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EVALUATING THE DISTRIBUTIONAL EFFECTS OF FISCAL POLICIES USING QUANTILE REGRESSIONS

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The objective of this paper is to propose and apply a new method to evaluate the distributional impact of fiscal policies and potential marginal reforms. The econometric tool adopted is structural quantile treatment effects regression, which allows a complete picture of the effects of the fiscal policy of interest on households with different incomes, abilities, and needs. We apply this method to personal income taxation and non-cash transfers in Italy for the year 2004. Our estimates suggest that, although heterogeneous, the redistributive effects of the potential fiscal reforms are almost zero.

JEL Codes: C21, D31, E62

Keywords: income redistribution, in-kind transfers, quantile regressions, taxation

1. INTRODUCTION

Redistribution in developed countries is the result of several interdependent public revenue and expenditure policies, ranging from taxation to cash and non-cash transfers. To evaluate the redistributive effect of a single mechanism without taking into account the distributional effects of others can be misleading. Let us suppose, for instance, that in a certain country public services, such as health care or education, mainly benefit the rich. If the expenditures are financed by a flat rate tax system, then the public policy can be interpreted as a form of redistribution from the poor to the rich. But, in the presence of a progressive tax system, this conclusion would not hold if the net effects of the fiscal system are considered.

Several theoretical contributions highlight the need for an analysis of both optimal taxation and public provision as reviewed by Balestrino (1999) and Currie and Gahvari (2008). In particular, studies analyzing the optimal structure of non-linear taxes in an asymmetric context, emphasize the role of non-cash transfers as mechanisms that relax the self-selection constraints for the rich, enabling

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the achievement of redistributive goals (Cremer and Gahvari, 1993; Blomquist and Christiansen, 1995; Boadway and Marchand, 1995; Boadway *et al.*, 1998; Pirttilä and Tuomala, 2002). Arrow's (1971) finding on the regressivity of public provision of education, confirmed in a different framework by Dur and Teulings (2001), has been challenged by analyses developed within a general equilibrium framework. Bovenberg and Jacobs (2005) extend the work of Ulph (1977) and Hare and Ulph (1979), and argue that, although the more able benefit more than proportionally from education provision, education subsidies are redistributive as long as they contribute to an efficient education level by offsetting the disincentive to accumulate human capital related to tax progressivity.

Drawing on these theoretical contributions, our paper evaluates the distributional impact of the fiscal system, identified by personal income taxation and non-cash income transfers, the latter being related to health and education services. Our empirical strategy is a structural quantile treatment effects regression method (Ma and Koenker, 2006), which enables a complete picture of the effects of both policies on different quantiles of the gross income distribution.

To the best of our knowledge, the present piece of work is the first attempt to evaluate heterogeneity in the potential effects of the two fiscal policies of interest on gross income distribution, using quantile regressions. The structural quantile treatment effect explores the potential heterogeneity in the effects of the two policy measures over the distribution of gross income as well as the distribution of the two policy variables. More specifically, by controlling for the interactions between families' unobservable needs and abilities, and the two policy measures of interest, Ma and Koenker's (2006) method allows us to provide the broadest possible view for evaluating the (re)distributive effects of in-kind transfers and personal income taxation, which should make a positive contribution to debate on these issues.

We apply this idea to Italian data. Italy is an interesting case to study the redistributive effect of fiscal policies since it is characterized by high inequality of outcomes, measured by gross and disposable income (see, e.g., Smeeding and Grodner, 2000; Bertola *et al.*, 2001). However, we believe the approach could be extended to other country cases.

The paper is organized as follows. Section 2 presents the method and motivation for the analysis. Section 3 describes the microsimulation exercise. Section 4 illustrates the dataset and the selection of instruments. Section 5 presents the results of the analysis, and Section 6 concludes.

2. Methodology and Motivation

By definition, a tax (in-kind income transfer) system is progressive if the tax liabilities (non-cash benefits) are distributed more unequally than the income to which they apply. Any progressive income tax (in-kind income transfer) is equivalent to a flat tax (in-kind benefit) with the same yield but with a rich to poor transfer (higher tax rate/lower in-kind transfer for the rich). That is, there must be a single crossing between the hypothetical proportional taxation system (in-kind income benefit system) and the real system.

The literature evaluates the (re)distributive impact of fiscal policies suggesting methods based on concentration or Lorenz curves. According to Yitzhaki and

Slemrod (1991), in-cash transfers financed by taxation are welfare improving for any social welfare function characterized by a (small) aversion to inequality if the concentration curve of the total post-tax and post-transfer income is higher than the Lorenz curve of the pre-tax and pre-transfer income. Sonedda and Turati (2005) study the dominance of Lorenz curves and compare Gini indexes to show that the redistributive impact of in-kind transfers in Italy is limited, while redistribution operates in part through income taxation but mainly through cash transfers. Mayshar and Yitzhaki (1996) propose a method for evaluating whether a tax reform improves social welfare if households' heterogeneity in abilities and needs is taken into account.

Our paper suggests an econometric approach that allows consideration of the two-dimensional ordering of households with respect to unobservable abilities and needs. It addresses the issue of whether a small increase in either overall public expenditures on health and education or personal income taxes increases social welfare for any social welfare function characterized by a (small) aversion to inequality. The key assumption here is that in-kind income transfers (personal taxation liabilities) improve (worsen) a family's relative position in the gross income distribution if the share, over the sample mean, of the in-kind transfers (personal taxation liabilities) is higher than the family's gross income share. Drawing on this prediction, in the rest of the paper, we empirically investigate the full distributional responses to changes in in-kind transfers and income tax liability, by regressing, for each quantile, the ratio between the pre-tax and pre-transfer income and its average value over the whole population, on the corresponding ratios for both personal income taxes and non-cash income. Using the estimated elasticities we then can calculate a new pre-tax and pre-transfer income distribution, and evaluate whether the potential fiscal policy reform generates a less unequal pre-state intervention income distribution. We can also assess whether this potential fiscal policy reform is redistributive by comparing the "estimated" gross income and the "estimated" net of taxes plus in-kind transfers income distributions. Although we estimate concentration curves, we can measure the redistributive impact in terms of Gini indexes as long as there is no re-ranking. We verify this condition by comparing "winner" and "loser" quantiles pre- and post-reform; if the quantile status remains unchanged no re-ranking has occurred.[1]

