and, at the same time, is independent from gross income. Tax liability in Italy depends on several issues: basically on the overall individual's gross income, but also on its source and on taxpayer's household characteristics. As an identification strategy, we then exploit the differences in tax liabilities due to the system of tax allowances depending on the source of the gross income, both of the head of the family and, if present, of the spouse[10]. In particular, in year 2000, we impute to each household the sum between the maximum tax credits, fixed by law, corresponding to each type of income's source[11] that may potentially be benefited by both the head of the family and the spouse (MAXCRED_HS), by the head of the family only (MAXCRED_H). In order to avoid endogeneity problems, we apply tax allowances, corresponding to each type of income's source considering only those who have not changed their type of income's source in the current fiscal year. For year 2004, we use as instruments the sum of the maximum tax allowances that, according to the law, may be benefited by both the head of the family and the spouse (MAXALL _HS), the maximum tax allowance that may be benefited by the spouse only (MAXALL _S) and a variable called GAP that measures the difference between the maximum and minimum tax allowances that, according to the law, may be benefited by the head of family.

4. The Data

The data used in this paper are two waves - 2000 and 2004 - of the Survey of Household Income and Wealth (SHIW). The SHIW is a nationally representative household survey conducted by the Bank of Italy on more than 8000 Italian households, or about 22000 individuals a

[10] The Italian direct tax system is individual-based and takes into account the taxpayer's family situations through a complex set of tax and family allowances.

[11] In 2000 tax credits ranged from 0 for capital or financial incomes to 1294 euros for pension incomes. In 2004 tax credits have been substituted by a system of tax deductions ranging from 3000 euros for the generality of taxpayers to 7500 for the employees. These tax deductions decrease with income.

year. The survey includes information on net pay and on household and job characteristics, which we use to compute both gross pay and individual income in-kind as in Sonedda and Turati (2005)[12]. Data are then collapsed into family income, ending up with a sample of 7802 and 8004 families in year 2000 and 2004 respectively once positive income only is considered. All income figures are adjusted by considering differences in family needs. We use the ISEE equivalence scale to adjust cash income, and evaluate in-kind income in per capita terms[13]. The scale is simply defined as n^0.65, where n is the number of household components and 0.65 is a fixed coefficient that controls for the presence of scale economies in households' production.

Table 1 presents some standard summary statistics for the variables considered in the analysis. For the sake of comparability, 2000's data are at 2004 prices and expressed in euros.

Gross income shows a typical right-skewed distribution. Mean and median household equivalent gross incomes in 2000 are respectively around 15000 and 12000. Four years later the two values raised respectively by 8 and 3% reflecting a small enlargement of the upper tail of the distribution. Despite this trend, in the same time span, the Gini index slightly decreased from 0.4 to 0.39 and the p90/p10 ratio from 6.2 to 5.4, which evidences an approaching of the two extreme tails of the distribution.

Direct taxation liabilities t^{dir} represent on average around 18% of the mean gross income in 2000 and only 13.5% in 2004, a trend suggesting a remarkable tax pressure reduction. Direct taxation shows, then, a more unequal distribution than gross income, as expected due to its progressive structure. In particular, the median of the t^{dir} distribution represents only 60% of its mean in 2000 (51% in 2004) and the Gini index is above 0.6 in both years. Notice, then, that the p90/p10 ratios cannot be calculated since people belonging to the first decile of the direct taxes distribution do not pay taxes at all.

When we look at the average of in-kind transfers, we first notice that in 2000 its value is close to the mean value of tax liabilities, around

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[12] Sonedda and Turati (2005) using the information contained in the SHIW attempt to identify the users of the health and educational services, or those on behalf of whom these expenditures were made, and to allocate to such users the value of the resources used in providing the service.

[13] ISEE is the standard means testing procedure applied in Italy to a variety of government benefits.

2700 euros. Nevertheless, the distance between the mean and the median value is greater than for taxation, as only a small part of Italian households benefit from transfers related to education. In other words, the distribution of education and health is more polarized than gross income. The Gini index is above 0.6 in both years but, unlike direct taxation, it is lower in 2004 than in 2000. Since a greater inequality of both mechanisms' distribution, compared to gross income, is a raw indicator of their redistributive power, these descriptive statistics suggest a small shift in the redistribution policy from non cash transfers to direct taxation.

Table 2 then illustrates the variables distributions in greater detail with an analysis per quantiles. We only report the statistics for the quantiles object of the following regressions, namely 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th}. As regards gross income, we observe that the reduction in the 2004 inequality mainly depends on the changes in the extreme tails of the distribution, and especially in the 10^{th} quantile which raised its relative position with respect to the median. The progressive structure of the Italian direct taxation system emerges by comparing the ratio between each quantile of gross income and direct tax liabilities and the corresponding medians[14]. On the one hand, in 2000 the 25^{th} quantile of gross income distribution was about 61% of the median and the corresponding quantile of the distribution of direct tax liabilities about 27%; on the other hand, the 90^{th} quantile of gross income distribution was around 223% of the median and the corresponding direct tax liabilities quantile around 364%. In 2004, then, the reduction in the taxes paid by lower deciles (i.e. from 27% to 12%) and the corresponding rise in the higher deciles of the tax revenues distribution (i.e. from 364% to 439%) suggests an increase in the progressivity of the Italian direct taxation system.

When we look at overall non cash transfer, we observe that, below median, its distribution is similar to gross income distribution, whereas above the 50^{th} quantile it turns out to be very polarized. This is the consequence of the non uniform distributions of education and health transfers which mainly benefit, respectively, households with either children or older people.

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[14] Notice that this exercise has a pure informative meaning and no conclusions can be drawn from it because people belonging to a decile of the gross income distribution do not necessarily correspond to people belonging to the same decile in the direct tax liabilities distribution.

As a last descriptive exercise in figure 1 for each decile of the distribution of the investigated variables we plot its average values, standardized by the mean of the whole distribution, per gross income distribution decile. As a result, we notice that for the households below the 7th decile of the gross income distribution, the ratio between the average gross income decile and the mean of the whole distribution lies above and below the corresponding values for in-kind transfers and direct taxation respectively. Thereafter, for the upper tail, the three lines cross suggesting that the two fiscal systems redistribute from the upper three deciles to the other deciles of the gross income distribution.

5. Results

We run regressions on a number of specifications. First and foremost we estimate the relationship existing between the two redistributive mechanisms taken as exogenous and the gross income.

For each covariate, these point estimates may be interpreted as the impact of a one-unit change of the covariate on the dependent variable, at the relevant quantile, holding other covariates fixed.

Figure 2 presents these quantile estimates when both in kind income transfers and tax liabilities are treated as exogenous. In order to establish if quantile regression is the best technique to be used with our data we will plot the results obtained in our estimates together with the conventional least squares estimates, as suggested in Koenker and Hallock (2001). The dashed line in each figure shows the ordinary least squares of the conditional mean effect. Figure 2 shows that the quantile regression estimates lie at some point outside the confidence intervals for the ordinary least squares regression, suggesting that the effects of these covariates is heterogeneous and not constant across the conditional distribution of the independent variable.

In-kind transfers and taxation cannot, however, be considered as exogenous in presence of unobserved characteristics affecting access to education services and the income taxation. Table 3a reports the results of the first stage regression of in-kind transfers on all the exogenous variables and instruments. Table 3b reports, instead, the results of the first stage regression of taxation on all the exogenous variables and instruments.. The F-statistic test on the significance of the instruments is then reported at the bottom of each table. All the selected instruments are statistically significant except for the number of years of compulsory education for each child living in the household (COMPSCHOOL) in the first decile in year 2000, the "supply" of higher education in the region of residence of the children who are potentially at college (HESUPPLY) in the two first quantiles in 2004 and in year 2000 the maximum tax credits that may potentially be benefited by both the head of the family and the spouse (MAXCRED_HS) and by the head of the family only (MAXCRED_H) in the 75th quantiles of the distribution of the unobservables affecting gross income. We find that an increase of either the number of years of compulsory education for each child living in the household or the "supply" of higher education in the region of residence of the children who are potentially at college generates a higher in-kind transfer to the family. Exceptions to this positive sign are the first two quantiles in the 2000 regressions when using the supply of higher education instrument. These findings suggest that increasing either the number of compulsory education or the supply of higher education affects positively the households' educational choices. An increase in either maximum tax credits in year 2000 or maximum tax deductions in year 2004 accruing to the family reduces the household's tax liability. There is also evidence that an increase in either the maximum tax credits accruing to the head of the family in year 2000 or the maximum tax deductions accruing to the spouse raises direct family tax liability. Finally, in year 2004, a higher difference between the maximum and minimum tax allowances that, according to the law, may be benefited by the head of family leads to higher family tax liability. On a priori grounds, one should expect a negative relationship between either tax credits or tax deductions and income tax liability. However, the dependent variable of our auxiliary regression is the family direct tax liability but the tax credits and deductions considered here are based on individual and not family income. Therefore, our results seem to suggest an intra-household allocation effect as long as the higher family income tax liability can be due to higher family earnings generated by an increase in the labour supply of the spouse that is not directly affected by the fiscal change.

As regards the F-test, according to the rule of thumb provided by Staiger and Stock (1997) which suggests that the instruments are weak if the F-test for their inclusion in the auxiliary regression is lower than 10, estimates evidence that the chosen instruments are weak only for the 1st decile. Generally speaking the effect of the instruments, both in the in-kind and in the taxation regressions, is lower for the lower quantiles of the distributions of the unobserved characteristics affecting the two analysed fiscal policies.

Tables 4a and 4b report the results of the estimates when both the in-kind income transfers and income taxation are treated as endogenous. The significance of the τ^{th} quantile estimated residuals of the auxiliary regressions and their interaction with the fiscal policy variables[15], clearly suggests that both mechanisms are endogenous and support the location-scale specification of the model. Table 4a and 4b report, further, the quantile effects and the mean quantile treatment effects. The former corresponds to the effect of in-kind income (over the sample mean) on the quantile of gross income distribution (over the sample mean) when in-kind income is treated as exogenous. The latter is equivalent to what is estimated by the two-stage least-squares estimator in the pure location shift model.

The results presented in Table 4a clearly show that the effects of in-kind income transfers are heterogeneous by indicating a certain dispersion in the structural quantile treatment effect.

By considering this quantile treatment effect $\pi_2(\tau_F, \tau_A)$ associated with in-kind income transfers we find that they are negative for all quantiles and statistically significant: according to our estimates, an increase in the non cash transfers is always associated with a decrease in the gross family income in all quantiles. To interpret the results let us consider first the 10th quantile of the τ_A distribution. The estimated coefficients of the non cash transfers lie approximately between -0.11 and -0.12 in 2000 and between -0.05 and -0.07 in 2004. No clear trend emerges when moving from the bottom deciles of the gross income distribution to the upper deciles. When we set τ_A =90 the effect is approximately of -0.04 unit change in 2000 and it is slightly smaller in absolute terms (around -0.03) in 2004 for all gross income quantiles. Again, we do not find any clear pattern in the coefficient values when moving along the gross income distribution. When considering the intermediate values of the distribution of the unobservable components affecting in-kind transfers we find that the estimated coefficients have a somehow U-shaped trend in both years. Moreover, coefficients corresponding to the two top quantiles (75th and 90th) of the distribution of the unobservable components affecting gross income are always greater than those of the bottom quantiles. Next, we can interpret the results reported in table 4a in a different way by keeping constant the decile of the distribution of the unobservable components affecting

[15] These results are reported in appendix.

gross income and by looking at the coefficient pattern along the distribution of the unobservable components affecting in-kind transfers. We find that for any decile of the distribution of the unobservable components affecting gross income the estimated coefficients decrease when moving from 10^{th} to the 25^{th} decile of the distribution of the unobservable components affecting in-kind transfers and then remain nearly constant for higher quantiles. This result suggests that for any income level only less "able" households (i.e. those households belonging to the 10^{th} decile of the distribution of the unobservable components affecting in-kind transfers) have to renounce to a greater income share to benefit from in-kind transfers. Summing up our results, we find that individuals who are in the extreme tails of the distribution of the unobservable components affecting in-kind transfers benefit from the in-kind transfers quite uniformly regardless of their position within the gross income distribution. On the other hand, individuals who are closer to the median value of the unobservable components affecting in-kind transfers have to give up a growing income share (over the sample mean) to receive an additional unit of non cash transfers as their gross income increase.

Tests on inter-quantile differences reported in Table 5[16] show that the in-kind (over the sample mean) coefficients are never statistically different when we compare the 10^{th} and the 50^{th} quantiles. Inter-quantile differences are, instead, statistically significant when we compare the 50^{th} and the 90^{th} quantiles in 2000, except for the 10^{th} decile of the distribution of the unobservable components affecting in-kind transfers. Results for 2004 are less clear-cut since interquantile differences are statistically significant at the 10% level only for the difference between the 50^{th} and the 90^{th} deciles at the 25^{th}, 50^{th} and 75^{th} deciles of the distribution of the unobservable components affecting in-kind transfers and for the difference between the 10^{th} and the 50^{th} deciles at the 90^{th} decile of the distribution of the unobservable components affecting in-kind transfers.

From these results it is possible to argue that, concerning in-kind income transfers, modeling the structural quantile treatment effect provides a more precise measure, as compared with other methodologies, of the fiscal policy effect for the values of the gross income above the median.

[16] We only report the results of the tests for the 10^{th} vs 50^{th} and for the 50^{th} vs 90^{th} quantiles. The other results are available upon request.

On the basis of previous estimates, we then have calculated the values of the elasticity of the gross income with respect to both fiscal policies for each gross income quantile. They represent the percentage change in the gross income associated with a 1% change in the value of each policy. Elasticities are calculated at the average values within the relevant quantiles of the (standardized) gross incomes, in kind transfers and direct taxation. Results are reported in Tables 6a and 6b.

In terms of elasticities, the effects are quite heterogeneous. Nevertheless, concerning in kind income, elasticities are always lower than 1 in absolute value except for the 10th quantile of gross income when setting $\tau_A = 10$ in year 2000. Therefore, generally speaking, a 1% change in the standardised non cash transfers is associated in each quantile with a reduction in the standardised gross income lower than 1%. We interpret the absolute value of the elasticity as an indicator of the possible implications in terms of losers (those who receive a quote, over the sample mean, of in-kind transfers lower than their quote, over the sample mean, of gross income) and winners (those who receive a quote, over the sample mean, of in-kind transfers higher than their quote, over the sample mean, of gross income) of a policy reform that changes in-kind income transfers. We expect that if the elasticity is lower than 1, following a 1% change in the in-kind income transfers, the winner remains winner while the loser may become a winner. This second circumstance never occurs and, according to our estimates, all households maintain their relative positions in terms of winners and losers[17]. Unlike coefficients, elasticities reach their highest value for the lowest decile of the gross income distribution for any decile of the distribution of the unobservable components affecting in-kind transfers. Afterwards, they decrease remaining quite stable along the whole distribution. As an example, for the 50th decile of the distribution of the unobservable components affecting in-kind transfers, a 1% increase in the (standardized) in kind transfer in 2000 is associated with a 0.2% reduction in the (standardized) gross income for the lowest quantile of the gross income distribution and only with a reduction between 0.07 and 0.09% for the other quantiles of the gross income distribution. These results suggest that the reduction in gross income, which is associated to a 1% increase in the non cash transfers, is highest for the lowest income households, whereas there are no remarkable differences

[17] Simulations on the effect of potential marginal reforms on "winners" and "losers" are available upon request.

among the households lying in the upper quantiles of the gross income distribution [18].

In Table 4b, when we look at the parameters associated with direct taxation we observe that the sign of the coefficients is, as expected, always positive in both years. However, if we look at the coefficient values and at their trend within the gross income distribution, holding the deciles of the distribution of the unobservable components affecting income tax liabilities constant, we notice that in both years, when we move along the gross income distribution, we find a U-shaped coefficient pattern or an increasing trend starting from the 75th decile of the distribution of the unobservable components affecting income tax liabilities.. These results seem to suggest that the Italian direct taxation system reaches its maximum level of tax progressivity at the 75th quantile of the gross income distribution, then its degree of progressivity reduces. In other words, following a tax reform the (relative) position of individuals in the top decile of the gross income distribution (over the sample mean) improves with respect to 75th quantile of the distribution.

For the bottom decile of the distribution of the unobservable components affecting income tax liabilities a one unit change in direct taxation is associated with a gross income increase ranging from 2.8 to 1.6 in 2000 and from 5.3 to 5.1 in 2004 when moving along the gross income distribution. For the median value of τ_C a one unit increase in direct taxes over the sample mean is associated with an increase in the gross income (over sample mean) by 1.44 for the 10th quantile of the gross income distribution and by 1.00 in the 90 quantile of the gross income distribution in year 2000, whereas in 2004 these values are respectively 0.83 and 0.97. When we control for the upper tail of the distribution of the unobservable characteristics that generates income taxation (i.e. τ_C =90), the effects range from 1.08 to 0.92 unit change when moving from the 10th to the 90th quantile of the gross income distribution in year 2000 while it ranges from 0.60 to 0.03 unit change when moving from the 10th to the 90th quantile of the gross income distribution in 2004. If, as an additional interpretation exercise, we keep constant the distribution of the unobservable components affecting gross income value and look at the coefficients pattern along the distribution of the unobservable components affecting income tax

[18] As it stands, this result cannot be interpreted as evidence of the fact that the hypothetical in-kind income transfers reform redistributes from the rich to the poor generating a less unequal income distribution.

liabilities distribution we find in both years that, for any in both years that for any τ_F, the estimated coefficients decrease when moving to the upper tail of the distribution of the unobservable components affecting income tax liabilities distribution. The reduction is, then, more marked in 2004 than in 2000[19]. This evidence suggests that, for any income level, the increase in the gross income (over the sample mean) which is associated with a one unit change in direct taxation (over the sample mean) decreases when we move to the upper tail of the distribution of those unobservable characteristics affecting the tax liability.