We start by defining the following quantile regression model. Let yg_i, $inkind_i$, and tax_i be, respectively, the gross income, in-kind transfers, and personal tax liabilities of household i, and μ_{yg}, μ_{inkind}, and μ_{tax} their average values over the whole population. The empirical equation to be estimated is:

$$\frac{yg_i}{\mu_{yg}} = \beta(A_i, F_i)\frac{inkind_i}{\mu_{inkind}} + \psi(C_i, F_i)\frac{tax_i}{\mu_{tax}} + A_i + C_i + F_i + \gamma X_i \tag{1}$$

where $A_i \sim G_A(0, \sigma_A^2)$ and $C_i \sim G_C(0, \sigma_C^2)$ represent unobserved household characteristics affecting the likelihood to accede to, respectively, in-kind transfers and personal tax liabilities, $F_i \sim G_F(0, \sigma_F^2)$ is an idiosyncratic income shock

[1]These conditions are necessary but not sufficient for a Pareto improving reform since we are evaluating whether the quantile group (and not necessarily every household in it) gains.

orthogonal to A_i and C_i, and G stands for a generic distribution.[2] Finally, X_i is a vector of controls which includes household and household head's characteristics. For family characteristics, we control for family size (the observable component of family needs), number of income recipients, and macro-area of residence. For household head, we control subsequently for gender, age, level of education, and employment condition.

We assume that the analyzed policies are redistributive if they produce different effects on different households' gross income quantiles. As a consequence, the superiority of quantile regression—compared to ordinary least square (OLS), which provides estimates of the effect of the covariates on the mean of the distribution only—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 LS methods.

We apply the structural quantile treatment effects method (Ma and Koenker, 2006) rather than quantile regression as in Koenker and Basset (1978), in order to address two problems. 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 (1) are endogenous.

The chosen method ensures that estimates of the key parameters are consistent, and allows us to evaluate the potential endogeneity of the fiscal policy variables by testing the statistical significance of the estimated coefficients of the residuals of the auxiliary regressions described below, and their interaction with the fiscal policy variables. More specifically, if we use W and Z to denote the instrumental variables, the auxiliary regressions of tax liabilities and in-kind transfers to be estimated are then:

$$\frac{inkind_i}{\mu_{inkind}} = \gamma_{inkind} X_i + \phi Z_i + \varepsilon A_i \tag{2}$$

$$\frac{tax_i}{\mu_{tax}} = \gamma_{tax} X_i + \chi W_i + \lambda C_i. \tag{3}$$

Let us apply $\tau_A = G_A(A_{\tau A})$, $\tau_C = G_C(C_{\tau C})$, and $\tau_F = G_F(F_{\tau F})$, where $A_{\tau A}$, $C_{\tau C}$, and $F_{\tau F}$ are the τ-quantiles of distribution of A_i, C_i, and F_i, respectively. Following Ma and Koenker (2006), we define the conditional quantile equations of the gross income, personal income taxation, and in-kind provision, respectively, as $Q_y[\tau_F|inkind, tax, X]$, $Q_{inkind}[\tau_A|X, Z]$, and $Q_{tax}[\tau_C|X, W]$, corresponding to equations (1), (2), and (3). Therefore we can write:

[2] Unobservable A_i can be thought of as the sum of individuals' abilities that lead to receipt of in-kind transfers in terms of non-compulsory education alone, as health care transfers are not imputed on actual usage but rather on the individual probability of receiving them (see Section 3). For unobservable C_i, it is possible to assume that it represents the sum of individual abilities affecting the capacity to generate income and, consequently, to pay taxes on it. Finally, we interpret the idiosyncratic income shock F_i in terms of unobservable family needs.

$$(4) \quad Q_y[\tau_F|Q_{inkind}(\tau_A|X,Z), Q_{tax}(\tau_C|X,W), X] = Q_{inkind}(\tau_A|X,Z)\pi_1(\tau_F,\tau_A) + Q_{tax}(\tau_C|X,W)\pi_2(\tau_F,\tau_C) + \gamma_y X + G_A^{-1}(\tau_A) + G_C^{-1}(\tau_C) + G_F^{-1}(\tau_F)$$

$$(5) \quad Q_{inkind}(\tau_A|X,Z) = \gamma_{inkind}X + \pi_2 Z + \upsilon G_A^{-1}(\tau_A)$$

$$(6) \quad Q_{tax}(\tau_C|X,W) = \gamma_{tax}X + \pi_1 W + \zeta G_C^{-1}(\tau_C).$$

Since the distribution of in-kind provision and taxation conditional on controls X and on instruments Z and W are affected by the distribution of unobservables A_i and C_i, then equations (4), (5), and (6) represent the effects of these unobserved characteristics on the various quantiles of the distribution of gross income. We can study how various quantiles Q_y of the gross income distribution are affected by endogenously determined Q_{inkind} and Q_{tax} quantiles of in-kind transfers and personal income taxation. That is, we evaluate the consequences 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 functions $\pi_1(\tau_F,\tau_A)$ and $\pi_2(\tau_F,\tau_C)$ are the quantile effects of changes in the publicly provided goods and taxation on gross income, respectively. When the distributional effects are heterogeneous, as assumed in this location-scale shift model, the structural quantile treatment effect, $\pi_1(\tau_F,\tau_A)$ and $\pi_2(\tau_F,\tau_C)$ represent a deconstruction of the mean effect (estimated by the two-stage LS estimator in a pure location shift model) into its elementary components. This method allows us to evaluate the role played by three factors: household's unobservable needs and abilities, household's choices and efforts related to income taxation and in-kind transfers, and the interactions between the unobservables and the two fiscal policy measures.

According to the method discussed above for each fiscal policy variable, we can run an auxiliary quantile regression, whose regressors include all the exogenous variables plus the selected instruments (i.e., equations (2) and (3)). 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.[3] We can then estimate the effect of each quantile of the analyzed mechanisms on each gross income quantile.