According to the tests on inter-quantile differences, coefficients are always statistically different in both years at the 5% level. These results evidence that, concerning taxation, the structural quantile treatment effect provides the broadest view for evaluating the effects of such policies.

Concerning elasticities, their values are quite heterogeneous, always positive and lower than one with some exceptions, for instance at the 10th quantile of the gross income distribution for all deciles of the distribution of the unobservable components affecting income tax liabilities above 25. As above, we interpret the absolute value of the elasticity as an indicator of the possible implications in terms of losers (those who pay a quote, over the sample mean, of income taxation higher than their quote, over the sample mean, of gross income) and winners (those who pay a quote, over the sample mean, of income taxation lower than their quote, over the sample mean, of gross income) of a policy reform that changes income taxation. Following a 1% change in income taxation, we expect that on the one hand, if the elasticity is lower than 1, the winner may become a loser while the loser does not change its status. On the other hand, if the elasticity is higher than 1, the winner stays a winner while the loser may become a winner. According to our results again, as for in kind transfer, no household changes its relative status in terms of winners and losers of the direct taxation system.

As for estimated coefficients, elasticities appear to be decreasing as we move to the upper tail of the gross income distribution for both years and any value of the distribution of the unobservable components affecting income tax liabilities. In particular, our results show a great

[19] Indeed, in year 2000 for quantiles of the distribution of the unobservables components affecting gross income higher than 10th there seems to be a U shape pattern.

reduction when moving from the first to the second quantile of the gross income distribution whereas when moving toward the upper quantiles the decrease is smoother. For instance, at the median value of the distribution of the unobservable components affecting income tax liabilities, a 1% increase in taxation is associated with a 1.17% increase in gross income for the poorest households and to a 0.58% increase for the richest households in 2000. In 2004 differences are even larger as a 1% increase in taxation is associated respectively with a 2.6% and a 0.33% increase for the lowest and the highest deciles. This result suggests that the (positive) variation in (standardized) gross income which is associated to a (positive) variation in the (standardized) direct taxation is decreasing with the gross income[20].

Our results clearly suggest that the effects on various quantiles of the gross income distribution of a perturbation of the prevailing distribution of both in-kind income transfers and income taxation are heterogeneous. This holds true particularly for income taxation when the effect is stronger than that related to in-kind income transfers.

Notice that we interpret the presence of heterogeneous effects as a necessary but not sufficient condition for redistribution from the rich to the poor. In order to have significant redistributive effects, these heterogeneous effects have to be stronger in the two extremes of the gross income distribution, enough to reduce overall income inequality.

The Reynolds-Smolensky index (Reynolds and Smolensky, 1977) measures the redistributive effect of taxation by the difference in the post-tax and pre-tax Gini coefficients. We adapt this index to obtain a measure of the potential redistributive effects of taxes and in-kind transfer benefits reforms that change income taxes and in-kind benefits by 1%. Given our estimates, we generate the new gross income distributions by applying to each quantile the corresponding estimated elasticities and we then compare the Gini after and before the tax (benefits) reforms. Results suggest that a 1% increase in in-kind benefit transfers contribute to reducing the Gini index by 0.14 percentage point in year 2000 but has no effect in year 2004. Therefore, consistently with the findings of small distributional effects, the redistributive effects are quite small when there are any. Moreover, a 1% increase in income taxation increases the Gini index by 0.09 percentage point in year 2000

[20] Again, as it stands, this result cannot be interpreted as evidence of the fact a hypothetical tax reform that increases income taxes by 1% redistributes from rich to poor, leading to a more unequal income distribution.

but reduces the index by 0.08 percentage point in year 2004. According to the estimates presented above, although the distributional effects of changing income taxation appeared to be higher than those associated with in-kind income transfers, the difference in the Gini coefficients suggests that there are no significant redistributive effects associated with both fiscal reforms. This result is not surprising given that, as discussed above, the fiscal reforms of interest are not able to modify the winner-loser position in the post-tax (post-benefit) income distribution of the Italian households.

5.1 An evaluation of the public economic policies using counterfactuals

Italy experienced a significant tax reform in year 2003. The reform introduced a complex system of tax allowances (in place of prior tax credits) depending on the size and the source of a taxpayer's income. This scheme was designed so that deductions were almost linearly decreasing with gross income and introduced a mass of so called "no tax areas" ranging from 7500 euros for employees to 7000 euros for pensioners, 4500 for self-employed and 3000 euros for the remaining taxpayers. Allowances, moreover, cancel out for incomes higher than 29.000 euros for incomes coming from capital/financial investments or higher than 33.500 euros for labour taxation. In this section, by using counterfactual tax rates, we apply quantile regressions to evaluate whether the effect of such reform are heterogeneous across different parts of the gross income distribution. To address this problem we simulate the value of direct taxation by applying the structure of the 2000 direct taxation system to the 2004 incomes, thus calculating a "counterfactual" taxation. The idea is that since households are likely to modify their behaviour, adapting them to the taxation structure in order to minimize their taxation liabilities, the "counterfactual" taxation might return a measure which should not depend, by definition, on the household's choices. The combination of counterfactual tax rates and quantile analysis allows us to control for the behavioural effects that violate the invariant condition of the pre-tax income distribution during such tax reform in view of either disincentives or incentives created (i.e. the "counterfactual" taxation is freed from the different distributional conditions in which the two tax systems operate). However, our measure of counterfactual taxation does still suffer from potential endogeneity due to measurement error and reverse causality. By construction these counterfactual tax rates still depend on the household's gross income.

Therefore, we apply the control variate methodology suggested by Ma and Koenker (2006) in this case also. The selected instruments correspond to those used for the year 2000.

In the estimates for in-kind transfers income (once controlled for counterfactual taxes) reported in the bottom part of table 4a, we find that the coefficients are always statistically significant and increasing in absolute values when moving from the bottom to the upper distribution of the gross income for any decile of the distribution of the unobservable components affecting in-kind transfers.. This result suggests that the gross income which individuals give up to benefit from a one unit increase in in-kind income is slightly increasing with gross income. Moreover, when we look at the inter-quantile differences in the bottom part of Table 5, we find that coefficients are statistically different only for some deciles of the distribution of the unobservable components affecting in-kind income transfers.. These findings suggest a small distributional impact of this mechanism.

The estimated coefficients of the counterfactual tax are then positive and statistically significant in all specifications. Their value are lower than in previous estimates where the actual tax rates are used, notably, considering the 10th decile of the distribution of the unobservable components affecting income tax liabilities, the coefficients' value ranges from 0.59 to 0.95 . A one unit increase in counterfactual direct taxation is then associated with a lower increase in family's gross equivalent income suggesting a weaker redistributive power of Italian direct taxation when the counterfactual tax indicator is chosen. The test on inter-quantile differences then show that, again, structural quantile treatment effect methodology appears to be particularly suited to studying the relationship existing between direct taxation and gross income.

Finally, concerning the calculation of the Gini indexes of the post-fiscal policies incomes, we find that income associated with a 1% increase in the counterfactual taxation is (slightly) more unequally distributed than income obtained by changing effective taxation. This result suggests that household behaviour led to a decrease in tax liabilities for the lower gross income quantiles and to an increase for higher quantiles, thus raising the progressivity level of the direct taxation system.

6. Conclusions

This paper investigates the distributional impact of both income taxation and noncash income transfers in Italy, where the latter are related to health and educational services. By this analysis we evaluate whether the benefit principle can be applied to publicly provided private goods against the alternative of an equity rule that guarantees equal opportunities to all individuals through education and health services. As far as we know, the current paper is the first attempt to evaluate the heterogeneity in the potential effects of the two fiscal policies of interest on the gross income distribution using quantile regression.

Our estimates suggest that both non cash transfers and direct taxation have heterogeneous effects on different gross income quantiles. However, concerning non cash transfers, in particular, we find that their distributional impact is quite small. As regards direct taxation, the effect is stronger than that related to the in-kind income transfers. We interpret the presence of such a heterogeneity among quantiles as a necessary but not sufficient condition for redistribution that is evaluated by calculating the difference between gross income Gini indexes pre and post potential fiscal reforms. These differences of Gini indexes are quite small in all cases. Indeed, both potential fiscal reforms that change taxes and in-kind income transfers by 1% are not able to modify the winner-loser position in the post-tax (post-benefit) income distribution of Italian households.

References

Arrow, K.J. (1971), "A Utilitarian Approach to the Concept of Equality in Public Expenditures", *Quarterly Journal of Economics*, 85(3), 409-415.

Balestrino, A. (1999), "The Desirability of In-kind Transfers in the Presence of Distortionary Taxes", *Journal of Economic Surveys*, 13, 333-354.

Besley T. and S. Coate (1991), "Public provision of private goods and the redistribution of income", *American Economic Review*, 81(4), 979-984.

Blackorby C. and D. Donaldson (1988), "Cash versus Kind, Self-Selection, and Efficient Transfers", *American Economic Review*, 78 (4), 691-700.

Blomquist, S. and V. Christiansen (1995), "Public Provision of Private Goods as a Redistributive Device in an Optimum Income Tax Model", *Scandinavian Journal of Economics*, 97(4), 547-567.

Boadway, R. and M. Marchand (1995), "The Use of Public Expenditures for Redistributive Purposes", *Oxford Economic Papers*, 47(1), 45-59.

Boadway, R., Marchand, M. and M. Sato (1998), "Subsidies versus Public Provision of Private Goods as Instruments for Redistribution", *Scandinavian Journal of Economics*, 100 (3), 545-564.

Brunello, G., Fort, M. and G. Weber (2009), "Changes in Compulsory Schooling, Education and the Distribution of Wages in Europe", *The Economic Journal*, 119(536), 516 – 539.

Card, David (1999), "The causal effect of education on earnings" in O. Ashenfelter & D. Card (ed.), *Handbook of Labor Economics*, vol. 3, chapter 30, 1801-1863.

Cremer, H. and F. Gahvari (1993), "Tax evasion and optimal commodity taxation" *Journal of Public Economics*, 50(2), 261-275.

Dur, R. and C.N. Teulings (2001), *Education and Efficient Redistribution*, CESifo Working Paper N.592.

Hare, P.G. and D. Ulph (1979), "On education and distribution", *The Journal of Political* Economy, 87 (5), S193–S212.

Head, J., (1964), "Lindahl's theory of the budget", *Finanzarchiv*, 23, 421-454.

Koenker, R, and G. Bassett (1978), "Regression Quantiles", *Econometrica*, 46(1), 33-50.

Koenker, R. and K.F. Hallock (2001), "Quantile Regression", *The Journal of Economic Perspectives*, 15(4), 143-156.

Ma, L. and R. Koenker, (2006), "Quantile regression methods for recursive structural equation models", *Journal of Econometrics*, 134 (2), 471-506.

Lambert, P. (2001), *The Distribution and Redistribution of Income*, 3rd edition, Manchester and New York: Manchester University Press.

Lans Bovemberg, A. and B. Jacobs (2005), "Redistribution and education subsidies are Siamese twins", *Journal of Public Economics*, 89, 2005-2035.

Musgrave R. and P. Musgrave (1984), *Public Finance in Theory and Practice*, 4th edition, New York: McGraw Hill.

Pirrtila J. and M. Tuomala (2002), "Publicly Provided Private Goods and Redistribution: A General Equilibrium Analysis", *The Scandinavian Journal of Economics*, 104(1), 173-188.

Reynolds, M and E. Smolensky (1977), *Public expenditure, taxes and the distribution of income: The United States, 1950, 1961, 1970*, New York: Academic Press.

Sonedda, D. and G. Turati (2005), "Winners and Losers in the Italian Welfare State: A Microsimulation Analysis of Income Redistribution Considering In-Kind Transfers", *Giornale degli Economisti e Annali di Economia,* Bocconi University, 64(4), 423-464.

Staiger, D., and J. H. Stock (1997), "Instrumental Variables Regression with weak instruments", *Econometrica,* 65, 557-586.

Tuomala, M. (1986),"On the Optimal Income Taxation and Educational Decisions" *Journal of Public Economics*, 30, 183-198.

Ulph, D. (1977), "On the optimal distribution of income and educational expenditure", *Journal of Public Economics*, 8, 341–356.

Tables and figures

Table 1 Descriptive statistics

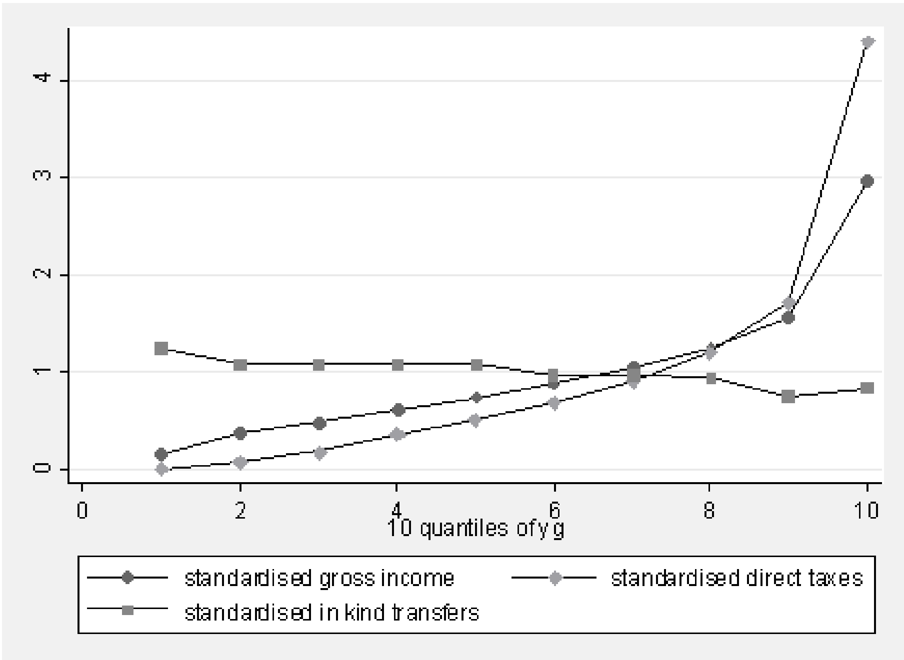
Year		Mean	Median	SD	Gini	p90/p10	Coefficient of variation	Obs
2000	yg	15250.93	12315.65	15283.83	0.401	6.18	1.0022	7802
	tax	2758.59	1656.99	5206.32	0.614	-	1.8873	7802
	in-kind	2745.93	484.35	3743.52	0.652	49.61	1.3633	7802
2004	yg	16439.87	12683.34	16696.72	0.391	5.43	1.0156	8004
	tax	2213.08	1126.84	4975.03	0.651	-	2.2480	8004
	in-kind	2830.19	835.40	3647.30	0.618	29.70	1.2887	8004

Table 2 Descriptive statistics by quantiles

		Gross Equivalent Income				Net Direct Tax				All in-kind transfers			
		Quantile	% of Median	Share, %	Cumul. Share	Quantile	% of Median	Share, %	Cumul. Share	Quantile	% of Median	Share, %	Cumul. Share
2000	10	4448.67	36.12	1.49	1.49	0	0	0	0	181.48	37.47	0.54	0.55
	25	7485.81	60.78	5.89	7.38	440.96	26.61	0.66	0.66	275.04	56.79	1.21	1.76
	50	12315.65	100	16.07	23.45	1656.99	100	9.42	10.08	484.35	100	3.39	5.15
	75	19028.42	154.51	25.35	48.8	3343.84	201.8	21.88	31.96	5071.06	1046.99	18.52	23.67
	90	27475.14	223.09	22.02	70.82	6027.31	363.75	23.99	55.95	9003.19	1858.83	34.66	58.33
2004	10	5382.86	42.44	2.18	2.18	0	0	0	0	302.42	36.2	0.88	0.88
	25	7920.79	62.45	6.11	8.29	132.47	11.76	0.11	0.11	425.97	50.99	1.93	2.81
	50	12683.34	100	15.64	23.93	1126.84	100	7.05	7.16	835.4	100	5.39	8.2
	75	19672.33	155.1	24.34	48.27	2667.14	236.69	20.41	27.57	4802.52	574.88	18.34	26.54
	90	29252.58	230.64	21.54	69.81	4951.51	439.42	24.37	51.94	8982.24	1075.2	33.34	59.88

Figure 1 Net direct taxes paid and in-kind transfers received by gross income quantile