Assume that we consider the 10th quantile of the gross income distribution $\tau_F = G_F(F_{\tau F}) = 10$, changes in τ_A and τ_C in $\pi_1(\tau_F,\tau_A)$ and $\pi_2(\tau_F,\tau_C)$ reflect how the distribution of τ_A and τ_C affects the 10th quantile of the response of the gross income. On the other hand, if we fix τ_A and τ_C to 10, we evaluate the effect of the 10th quantile of τ_A and τ_C on the whole distribution of the response of the gross income, τ_F. For simplicity, let us assume a negative sign of $\pi_1(\tau_F,\tau_A)$. This circumstance indicates that the higher the benefit received by households, the lower will be the corresponding gross income. If for any τ_A the estimated $\pi_1(\tau_F,\tau_A)$ increases (decreases)—in absolute value—along the τ_F distribution, we can argue only that the income reduction associated to a unit increase of transfers grows (falls) with

[3]Estimates of the residuals of the auxiliary regressions and their interactions with fiscal policy variables in the gross income equation are available upon request.

household income. No further conclusions can be drawn, however, because coefficients expressed in absolute values are not easily comparable. The calculation of corresponding elasticities, namely of the income percentage variation associated with a 1 percent increase in the in-kind transfer, allows comparisons among income changes. Elasticity can be interpreted in a different way, which adds to our analysis. By construction, the elasticity of the (standardized) gross income with respect to the (standardized) in-kind transfer, is equal to the ratio of average and marginal transfers.[4] Consequently, according to the standard progressivity indicator, a ratio greater (lower) than 1 indicates that transfers are progressive (regressive). Since we estimate the elasticity for each τ_F quantile, our results are evidence of possible modifications to the redistributive power of in-kind transfers, along the gross income distribution. From a different perspective, a decrease of $\pi_1(\tau_F, \tau_A)$—in absolute value—along the τ_A distribution for any τ_F, suggests that the allocation of state resources is carried out on "efficiency" grounds since households that are more able to take advantage of in-kind transfers incur smaller income contractions. However, a $\pi_1(\tau_F, \tau_A)$ increase along τ_A would suggest that households that are less able to obtain in-kind transfers, experience smaller trade-offs between income and in-kind benefits.

While we do not have any *a priori* knowledge concerning the sign of $\pi_1(\tau_F, \tau_A)$, we would expect a positive sign of $\pi_2(\tau_F, \tau_C)$ since any tax is characterized by a positive relation between the tax base (income) and the tax liability. By looking at the values assumed by the coefficient along the distribution of the unobservables, if $\pi_2(\tau_F, \tau_C)$ decreases (increases) along the τ_F distribution for any τ_C, then the higher the household income, the lower (higher) will be the income increase associated with a positive variation in the unit tax liability. As before, however, the coefficients cannot be easily compared without calculating the corresponding elasticities which indicate the income percentage variation associated with a 1 percent increase in tax liability. Since elasticity, as already noted, is equal to the ratio of average and marginal tax rates,[5] a value lower (greater) than 1 indicates that the personal tax system is progressive (regressive). We can then assess whether the Italian direct tax system is progressive along the whole gross income distribution.

3. The Microsimulation Exercise on In-Kind Transfers: Imputation Rules

The development of microsimulation models aimed at studying the income distribution in Italy includes, among others, work by Fiorio (2009) and Baldini (2001). In general, almost all microsimulation exercises on Italian data concentrate on reconstructing gross income and taxation.

[4]The elasticity can be written as follows:

$$\varepsilon_{\frac{y_{g_i}}{\mu_{yg}},\frac{inkind_i}{\mu_{inkind}}} = \frac{\partial\left(\frac{y_{g_i}}{\mu_{yg}}\right)}{\partial\left(\frac{inkind_i}{\mu_{inkind}}\right)} \frac{\frac{inkind_i}{\mu_{inkind}}}{\frac{y_{g_i}}{\mu_{yg}}} = \frac{\mu_{inkind}}{\mu_{yg}} \frac{\partial y_{g_i}}{\partial inkind_i} \frac{inkind_i}{y_{g_i}} \frac{\mu_{yg}}{\mu_{inkind}} = \frac{\frac{inkind_i}{y_{g_i}}}{\frac{\partial inkind_i}{\partial y_{g_i}}}$$

which represents the ratio between the average and the marginal in-kind transfer.

[5]To see this it is sufficient to substitute $\frac{tax_i}{\mu_{tax}}$ in place of $\frac{inkind_i}{\mu_{inkind}}$ in footnote 4.

In the present paper we update to 2004 Sonedda and Turati's (2005) microsimulation model of in-kind income transfers for the year 2000. It takes account of the two most important in-kind transfers provided directly by government, for health care and education. The main imputation rules are as follows.

Microsimulated health care and education are both net of the costs borne by households. Gross health benefits are considered net of co-payments, and education benefits are considered net of enrolment taxes paid to access the service. As in similar exercises (e.g., Smeeding *et al.*, 1993; Citoni, 2000), the (gross) value for the transfer recipients is assumed to be equal to the amount of government spending on each item. Moreover, since we use the Survey of Household Income and Wealth (SHIW) data, we do not have information on the actual utilization of health care services by household members; hence, we cannot attribute the in-kind transfer according to actual individual usage.

We start by estimating the average cost of hospital treatment, and the average cost of a drug prescription, for each Italian region. This allows us to impute the value of in-kind transfers on the basis of the risk of consuming the service (hospitalization or drug therapy), for almost all individuals, varying by age, gender, and region. A different imputation rule is used for the small group of employees who provided information on the number of days they had been sick in 2004. More specifically, if the illness period is longer less than 15 days, the individual is assumed to require drug therapy; otherwise, the individual is assumed to require hospital treatment. We assume also that for illnesses lasting less than 7 days, individuals need only one drug prescription, and for illnesses lasting between 7 and 15 days, they need two drug prescriptions.

Gross education benefits (relative to all school grades before entry to undergraduate university courses) are attributed only to families with children enrolled in school. We assume that the value of the transfer corresponds to the (estimated) average cost per student (heterogeneous across level of education and region of residence), and weight this cost by the probability of attending a public school (heterogeneous across each grade of education and each region). Attending public schools generally implies the payment of a negligible, with respect to the average cost per student, fee: not considering this fee does not alter our findings significantly. For tertiary education services, we impute the net value of transfers only to those families with relatives enrolled in an undergraduate university course; once again, differences in the quality of education received are not accounted for. Estimated average cost per student (i.e., the gross transfer), heterogeneous across regions, is reduced by the university fees. We estimate universities' fees by calculating an average regional fee, weighted by the number of students attending each institution in a given region. Using estimated fees has two main drawbacks: they do not consider the progressive structure of university fees; and they do not take account of students' migration across country regions.[6]

[6]Students' migration across regions does not represent a big concern with our data since Italian students mostly enroll at a university located in their region of residence (MIUR-CNVSU, 2003).