2000



2004

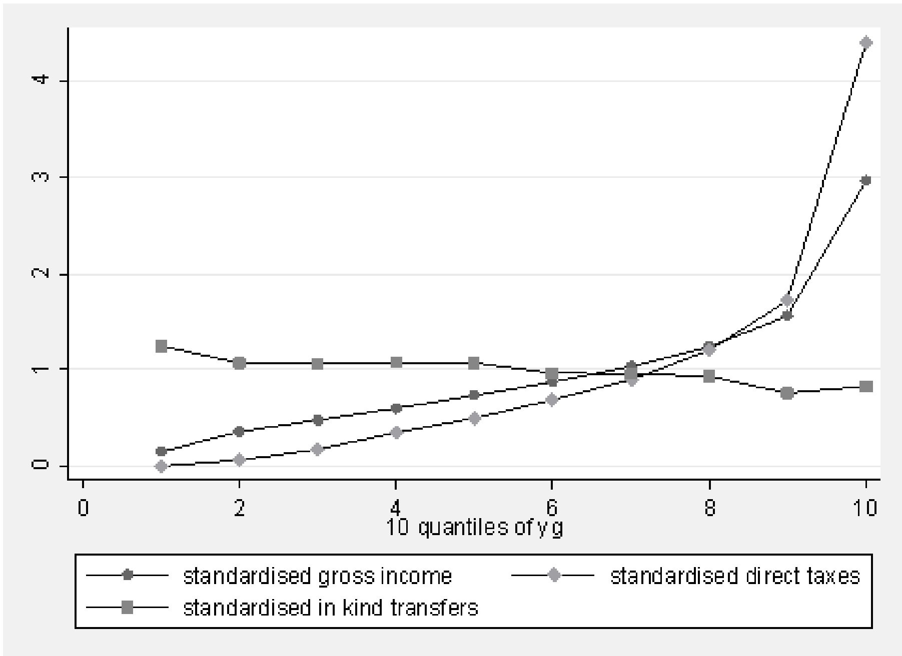


Figure 2

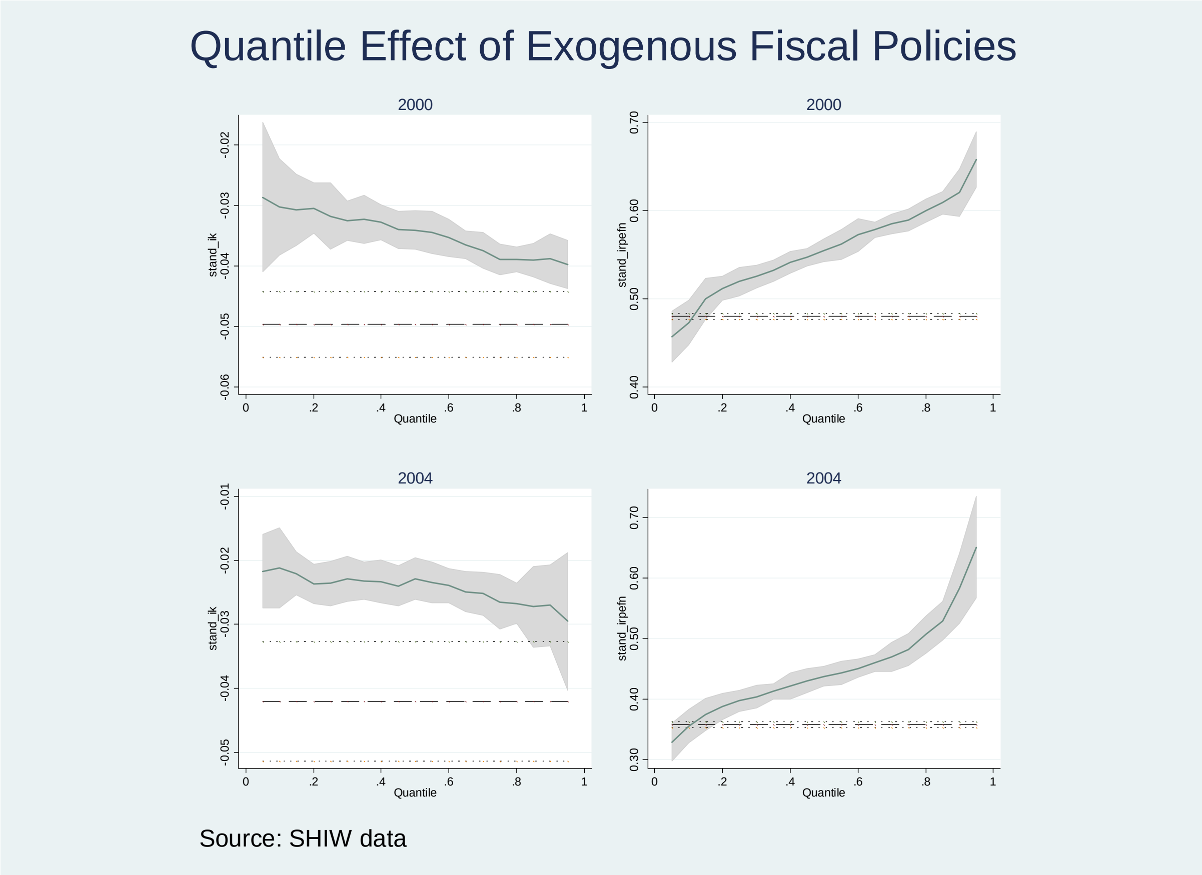

Quantile Effect of Exogenous Fiscal Policies
2000
stand_ik
-0.02
-0.03
-0.04
-0.05
-0.06
0
.2
.4
.6
.8
1
Quantile
2000
stand_irpefn
0.70
0.60
0.50
0.40
2004
-0.01
-0.02
-0.03
-0.04
-0.05
2004
0.70
0.60
0.50
0.40
0.30
Source: SHIW data

Table 3a First stage effects of instruments on education transfers

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
COMPSCHOOL	0.0297	.2222***	.2367***	.2552***	.2289***
	[0.0357]	[0.002]	[0.0074]	[0.0091]	[0.0103]
HESUPPLY	-.4236**	-1.224***	49.577***	49.4336***	57.543***
	[0.191]	[0.3051]	[10.21]	[10.34]	[8.699]
Constant	0.1024***	.1449***	1.4048***	5.6451***	8.8716***
	[0.0073]	[0.0075]	[0.2423]	[0.2809]	[.3295]
F test	2.97	5674.31	605.14	409.53	248.12
	[0.0515]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
2004					
COMPSCHOOL	0.0959*	0.2113***	0.2386***	0.2564***	0.2495***
	[0.0499]	[0.0017]	[0.0066]	[0.0081]	[0.0144]
HESUPPLY	0.4765	0.7589	79.033***	57.276***	55.736***
	[0.3503]	[0.7225]	[4.483]	[7.179]	[9.734]
Constant	0.1766***	0.2836***	.4826***	5.581***	9.580***
	[0.0113]	[0.0143]	[0.0518]	[0.2696]	[0.487]
F test	2.64	8349.02	818.37	547.83	194.21
	[0.0713]	[0.0000]	[0.0000]	[0.0000]	[0.0000]

τ_F denotes the quantile of the distribution of the unobservables affecting gross income. Three stars, two stars and one star for statistically significant coefficients at the 1%, 5% and 10% confidence level. Bootstrapped standard errors in brackets. For the F- test on the significance of the instruments p-values in brackets.

Table 3b First stage effects of instruments on tax liabilities

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
MAXCRED_HS	-0.00003***	-0.0001***	-0.00001***	-0.0001	-0.0001**
	[9.61e-06]	[0.0000]	[0.0000]	[0.0090]	[0.0000]
MAXCRED_H	0.00004***	0.00009***	0.0001***	0.0001	0.0001**
	[8.16e-06]	[.0000]	[.0000]	[0.0004]	[0.0000]
Constant	-0.1134***	-0.2746***	-0.3684***	-0.1918**	-0.1889
	[0.0384]	[0.0546]	[0.0926]	[1.93e+14]	[0.208]
F test	11.34	32.51	26.35	10.11	3.43
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
2004					
MAXALL_HS	3.84e-06**	-0.00003***	-0.00008***	-0.0001***	-0.0002***
	[1.71e-06]	[5.27e-06]	[7.39e-06]	[0.00001]	[0.0000]
MAXALL_S	8.70e-06**	0.00006***	0.0001***	0.0002***	0.0003**
	[3.49e-06]	[7.67e-06]	[0.0000]	[.00002]	[0.00002]
GAP	4.59e-06**	0.00004***	0.00011***	0.0001***	0.0002***
	[2.08e-0]	[6.28e-06]	[0.0000]	[.00002]	[0.0000]
Constant	-0.0718**	-0.5427***	-0.6609**	-0.5845***	-.5493**
	[0.0310]	[0.0627]	[0.1093]	[0.1450]	[0.2632]
F test	2.19	30.94	55.27	58.41	25.51
	[0.0872]	[0.0000]	[0.0000]	[0.0000]	[0.0000]

τ_F denotes the quantile of the distribution of the unobservables affecting gross income. Three stars, two stars and one star for statistically significant coefficients at the 1%, 5% and 10% confidence level. Bootstrapped standard errors in brackets. For the F- test on the significance of the instruments p-values in brackets.

Table 4a Estimates of the redistributive effect of In kind income on gross income once controlled for direct taxation

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
$\tau_A = 10$	-0.1201**	-0.1318**	-0.1187***	-0.12137***	-0.1222***
	[0.0483]	[0.05856]	[0.02421]	[0.0301]	[0.01032]
$\tau_A = 25$	-0.0475***	-0.0457***	-0.0507***	-0.0526***	-0.0545***
	[0.0003]	[0.0004]	[0.0006]	[0.0002]	[0.0002]
$\tau_A = 50$	-0.0458***	-0.0439***	-0.0500***	-0.0511***	-0.0527***
	[0.0004]	[0.0002]	[0.0005]	[0.0001]	[0.0002]
$\tau_A = 75$	-0.0441***	-0.0418***	-0.0448***	-0.0468***	-0.0501***
	[0.0004]	[0.0002]	[0.0004]	[0.0002]	[0.0003]
$\tau_A = 90$	-0.0487***	-0.0429***	-0.0446***	-0.0453***	-0.0494***
	[0.0006]	[0.0003]	[0.0005]	[0.0003]	[0.0004]
Mean Quantile Treatment Effect	-0.0612	-0.0612	-0.0618	-0.0634	-0.0658
Quantile Effect	-0.0303	-0.0317	-0.034	-0.0389	-0.0388
2004					
$\tau_A = 10$	-0.0613*	-0.0561**	-0.0500**	-0.0709**	-0.0705***
	[0.0318]	[0.0271]	[0.0220]	[0.0312]	[0.0257]
$\tau_A = 25$	-0.0352***	-0.0326***	-0.0304***	-0.0412***	-0.0417***
	[0.0002]	[0.0002]	[0.0002]	[0.0000]	[0.0001]
$\tau_A = 50$	-0.0295***	-0.0271***	-0.0262***	-0.0348***	-0.0396***
	[0.0001]	[0.0002]	[0.0002]	[0.0002]	[0.0002]
$\tau_A = 75$	-0.0291***	-0.0282***	-0.0269***	-0.0344***	-0.0398***
	[0.0001]	[0.0001]	[0.0001]	[0.0002]	[0.0001]
$\tau_A = 90$	-0.0321***	-0.0286***	-0.0283***	-0.0365***	-0.2079***
	[0.0002]	[0.0002]	[0.0001]	[0.0001]	[0.0008]
Mean Quantile Treatment Effect	-0.0374	-0.0345	-0.0324	-0.0436	-0.0799
Quantile Effect	-0.0211	-0.0236	-0.0228	-0.0264	-0.0270
2004 counterfactual					
$\tau_A = 10$	-0.0513***	-0.0584**	-0.0558**	-0.0631***	-0.0684**
	[0.0167]	[0.0257]	[0.0218]	[0.0236]	[0.0334]
$\tau_A = 25$	-0.0350***	-0.0393***	-0.0404***	-0.0439***	-0.0453***
	[0.0003]	[0.0001]	[0.0000]	[0.0001]	[0.0001]
$\tau_A = 50$	-0.0329***	-0.0375***	-0.0392***	-0.0411***	-0.0429***
	[0.0002]	[0.0000]	[0.0000]	[0.0001]	[0.0002]
$\tau_A = 75$	-0.0319***	-0.0358***	-0.0364***	-0.0376***	-0.0410***
	[0.0001]	[0.0001]	[0.0000]	[0.0000]	[0.0001]
$\tau_A = 90$	-0.0328***	-0.0354***	-0.0352***	-0.0361***	-0.0407***
	[0.0001]	[0.0002]	[0.0001]	[0.0001]	[0.0002]
Mean Quantile Treatment Effect	-0.0368	-0.0413	-0.0414	-0.0444	-0.0477
Quantile Effect	-0.0241	-0.0255	-0.0285	-0.0275	-0.0270

τ_F denotes the quantile of the distribution of the unobservables affecting gross income; τ_A denotes the quantile of the distribution of unobservables characteristics that affect the family's educational choices (i.e. in-kind). Quantile effects correspond to the effects of in-kind income (over the sample mean) on the quantile of gross income distribution (over the sample mean) when in-kind income is treated as exogenous. Each regression includes the following variables: a constant, dummies for the family's geographical area of residence, the number of income earners within the family, dummies for the dimension of the family , dummies for the educational level of the principal earner of the family, industry and occupational dummies of the principal earner, gender dummy of the family's principal earner, age, age square. Three stars, two stars and one star for statistically significant coefficients at the 1%, 5% and 10% confidence level. Bootstrapped standard errors in brackets.

Table 4b Estimates of the redistributive effect of direct taxation on gross income once controlled for in kind income

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
$\tau_C = 10$	2.7867***	2.4352***	1.9413***	1.5660***	1.5717***
	[0.01606]	[0.0033]	[0.01042]	[0.0129]	[0.01246]
$\tau_C = 25$	1.5207***	1.3713***	1.1745***	1.0177***	1.0461***
	[0.0088]	[0.0032]	[0.0050]	[0.0058]	[0.0037]
$\tau_C = 50$	1.4348***	1.3078***	1.1031***	0.9779***	0.9948***
	[0.0353]	[0.0209]	[0.0164]	[0.0121]	[0.0110]
$\tau_C = 75$	1.0776***	1.0591***	0.9463***	0.8779***	0.9144***
	[0.0550]	[0.0372]	[0.0278]	[0.0199]	[0.0149]
$\tau_C = 90$	1.0772***	1.0705***	0.9587***	0.8859***	0.9156***
	[0.0710]	[0.0421]	[0.0255]	[0.0175]	[0.0115]
Mean Quantile Treatment Effect	1.5794	1.4488	1.2248	1.0651	1.0885
Quantile Effect	0.4730	0.5195	0.5549	0.5894	0.6205
2004					
$\tau_C = 10$	5.3310***	5.3935***	4.8192***	4.5935***	5.0681***
	[0.0186]	[0.0607]	[0.0722]	[0.0801]	[0.0893]
$\tau_C = 25$	1.1772***	1.1728***	1.0876***	1.1259***	1.2358***
	[0.0003]	[0.0036]	[0.0031]	[0.0059]	[0.0015]
$\tau_C = 50$	0.8245***	0.8239***	0.8084***	0.8619***	0.9702***
	[0.0001]	[0.0000]	[0.0008]	[0.0013]	[0.0064]
$\tau_C = 75$	0.6818***	0.6871***	0.6871***	0.7501***	0.8637***
	[0.0033]	[0.0027]	[0.0015]	[0.0016]	[0.0027]
$\tau_C = 90$	0.5972***	0.6079***	0.6169***	0.6760***	0.0271***
	[0.0027]	[0.0018]	[0.0009]	[0.0004]	[0.0000]
Mean Quantile Treatment Effect	1.7223	1.7370	1.6038	1.6015	1.6330
Quantile Effect	0.3557	0.3973	0.4381	0.4822	0.5831
2004 counterfactual					
$\tau_C = 10$	0.9448***	0.7728***	0.6579***	0.6057***	0.5921***
	[0.0028]	[0.0027]	[0.0022]	[0.0021]	[0.0134]
$\tau_C = 25$	0.7698***	0.6682***	0.6120***	0.59932***	0.6298
	[0.0026]	[0.0012]	[0.0004]	[0.0016]	[0.0104]
$\tau_C = 50$	0.7088***	0.6286***	0.5896***	0.5855***	0.6388***
	[0.0037]	[0.0022]	[0.0008]	[0.0001]	[0.0068]
$\tau_C = 75$	0.6811***	0.6106***	0.5768***	0.5837***	0.6438***
	[0.0030]	[0.0018]	[0.0004]	[0.0015]	[0.0082]
$\tau_C = 90$	0.6457***	0.5930***	0.5675***	0.5825***	0.6392***
	[0.0055]	[0.0025]	[0.0008]	[0.0013]	[0.0082]
Mean Quantile Treatment Effect	0.7500	0.6546	0.6008	0.5913	0.6287
Quantile Effect	0.420	0.471	0.521	0.578	0.696

τ_F denotes the quantile of the distribution of the unobservables affecting gross income; τ_C denotes the quantile of the distribution of unobservables characteristics that affect the family's tax liability. Quantile effects corresponds to the effects of income taxation (over the sample mean) on the quantile of gross income distribution (over the sample mean) when income taxation is treated as exogenous. Each regression includes the following variables: a constant, dummies for the family's geographical area of residence, the number of income earners within the family, dummies for the dimension of the family dummies for the educational level of the principal earner of the family, industry and occupational dummies of the principal earner, gender dummy of the family's principal earner, age, age square. Three stars, two stars and one star for statistically significant coefficients at the 1%, 5% and 10% confidence level. Bootstrapped standard errors in brackets.

Table 5 Test on inter-quantile differences

2000	$\tau_A = 10$	$\tau_A = 25$	$\tau_A = 50$	$\tau_A = 75$	$\tau_A = 90$
In-kind[10]= In-kind[50]	0.39	0.03	0.25	0.00	0.06
	0.5324	0.8556	0.6170	0.9830	0.8042
In-kind[50]= In-kind[90]	0.30	2138.20	10.49	90.70	4.73
	0.5826	0.0000	0.0012	0.0000	0.0296
	$\tau_C = 10$	$\tau_C = 25$	$\tau_C = 50$	$\tau_C = 75$	$\tau_C = 90$
tax[10]= tax[50]	8.65	43.07	15.16	37.24	58.10
	0.0033	0.0000	0.0001	0.0000	0.0000
tax[50]= tax[90]	45.64	20.63	461.15	278.25	9.86
	0.0000	0.0000	0.0000	0.0000	0.0017
2004	$\tau_A = 10$	$\tau_A = 25$	$\tau_A = 50$	$\tau_A = 75$	$\tau_A = 90$
In-kind[10]= In-kind[50]	2.49	0.43	0.60	0.13	312.43
	0.1146	0.5127	0.4405	0.7169	0.0000
In-kind[50]= In-kind[90]	0.17	6.28	3.61	3.54	1.80
	0.6791	0.0122	0.0575	0.0599	0.1801
	$\tau_C = 10$	$\tau_C = 25$	$\tau_C = 50$	$\tau_C = 75$	$\tau_C = 90$
tax[10]= tax[50]	395.16	5.21	4.60	22.37	311.44
	0.0020	0.0225	0.0320	0.0000	0.0000
tax[50]= tax[90]	4.85	27.00	61.23	86.49	78.95
	0.0276	0.0000	0.0000	0.0000	0.0000
2004 counterfactual	$\tau_A = 10$	$\tau_A = 25$	$\tau_A = 50$	$\tau_A = 75$	$\tau_A = 90$
In-kind[10]= In-kind[50]	0.23	1.06	2.99	4.33	0.07
	0.6324	0.3031	0.0839	0.0376	0.7981
In-kind[50]= In-kind[90]	0.67	8.55	1.02	95.78	0.93
	0.4137	0.0035	0.3125	0.0000	0.3346
	$\tau_C = 10$	$\tau_C = 25$	$\tau_C = 50$	$\tau_C = 75$	$\tau_C = 90$
tax[10]= tax[50]	18970.18	54.83	1391.76	452.41	6.91
	0.0000	0.0000	0.0000	0.0000	0.0086
tax[50]= tax[90]	4.51	68.75	0.28	5.64	7.16
	0.0338	0.0000	0.5981	0.0176	0.0075

τ_A denotes the quantile of the distribution of unobservables characteristics that affect the family's educational choices (i.e. in-kind); τ_C denotes the quantile of the distribution of unobservables characteristics that affect the family's tax liability.