TABLE 1
Descriptive Statistics

	Mean	Median	SD	Gini	p90/p10	Coefficient of Variation	Obs
Gross equivalent income (yg)	16,439.87	12,683.34	16,696.72	0.391	5.43	1.067	8,004
Net personal tax (tax)	2,213.08	1,126.84	4,975.03	0.651	–	2.401	8,004
In-kind transfers (inkind)	2,830.19	835.40	3,647.30	0.618	29.70	1.320	8,004
Disposable income (yg – tax + inkind)	17,056.98	14,610.33	12,719.8	0.316	3.78	0.796	8,004

The in-kind provision imputed to each household is the sum of these monetary values of the education and health care services utilized by the family.[7]

4. Data

The data are from the SHIW 2004 wave. SHIW is a nationally representative household survey conducted every two years by the Bank of Italy with the main aim of gathering data on net incomes and savings of Italian households.[8] Individual data are collapsed into family income, providing a sample of 8,004 families, once we consider positive incomes only. All income figures are adjusted by considering differences in family needs. We use the ISEE (Indicatore della Situazione Economica Equivalente) equivalence scale, a method applied in Italy to assess on a means-testing basis the economic situation of households claiming social benefits or services provided by the state, to adjust cash income, and evaluate in-kind income in per capita terms. The ISEE 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.[9]

Table 1 presents some standard summary statistics for the variables considered in the analysis. Personal taxation liabilities (*tax*) on average represent only about 13.5 percent of the mean gross income and, as expected, show a more unequal distribution than income. When we look at the average in-kind transfer, we see that the distance between the mean and median values is greater than for taxation, since only a small part of Italian households benefit from transfers related to education. The last row reports the descriptive statistics for an enlarged version of disposable income, defined as the sum of the net of taxes income and the monetary value of the in-kind transfers. This value is greater than the average gross income value, evidence that the balance between personal taxes and in-kind

[7]Since, as stated above, in-kind health benefits are attributed to all individuals on the basis of their risk of consuming the health service, overall in-kind income transfers are positive for all households including those without children, which, by definition, have an education-related in-kind transfer equal to zero.

[8]We thank C. Fiorio for providing us with the gross-income data.

[9]In order to test the robustness of our results, estimates were also run on an equivalent income obtained by dividing the overall household income by the square root of the number of family members. Results are qualitatively robust and available upon request from the authors.

TABLE 2
Descriptive Statistics by Quantiles

	Gross Equivalent Income (yg)				Net Personal Tax				In-Kind Transfers			
Quantiles	€	% of Median	Share, %	Cumul. Share	€	% of Median	Share, %	Cumul. Share	€	% of Median	Share, %	Cumul. Share
10	5,382.86	42.44	2.18	2.18	0	0	0	0	302.42	36.2	0.88	0.88
25	7,920.79	62.45	6.11	8.29	132.47	11.76	0.11	0.11	425.97	50.99	1.93	2.81
50	12,683.34	100	15.64	23.93	1,126.84	100	7.05	7.16	835.4	100	5.39	8.2
75	19,672.33	155.1	24.34	48.27	2,667.14	236.69	20.41	27.57	4,802.52	574.88	18.34	26.54
90	29,252.58	230.64	21.54	69.81	4,951.51	439.42	24.37	51.94	8,982.24	1075.2	33.34	59.88

transfers is positive for Italian families on average. Moreover, the distribution of disposable income is more equal than the distribution of gross income.

Table 2 presents the distribution of the variables ranking individuals according to their gross income quantile. For taxes, the statistics show a clear progressive personal taxation system, with lower income individuals paying proportionally less taxes than higher income taxpayers. The distribution of non-cash transfers below the median is quite similar to the distribution of gross income, while quantiles above the 50th benefit from a higher fraction of in-kind transfers than the fraction of gross income accruing to them. This is the consequence of the non-uniform distribution of education and health transfers, which go mainly to households that include children and older people, respectively.

4.1. *The Selection of Instruments*

Consistent estimates of the effects of interest can be derived if, for each endogenous fiscal policy, there is at least one variable correlated with these measures, but not with household income.

In relation to non-cash benefits, since primary school is compulsory and in-kind income transfers related to national health services, by construction, depend on the individual's age, gender, and region of residence, we consider only in-kind transfers related to secondary and tertiary education as potentially endogenous. Therefore, as an identification strategy we adopt two different instruments. According to the literature (see, e.g., Brunello *et al*., 2009), we first use the number of years of compulsory education for each child in the household (COMPSCHOOL). Law 20/1999 (or Legge Berlinguer) raised the age for compulsory schooling in Italy from 14 years of age to 15 years of age from the school year 1999/2000, in other words, for individuals born after 1985. Law 53/2003 (or Riforma Moratti) restored the age for compulsory schooling to 14 years for cohorts born after 1989. Thus, for each household we have three different values of compulsory years of schooling: zero if there are no children of high school age living in the household; 8 for households with children of high school age and not affected by the Berlinguer reform; and 9 for those with children of high school age affected by the reform.

The second instrument is a proxy for the "supply" of higher education in the region of residence of children who potentially could be attending university (HESUPPLY). The idea is that, especially for individuals from poorer backgrounds, the presence of higher education institutions close to the household's residence could positively affect a child's decision to enroll at college because it relaxes household credit constraints (see, e.g., Card, 1999). Therefore, we calculate for each child who potentially could be attending a higher education institution in 2004 the number of degree courses per square kilometer provided in his (her) region of residence, in his (her) first year of enrolment. For families without children of university age, we impute a zero value.