Table 6a Estimates of the elasticities of gross income with respect to in kind income

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
$\tau_A = 10$	-1.0174	-0.4024	-0.3880	-0.3736	-0.4125
$\tau_A = 25$	-0.3505	-0.1215	-0.1167	-0.1112	-0.1141
$\tau_A = 50$	-0.2042	-0.0872	-0.0860	-0.0771	-0.0767
$\tau_A = 75$	-0.1174	-0.0509	-0.0494	-0.0453	-0.0438
$\tau_A = 90$	-0.0668	-0.0298	-0.0288	-0.0274	-0.0270
2004					
$\tau_A = 10$	-0.425	-0.24405	-0.2045	-0.2018	-0.2226
$\tau_A = 25$	-0.1532	-0.0890	-0.0740	-0.0770	-0.0781
$\tau_A = 50$	-0.0788	-0.0479	-0.0413	-0.0424	-0.0446
$\tau_A = 75$	-0.0673	-0.0391	-0.0330	-0.0326	-0.0346
$\tau_A = 90$	-0.0405	-0.0240	-0.0227	-0.0229	-0.1194
2004 counterfactual					
$\tau_A = 10$	-0.3557	-0.2427	-0.2281	-0.2212	-0.2274
$\tau_A = 25$	-0.1594	-0.1073	-0.1024	-0.0977	-0.0966
$\tau_A = 50$	-0.0879	-0.0636	-0.0618	-0.0573	-0.0554
$\tau_A = 75$	-0.0599	-0.0416	-0.0390	-0.0357	-0.0342
$\tau_A = 90$	-0.0393	-0.0260	-0.0246	-0.0236	-0.0234

τ_F denotes the quantile of the distribution of the unobservables affecting gross income F; τ_A denotes the quantile of the distribution of unobservables characteristics that affect the family's educational choices (i.e. in-kind).

Table 6b Estimates the elasticities of gross income with respect to tax liability

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
$\tau_C = 10$	0.0816	0.0445	0.0420	0.0316	0.0316
$\tau_C = 25$	0.5233	0.2947	0.2810	0.2276	0.2300
$\tau_C = 50$	1.1744	0.7105	0.6673	0.5725	0.5800
$\tau_C = 75$	1.3439	0.8734	0.8392	0.7534	0.7602
$\tau_C = 90$	1.6781	1.1169	1.0621	0.9763	0.9776
2004					
$\tau_C = 10$	0.1504	0.0332	0.0233	0.0192	0.0168
$\tau_C = 25$	0.8881	0.1931	0.1357	0.1131	0.1001
$\tau_C = 50$	2.6049	0.5879	0.4370	0.3714	0.3334
$\tau_C = 75$	4.0841	1.0011	0.7663	0.6669	0.6010
$\tau_C = 90$	5.7709	1.4072	1.1047	0.9835	0.0309
2004 counterfactual					
$\tau_C = 10$	0.0838	0.0683	0.0629	0.0604	0.0573
$\tau_C = 25$	0.2418	0.2090	0.1967	0.1910	0.1855
$\tau_C = 50$	0.3556	0.3308	0.3187	0.3118	0.3067
$\tau_C = 75$	0.5385	0.5329	0.5206	0.5190	0.5179
$\tau_C = 90$	0.6742	0.7171	0.7274	0.7331	0.7278

τ_F denotes the quantile of the distribution of the unobservables affecting gross income F; τ_C denotes the quantile of the distribution of unobservables characteristics that affect the family's tax liability.

Appendix

Table A.1a Estimates of the residuals of the auxiliary regression of in kind income in the gross income regression

	$\tau_F=10$	$\tau_F=25$	$\tau_F=50$	$\tau_F=75$	$\tau_F=90$
2000					
$\tau_A=10$	0.0704	0.0875	0.0655***	0.0611**	0.0603***
	[0.0487]	[0.0587]	[0.0247]	[0.0302]	[0.0101]
$\tau_A=25$	0.0056***	0.0077***	0.0017***	-0.0020***	-0.0027***
	[0.0003]	[0.0003]	[0.000]	[0.0001]	[0.0003]
$\tau_A=50$	0.0080***	0.0111***	0.0072***	0.0004***	0.0011***
	[0.0003]	[0.0002]	[0.0001]	[0.0000]	[0.0002]
$\tau_A=75$	0.0096***	0.0106***	0.0078***	0.0026***	0.0045***
	[0.0000]	[0.0001]	[0.0001]	[0.0000]	[0.0004]
$\tau_A=90$	0.0182***	0.0139***	0.0107***	0.0059***	0.0084***
	[0.0003]	[0.0001]	[0.0002]	[0.0001]	[0.0005]
2004					
$\tau_A=10$	0.0423	0.0353	0.0289	0.0444	0.0497**
	[0.0321]	[0.0272]	[0.0220]	[0.0314]	[0.0256]
$\tau_A=25$	0.0183***	0.0135***	0.0125***	0.0210***	0.0253***
	[0.0005]	[0.0002]	[0.0002]	[0.0001]	[0.0000]
$\tau_A=50$	0.0174***	0.0130***	0.0148***	0.0202***	0.0280***
	[0.0004]	[0.0002]	[0.0001]	[0.0001]	[0.0002]
$\tau_A=75$	0.0173***	0.0140***	0.0138***	0.0198***	0.0263***
	[0.0005]	[0.0001]	[0.0001]	[0.0002]	[0.0002]
$\tau_A=90$	0.0196***	0.0133***	0.0130***	0.0210***	0.0271
	[0.0005]	[0.0003]	[0.0002]	[0.0002]	[0.0000]
2004 counterfactual					
$\tau_A=10$	0.0239	0.0283	0.0209	0.0279	0.0317
	[0.0172]	[0.0259]	[0.0222]	[0.0237]	[0.0341]
$\tau_A=25$	0.0089***	0.0108***	0.0075***	0.0084***	0.0093***
	[0.0002]	[0.0003]	[0.0002]	[0.0001]	[0.0007]
$\tau_A=50$	0.0111***	0.0119***	0.0111***	0.0100***	0.0183***
	[0.0004]	[0.0002]	[0.0001]	[0.0003]	[0.0005]
$\tau_A=75$	0.0122***	0.0114***	0.0086***	0.0100***	0.0179***
	[0.0002]	[0.0002]	[0.0001]	[0.0002]	[0.0002]
$\tau_A=90$	0.0131***	0.0127***	0.0094***	0.0118***	0.0188***
	[0.0003]	[0.0003]	[0.0002]	[0.0003]	[0.0003]

τ_F denotes the quantile of the distribution of the unobservables affecting gross income; τ_A denotes the quantile of the distribution of unobservables characteristics that affect the family's educational choices (i.e. in-kind). Each regression includes the following variables: a constant, dummies for the family's geographical area of residence, the number of income earners within the family, dummies for the dimension of the family , dummies for the educational level of the principal earner of the family, industry and occupational dummies of the principal earner, gender dummy of the family's principal earner, age, age square. Three stars, two stars and one star for statistically significant coefficients at the 1%, 5% and 10% confidence level. Bootstrapped standard errors in brackets.

Table A.1b Estimates of the residuals of the auxiliary regression of direct taxation in the gross income regression

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
$\tau_C = 10$	-2.1885***	-1.8484***	-1.3572***	-0.9592***	-0.9364***
	[0.01503]	0.0027	[0.0092]	[0.01271]	[0.0134]
$\tau_C = 25$	-0.9277***	-0.7892***	-0.5929***	-0.4107***	-0.4110***
	[0.0079]	[0.0024]	[0.0038]	[0.0055]	[0.0046]
$\tau_C = 50$	-0.8481***	-0.7311***	-0.5237***	-0.3723***	-0.3604***
	[0.0347]	[0.0202]	[0.0152]	[0.0119]	[0.0118]
$\tau_C = 75$	-0.5052***	-0.4903***	-0.3691***	-0.2749***	-0.2820***
	[0.0546]	[0.0366]	[0.0270]	[0.0198]	[0.0156]
$\tau_C = 90$	-0.5207***	-0.5153***	-0.3879***	-0.2852***	-0.2852***
	[0.0708]	[0.0415]	[0.0250]	[0.0176]	[0.0121]
2004					
$\tau_C = 10$	-4.9155***	-4.9642***	-4.3714***	-4.0974***	-4.4674***
	[0.0175]	[0.0599]	[0.0721]	[0.0808]	[0.0924]
$\tau_C = 25$	-0.7648***	-0.7463***	-0.6417***	-0.6314***	-0.6369***
	[0.0011]	[0.0028]	[0.0030]	[0.0065]	[0.0044]
$\tau_C = 50$	-0.4101***	-0.4000***	-0.3648***	-0.3705***	-0.3742***
	[0.0009]	[0.0006]	[0.0009]	[0.0005]	[0.0032]
$\tau_C = 75$	-0.2703***	-0.2663***	-0.2444***	-0.2606***	-0.2703***
	[0.0024]	[0.0023]	[0.0014]	[0.0023]	[0.0006]
$\tau_C = 90$	-0.1926***	-0.1926***	-0.1764***	-0.1901***	-0.2079***
	[0.0017]	[0.0015]	[0.0008]	[0.0004]	[0.0008]
2004 counterfactual					
$\tau_C = 10$	-0.4486***	-0.2596***	-0.1214***	-0.0107***	0.1362
	[0.0012]	[0.0018]	[0.0019]	[0.0025]	[0.0157]
$\tau_C = 25$	-0.2752***	-0.1569***	-0.0757***	-0.0049**	0.0993***
	[0.0041]	[0.0021]	[0.0002]	[0.0021]	[0.0126]
$\tau_C = 50$	-0.2180***	-0.1197***	-0.0542***	0.0072***	0.0866***
	[0.0051]	[0.0030]	[0.0010]	[0.0005]	[0.0087]
$\tau_C = 75$	-0.1957***	-0.1050***	-0.0448***	0.0067***	0.0802***
	[0.0043]	[0.0025]	[0.0005]	[0.0020]	[0.0104]
$\tau_C = 90$	-0.1693***	-0.0956***	-0.0380***	0.0059***	0.0818***
	[0.0066]	[0.0029]	[0.0008]	[0.0059]	[0.0103]

τ_F denotes the quantile of the distribution of the unobservables affecting gross income; τ_C denotes the quantile of the distribution of unobservables characteristics that affect the family's tax liability. Each regression includes the following variables: a constant, dummies for the family's geographical area of residence, the number of income earners within the family, dummies for the dimension of the family , dummies for the educational level of the principal earner of the family, industry and occupational dummies of the principal earner, gender dummy of the family's principal earner, age, age square. Three stars, two stars and one star for statistically significant coefficients at the 1%, 5% and 10% confidence level. Bootstrapped standard errors in brackets.

Table A.2a Estimates of the interactions of the residuals in the auxiliary regression with in kind income in the gross income regression

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
$\tau_A = 10$	0.0046***	0.0038***	0.0046***	0. 0053***	0. 0051***
	[0.0000]	[0. 0000]	[0. 0000]	[0. 0000]	[0. 0000]
$\tau_A = 25$	0.0029***	0.0028***	0.004***	0.0044***	0.0043***
	[0.0001]	[0.0001]	[0.000]	[0.0000]	[0.0000]
$\tau_A = 50$	0.0022***	0.0015***	0.0031***	0.0041***	0.0035***
	[0.0001]	[0.000]	[0.000]	[0.0000]	[0.0000]
$\tau_A = 75$	0.0018***	0.0016***	0.0024***	0.0036***	0.0028***
	[0.0000]	[0.0001]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 90$	-0.0002***	0.0006***	0.0022***	0.0032***	0.0023***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
2004					
$\tau_A = 10$	0.0009***	0.0008***	0.0006***	0.0012***	-0.0001***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 25$	0.0005***	0.0005***	0.0002***	0.0004***	-0.0009***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 50$	-0.0005***	-0.0001***	-0.001***	-0.0004***	-0.0012***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 75$	-0.0006***	-0.0000***	-0.0010***	-0.0004***	-0.0012***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 90$	-0.0003***	0.0002***	-0.0004***	-0.0004***	-0.0013***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
2004 counterfactual					
$\tau_A = 10$	0.0018***	0.0018***	0.0023***	0.0026***	0.0030***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 25$	0.0016***	0.0016***	0.0020***	0.0029***	0.0028***
	[0.0002]	[0.0003]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 50$	0.0006***	0.0010***	0.0012***	0.0021***	0.0010***
	[0.0001]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 75$	-0.0001***	0.0010***	0.0019***	0.0021***	0.0008***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_A = 90$	-0.0003***	0.0008***	0.0019***	0.00190***	0.0008***
	[0.0001]	[0.0000]	[0.0000]	[0.0000]	[0.0000]

τ_F denotes the quantile of the distribution of the unobservables affecting gross income; τ_A denotes the quantile of the distribution of unobservables characteristics that affect the family's educational choices (i.e. in-kind). Each regression includes the following variables: a constant, dummies for the family's geographical area of residence, the number of income earners within the family, dummies for the dimension of the family , dummies for the educational level of the principal earner of the family, industry and occupational dummies of the principal earner, gender dummy of the family's principal earner, age, age square. Three stars, two stars and one star for statistically significant coefficients at the 1%, 5% and 10% confidence level. Bootstrapped standard errors in brackets.

Table A.2b Estimates of the interactions of the residuals of the auxiliary regression with direct taxation in the gross income regression

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
2000					
$\tau_C = 10$	-0.0108***	-0.0077***	-0.0039***	-0.0024***	-0.0018***
	[0.0001]	[0.0000]	[0.0002]	[0.0001]	[0.0000]
$\tau_C = 25$	-0.0105***	-0.0075***	-0.0036***	-0.0024***	-0.0018***
	[0.0001]	[0.0001]	[0.0002]	[0.0001]	[0.0000]
$\tau_C = 50$	-0.0106***	-0.0070***	-0.0036***	-0.0024***	-0.0018***
	[0.0001]	[0.0001]	[0.0002]	[0.0001]	[0.0000]
$\tau_C = 75$	-0.0101***	-0.0069***	-0.0036***	-0.0024***	-0.0018***
	[0.0000]	[0.0001]	[0.0002]	[0.0001]	[0.0000]
$\tau_C = 90$	-0.0098***	-0.0060***	-0.0036***	-0.0023***	-0.0018***
	[0.0000]	[0.0001]	[0.0002]	[0.0000]	[0.0000]
2004					
$\tau_C = 10$	-0.0032***	-0.0031***	-0.0020***	-0.0015***	-0.0024***
	[0.0000]	[0.0001]	[0.0000]	[0.0000]	[0.0000]
$\tau_C = 25$	-0.0030***	-0.0030***	-0.0016***	-0.0015***	-0.0023***
	[0.0000]	[0.0001]	[0.0000]	[0.0000]	[0.0000]
$\tau_C = 50$	-0.0033***	-0.0029***	-0.0011***	-0.0015***	-0.0023***
	[0.0001]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_C = 75$	-0.0034***	-0.0029***	-0.0011***	-0.0015***	-0.0023***
	[0.0001]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\tau_C = 90$	-0.0034***	-0.0028***	-0.0011***	-0.0015***	-0.0023***
	[0.0001]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
2004 counterfactual					
$\tau_C = 10$	-0.0054***	-0.0046***	-0.0029***	-0.0022***	-0.0035***
	[0.0001]	[0.0001]	[0.0000]	[0.0000]	[0.0000]
$\tau_C = 25$	-0.0054***	-0.0045***	-0.0029***	-0.0022**	-0.0035***
	[0.0002]	[0.0001]	[0.0002]	[0.0000]	[0.0000]
$\tau_C = 50$	-0.0052***	-0.0045***	-0.0029***	-0.0022***	-0.0035***
	[0.0002]	[0.0001]	[0.0000]	[0.0000]	[0.0000]
$\tau_C = 75$	0.0050***	-0.0045***	-0.0021***	-0.0022***	-0.0035***
	[0.0001]	[0.0002]	[0.0000]	[0.0000]	[0.0000]
$\tau_C = 90$	-0.0047***	-0.0042***	-0.0016***	-0.0022***	-0.0035***
	[0.0001]	[0.0001]	[0.0000]	[0.0000]	[0.0000]

τ_F denotes the quantile of the distribution of the unobservables affecting gross income; τ_C denotes the quantile of the distribution of unobservables characteristics that affect the family's tax liability. Each regression includes the following variables: a constant, dummies for the family's geographical area of residence, the number of income earners within the family, dummies for the dimension of the family , dummies for the educational level of the principal earner of the family, industry and occupational dummies of the principal earner, gender dummy of the family's principal earner, age, age square. Three stars, two stars and one star for statistically significant coefficients at the 1%, 5% and 10% confidence level. Bootstrapped standard errors in brackets.

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