With regard to tax liability, the choice of instruments is more complex since we need a variable that affects tax liability but is also independent of gross income. Tax liability in Italy depends on several issues: on the individual's gross income, but also on its source and on the taxpayer's household characteristics. As an identification strategy, we exploit differences in tax liabilities due to the system of tax deductions related to the source of the gross income (i.e., whether it is related to employment, self-employment, or retirement status) of both the household head and, if present, of the household head's spouse and of third income earners within the household. We impute to each household the expected value of the maximum tax deductions which, according to the law, may benefit the three main potential income earners in the family (MAXALL). The expected value is calculated by weighting the maximum tax deductions fixed by law, corresponding to each type of income source, by the individual probability to claim these deductions. This probability is defined as the one-year lagged value of the share of employees, retired persons, and self-employed, over the whole population, and varies according to region of residence, age class, and gender of each family member considered. Data used to calculate these shares are drawn from ISTAT (2003). By construction, this instrument is exogenous because it depends on the tax deductions fixed by law and on the exogenous—as predetermined—probability to earn each type of income. We also employ two variables (GAP_SPOUSE and GAP_THIRD) that measure the difference between the expected maximum tax deduction (that corresponding to income earned as an employee) and the minimum tax deduction fixed by law (€3,000), accruing to the spouse and to third income earners in the family.

5. Results

We start by regressing gross income on the two fiscal policy mechanisms, which are taken as exogenous. For each covariate, these point estimates can be interpreted as the impact of a one-unit change in the covariate on the dependent variable, at the relevant quantile, holding the other covariates fixed. Figure 1 presents these estimates. In order to establish whether quantile regression is the best technique in our case, we plot our estimation results and those obtained using conventional LS as suggested in Koenker and Hallock (2001). The thick line and the grey area, respectively, represent the quantile regression coefficients and the corresponding confidence interval; the dashed and dotted lines, respectively, are the LS of the conditional mean effect and the corresponding confidence interval. The quantile regression estimates lie at some point outside the confidence intervals for the OLS regression, suggesting that the effects of these covariates is heterogeneous across the conditional distribution of the independent variable. This evidence confirms the superiority of the quantile method. Also, the wide confidence

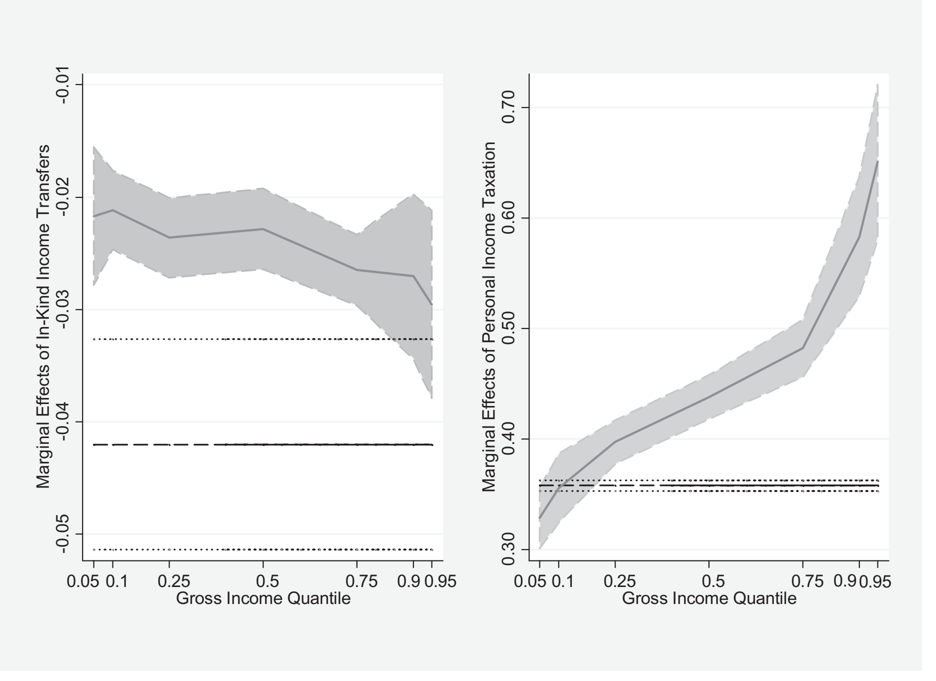

Figure 1. Marginal Effects of Exogenous Fiscal Policies

Source: SHIW, 2004.

intervals for both the quantile and OLS regressions suggest that the marginal effects of in-kind transfers are estimated imprecisely. Given the endogeneity of the fiscal policies, the estimated quantile and OLS coefficients in Figure 1 are biased and inconsistent. Therefore, the figure supports also the use of a structural quantile treatment effects approach rather than pure quantile regression.

Tables 3a and 3b report the results of the first stage regression of in-kind transfers and taxation on the exogenous variables and instruments. Instruments related to in-kind transfers are statistically significant in almost all cases and, as expected, they positively affect the in-kind transfer received by families. We see that a higher availability of degree courses in the region of residence of the family (HESUPPLY) has a positive effect on receiving an in-kind transfer. For taxation, a priori we would expect a negative relationship between tax deductions and income tax liability. This result holds when we consider the (expected) maximum tax deduction accruing to the household (MAXALL). The (expected) tax deduction gap relating to the third income earner within the family (GAP_THIRD) affects the family's tax liabilities positively. These findings would suggest an intra-household allocation effect as long as the higher family income tax liability is due to higher household earnings generated by an increase in the labor supply of the household component that is not directly affected by the fiscal change.

In relation to the F-test reported in the last rows of the tables, Staiger and Stock's (1997) rule of thumb suggests that the instruments are weak if the F-test for

TABLE 3a

FIRST STAGE EFFECTS OF INSTRUMENTS ON EDUCATION TRANSFERS

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
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***	0.4826***	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]

Notes: τ_F denotes the quantile of the distribution of the unobservables affecting gross income. 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, age, and age square of the family's principal earner. ***, **, and *, respectively, indicate significance 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 are in brackets.

TABLE 3b

FIRST STAGE EFFECTS OF INSTRUMENTS ON TAX LIABILITIES

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
MAXALL	−9.36e-07	−0.00001***	−0.00002***	−0.00003***	−0.00003**
	[9.60e-07]	[3.05e-06]	[4.56e-06]	[5.72e-06]	[.00001]
GAP_SPOUSE	3.51e-07	−1.38e-06	−0.00001	−9.32e-06	−0.00004*
	[8.61e-07]	[6.03e-06]	[8.96e-06]	[0.00001]	[0.0000]
GAP_THIRD	1.61e-06	0.00001***	0.00003***	0.00005***	0.00007***
	[1.71e-06]	[4.82e-06]	[8.22e-06]	[0.00001]	[0.0000]
Constant	−0.02216	−0.3301***	−0.3270***	−0.1126	0.3165
	[0.0222]	[0.0680]	[0.1082]	[0.1616]	[0.2958]
F-test	0.33	14.99	21.50	21.80	8.68
	[0.8068]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Counterfactual taxation					
MAXALL2000	−0.00002***	−0.00005***	−0.0001***	−0.0001***	−0.0002***
	[5.10e-06]	[7.16e-06]	[0.0000]	[0.0000]	[0.0000]
GAP_THIRD	0.00006***	0.00009***	0.0002**	0.0002***	0.0004***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Constant	−0.1404***	−0.2610	−0.2422**	−0.2002	0.1404
	[0.0397]	[0.0789]	[0.1078]	[0.1455]	[0.2784]
F-test	13.56	24.26	49.05	60.13	20.24
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]

Notes: τ_F denotes the quantile of the distribution of the unobservables affecting gross income. 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, age, and age square of the family's principal earner. ***, **, and *, respectively, indicate significance 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 are in brackets.

TABLE 4

Estimates of the Redistributive Effect of In-Kind Transfers on Gross Income Once Controlled for Personal Taxation

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
$\tau_A = 10$	−0.0668***	−0.0430***	−0.0382***	−0.0456***	−0.0535***
	[0.0138]	[0.0108]	[0.0107]	[0.0089]	[0.0127]
$\tau_A = 25$	−0.0349***	−0.0221***	−0.0224***	−0.0247***	−0.0319***
	[0.0001]	[0.0000]	[0.0001]	[0.0000]	[0.0000]
$\tau_A = 50$	−0.0300***	−0.0204***	−0.0226***	−0.0260***	−0.0349***
	[0.0001]	[0.0003]	[0.0003]	[0.0000]	[0.0000]
$\tau_A = 75$	−0.0316***	−0.0242***	−0.0243***	−0.0276***	−0.0370***
	[0.0000]	[0.0001]	[0.0002]	[0.0000]	[0.0000]
$\tau_A = 90$	−0.0357***	−0.0305***	−0.0307***	−0.0393***	−0.0452***
	[0.0001]	[0.0001]	[0.0001]	[0.0003]	[0.0000]
Mean quantile treatment effect	−0.0398	−0.02804	−0.02764	−0.03264	−0.0405
Quantile effect	−0.0211	−0.0236	−0.0228	−0.0264	−0.0270
Controlling for counterfactual taxation					
$\tau_A = 10$	−0.0722***	−0.0580**	−0.0450***	−0.0504***	−0.0786**
	[0.0236]	[0.0235]	[0.0138]	[0.0144]	[0.0392]
$\tau_A = 25$	−0.0282***	−0.0229***	−0.0204***	−0.0192***	−0.0313***
	[0.0001]	[0.0001]	[0.0000]	[0.0000]	[0.0004]
$\tau_A = 50$	−0.0296***	−0.0275***	−0.0251***	−0.0258***	−0.0387***
	[0.0002]	[0.0000]	[0.0000]	[0.0001]	[0.0002]
$\tau_A = 75$	−0.0291***	−0.0244***	−0.0217***	−0.0212***	−0.0357***
	[0.0001]	[0.0002]	[0.0002]	[0.0002]	[0.0003]
$\tau_A = 90$	−0.0345***	−0.0300***	−0.0251***	−0.0256***	−0.0397***
	[0.0004]	[0.0004]	[0.0004]	[0.0005]	[0.0009]
Mean quantile treatment effect	−0.03872	−0.03256	−0.02746	−0.02844	−0.0448
Quantile effect	−0.02475	−0.02409	−0.0255	−0.0285	−0.0275

Notes: 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 transfers). Quantile effects correspond to the effects of in-kind income (standardized over the sample mean) on the quantile of gross income distribution (standardized over the sample mean) when in-kind income is treated as exogenous. Mean quantile treatment effects is equivalent to the two-stage LS estimator in a pure location shift model. 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, age, and age square of the family's principal earner. ***, **, and *, respectively, indicate significance at the 1%, 5%, and 10% confidence level. Bootstrapped standard errors in brackets.

their inclusion in the auxiliary regression is lower than 10; the estimates show that the chosen instruments are weak only for the 1st decile of τ_F.

Table 4 reports the results of the estimates with in-kind income transfers treated as exogenous (quantile effects) and endogenous. The significance of the τ-th quantile estimated residuals of the auxiliary regression and their interaction with the fiscal policy variable, suggest that the mechanism is endogenous, and support location-scale specification of the model.[10]

The structural quantile treatment effects $\pi_1(\tau_F, \tau_A)$ associated with in-kind income transfers are heterogeneous, negative for all quantiles, and statistically significant: according to our estimates, an increase in non-cash transfers is always

[10]These results are available upon request.

TABLE 5

Test on Inter-Quantile Differences for In-Kind Income

	$\tau_A = 10$	$\tau_A = 25$	$\tau_A = 50$	$\tau_A = 75$	$\tau_A = 90$
In-kind[10] = In-kind[50]	0.80	27.85***	0.01	1.52	0.26
	0.3697	0.0000	0.9235	0.2175	0.6075
In-kind[50] = In-kind[90]	3.76*	1.06	1.15	4.54**	29.28***
	0.0525	0.3031	0.2830	0.0331	0.0000
With counterfactual taxation					
In-kind[10] = In-kind[50]	1.25	19.96***	6.03**	0.42	0.07
	0.2643	0.0000	0.0141	0.5184	0.7981
In-kind[50] = In-kind[90]	1.64	0.82	3.92**	0.54	0.93
	0.2003	0.3664	0.0478	0.4616	0.3346

Notes: τ_A denotes the quantile of the distribution of unobservable characteristics that affect the family's educational choices (i.e., in-kind transfers). ***, **, and *, respectively, indicate significance at the 1%, 5%, and 10% confidence level.

associated with a decrease in gross family income. To interpret these results, we first consider the coefficients along the τ_A distribution for any τ_F quantile, that is, we look at the estimated distributive effect of the in-kind transfers for households with different unobservable abilities. We see that the estimated coefficients of the non-cash transfers are always higher (in absolute values) for $\tau_A = 10$ than for any other τ_A quantile. This indicates that families less able to take advantage of in-kind transfers due to their lower unobservable ability, are the most negatively affected by a unit increase in benefits, which suggests that transfers tend to increase the gap between low and high ability. If we move along the τ_F distribution, a reverse U-shaped trend emerges with a minimum (in absolute values) at $\tau_F = 50$. For any τ_A, with the exception of $\tau_A = 10$, the estimated coefficients suggest that the greatest income decreases due to a unit increase in the in-kind transfer are for the highest gross income quantile. Tests on inter-quantile differences reported in Table 5 show that the in-kind coefficients are statistically different only for some values of τ_A among the coefficients of the upper tail of the gross income distribution (50th vs. 90th quantile). In other words, modeling the structural quantile treatment effect of in-kind income transfers provides a more precise measure of the fiscal policy effect for gross income values above the median.

Estimated elasticities are negative, lower than 1, and decreasing (in absolute value) along the τ_F distribution for any τ_A (Table 6). These results can be interpreted within three perspectives. First, they indicate that the lower the income and the ability of the household to benefit from in-kind transfers, the higher will be the relative income reduction related to a 1 percent increase in in-kind transfers. Second, if elasticity is interpreted as the ratio between the average and the marginal in-kind transfer, the estimates show that, in Italy, non-cash benefits, with few exceptions, are "regressive" since a 1 percent increase in in-kind transfers penalizes higher income households relatively less than lower income households. Third, we can interpret the absolute value of the elasticity as an indicator of the possible implications of a policy reform that changes in-kind income transfers at the margin for "loser" ("winner") quantiles, defined as those that receive a share, over the sample mean, of in-kind transfers, that is lower (higher)

TABLE 6

Estimates of the Elasticities of Gross Income with Respect to In-Kind Income

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
$\tau_A = 10$	−0.4818	−0.1222	−0.0613	−0.0443	−0.0311
$\tau_A = 25$	−0.2517	−0.0991	−0.0359	−0.0240	−0.0185
$\tau_A = 50$	−0.2164	−0.0579	−0.0362	−0.0253	−0.0203
$\tau_A = 75$	−0.2279	−0.0687	−0.0390	−0.0268	−0.0215
$\tau_A = 90$	−0.2575	−0.0866	−0.0492	−0.0382	−0.0262
Controlling for counterfactual taxation					
$\tau_A = 10$	−0.5208	0.0051	−0.0038	0.0026	−0.0457
$\tau_A = 25$	−0.2034	−0.0650	−0.0327	−0.0186	−0.0182
$\tau_A = 50$	−0.2135	−0.0781	−0.0402	−0.0251	−0.0225
$\tau_A = 75$	−0.2099	−0.0693	−0.0348	−0.0206	−0.0207
$\tau_A = 90$	−0.2488	−0.0852	−0.0402	−0.0249	−0.0230

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

than their share, over the sample mean, of gross income. We expect that if the elasticity is lower than 1, a 1 percent increase in in-kind income transfers will increase the net benefit for "winners" and decrease the net loss for losers who then might become winners. However, this latter possibility never occurs; according to our estimates, all quantiles maintain their relative positions in terms of being winners or losers.

Table 7 reports the results of the estimates with personal income taxation as exogenous (quantile effects) and endogenous. As above, the τ-th quantile estimated residuals of the auxiliary regression and their interaction with the fiscal policy variable are significant. The sign of the quantile treatment effects $\pi_2(\tau_F, \tau_C)$ is always positive. However, if we look at the coefficient values along the gross income distribution, and holding the deciles τ_C constant, we find a rather monotonic increasing trend with the exception of the values estimated for $\tau_C = 10$. For households in the lowest τ_C decile, we find the estimated coefficients, in most cases, are almost ten times higher. This result is the effect of the personal income tax structure in Italy in 2004, which includes a set of tax deductions (the so called "no tax area") such that low incomes are not taxed.

According to the tests on inter-quantile differences, the coefficients are mostly statistically different at the 1 percent level (Table 8). Thus, for taxation, the structural quantile treatment effect provides the broadest context for evaluating the effects of this policy.

As reported in Table 9, the estimated elasticities are heterogeneous and lower than 1, with some exceptions, mainly in the lowest decile of the τ_C distribution for upper quantiles of τ_F. Again, these results provide different kinds of information. First, the elasticities appear to be increasing along the gross income distribution, suggesting that the higher the gross income, the higher is the income increase associated with an increase in personal taxation of 1 percent. Second, if elasticity is interpreted as the ratio between the average and marginal personal tax rates,

TABLE 7

Estimates of the Redistributive Effect of Personal Income Taxation on Gross Income Once Controlled for In-Kind Income

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
$\tau_C = 10$	0.5215***	5.6247***	6.0861***	7.0774***	4.3130***
	[0.1053]	[0.0325]	[0.0039]	[0.0683]	[0.1556]
$\tau_C = 25$	0.6160***	0.9179***	0.94591***	1.0830***	1.04453***
	[0.0027]	[0.0021]	[0.0017]	[0.0092]	[0.0088]
$\tau_C = 50$	0.5089***	0.6716***	0.6796***	0.7710***	0.7706***
	[0.0033]	[0.0039]	[0.0022]	[0.0000]	[0.0017]
$\tau_C = 75$	0.4315***	0.5457***	0.5775***	0.6447***	0.6810**
	[0.0010]	[0.0017]	[0.0012]	[0.0012]	[0.0030]
$\tau_C = 90$	0.3644***	0.4393***	0.4702***	0.4988***	0.5675***
	[0.0011]	[0.0003]	[0.0012]	[0.0042]	[0.0045]
Mean quantile treatment effect	0.4884	1.6398	1.7518	2.0149	1.4753
Quantile effect	0.3557	0.3973	0.4380	0.4822	0.5831
Using counterfactual taxation					
$\tau_C = 10$	0.1300***	0.566***	0.9135***	0.9052***	0.5394***
	[0.0131]	[0.0074]	[0.0071]	[0.0100]	[0.0092]
$\tau_C = 25$	0.7564***	0.8998***	1.0332***	1.1476***	1.0211***
	[0.0004]	[0.0002]	[0.0019]	[0.0021]	[0.0041]
$\tau_C = 50$	0.5686***	0.6540***	0.7419***	0.8007***	0.7915***
	[0.0037]	[0.0022]	[0.0008]	[0.0001]	[0.0068]
$\tau_C = 75$	0.5510***	0.6325***	0.7041***	0.7640***	0.7764***
	[0.0038]	[0.0026]	[0.0038]	[0.0025]	[0.0010]
$\tau_C = 90$	0.4868***	0.5523***	0.6239***	0.6805***	0.7210***
	[0.0036]	[0.0034]	[0.0041]	[0.0034]	[0.0021]
Mean quantile treatment effect	0.4985	0.66092	0.8033	0.0859	0.0769
Quantile effect	0.3849	0.4194	0.4705	0.5205	0.5780

Notes: 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 (standardized over the sample mean) on the quantile of gross income distribution (standardized over the sample mean) when income taxation is treated as exogenous. Mean quantile treatment effects is equivalent to the two-stage LS estimator in a pure location shift model. 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, age, and age square of the family's principal earner. ***, **, and *, respectively, indicate significance at the 1%, 5%, and 10% confidence level. Bootstrapped standard errors in brackets.

these estimates show that personal income taxation in general is progressive, although it is regressive for the lowest-ability households with medium–high incomes. The incomplete progressivity of taxation depends probably on the fact that households less able to generate income and, therefore, to pay taxes, are more affected by the contemporary presence of tax-exempt incomes, smaller tax brackets, and deductible expenses. Finally, as before, we interpret the absolute value of the elasticity as an indicator of the possible implications of a policy reform that changes income taxation at margin for "loser" ("winner") quantiles, defined as those that pay a share, over the sample mean, of income taxation higher (lower) than their share, over the sample mean, of gross income. Following a 1 percent change in income taxation, we can expect, on the one hand, that if elasticity is lower than 1, the winners' net benefit will decrease and they could become losers,

TABLE 8

Test on Inter-Quantile Differences for Personal Income Taxation

	$\tau_C = 10$	$\tau_C = 25$	$\tau_C = 50$	$\tau_C = 75$	$\tau_C = 90$
tax[10] = tax[50]	17.546***	74.90***	41,304.56***	74.56***	12.49***
	0.0000	0.0000	0.0000	0.0000	0.0004
tax[50] = tax[90]	0.08	0.67	122.24***	19.96***	538.41***
	0.7711	0.4116	0.0000	0.0000	0.0000
With counterfactual taxation					
tax[10] = tax[50]	152.57***	32.97***	1,400.85***	289.75***	6.91***
	0.0000	0.0000	0.0000	0.0000	0.0086
tax[50] = tax[90]	12,508.85***	0.09	1.03	2.23	7.16***
	0.0000	0.7675	0.3093	0.1353	0.0075

Notes: τ_C denotes the quantile of the distribution of unobservable characteristics that affect the family's tax liability. ***, **, and *, respectively, indicate significance at the 1%, 5%, and 10% confidence level.

TABLE 9

Estimates of the Elasticities of Gross Income with Respect to Tax Liability

	$\tau_F = 10$	$\tau_F = 25$	$\tau_F = 50$	$\tau_F = 75$	$\tau_F = 90$
$\tau_C = 10$	0.0150	0.8169	3.172	6.199	4.879
$\tau_C = 25$	0.0177	0.1333	0.4930	0.9486	1.225
$\tau_C = 50$	0.0146	0.0975	0.3542	0.6753	0.8717
$\tau_C = 75$	0.0124	0.0792	0.3009	0.5647	0.7704
$\tau_C = 90$	0.0104	0.0638	0.2450	0.4369	0.6420
Using counterfactual taxation					
$\tau_C = 10$	0.0113	0.1655	0.4761	0.7928	0.6102
$\tau_C = 25$	0.0658	0.2211	0.5385	1.005	1.155
$\tau_C = 50$	0.0495	0.1912	0.3866	0.7013	0.8954
$\tau_C = 75$	0.0479	0.1849	0.3669	0.6692	0.8783
$\tau_C = 90$	0.0423	0.1614	0.3251	0.5960	0.8156

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

and the losers' net loss increases, which does not change their status. The opposite occurs if the elasticity is higher than 1. Our evidence shows that in most cases a fiscal reform that raises income taxation by 1 percent has a negative effect on quantile positions in terms of (standardized) taxes paid vs. (standardized) gross income. However, there is no change in quantile winner/loser status.

Our findings suggest that the effects on various quantiles of the gross income distribution of a perturbation in the prevailing distribution of both in-kind income transfers and income taxation are heterogeneous. This is true particularly for income taxation whose effect is stronger than the effect of in-kind income transfers. We interpret the presence of heterogeneous effects as a necessary, but not sufficient condition for a redistribution from rich to poor. In order to have significant redistributive effects, these heterogeneous effects must be sufficiently strong in the two extremes of the gross income distribution, to reduce overall income inequality. The Reynolds–Smolensky index (Reynolds and Smolensky, 1977) measures the redistributive effect of taxation by the difference between 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 benefit reforms which change income taxes and in-kind benefits by 1 percent. Based on our estimates, we can generate new gross income distributions by applying the corresponding estimated elasticities to each quantile, and comparing the difference between pre-state and post-state intervention (post-tax plus in-kind transfer income) Gini coefficients after and before the tax (benefits) reforms. Our results suggest that a 1 percent increase in either in-kind benefit transfers or income taxation leaves the difference between the pre-state and post-state intervention Gini index statistically unchanged, that is, the potential fiscal reforms do redistribute income by reducing the Gini index of the post-state intervention with respect to the pre-state intervention position. However, this redistributive power is the same as that observed in the absence of the potential fiscal reform and measured by the difference of actual pre-state and post-state Gini coefficients (see Table 1).

Since 2000, several studies have focused on the distributional impact of public spending in non-cash transfers in Italy (Citoni, 2000; Sonedda and Turati, 2005; Baldini *et al.*, 2007; Gigliarano and D'Ambrosio, 2009). This work builds on the large body of literature on cross-national investigation of inequality incorporating health and education expenditures (Smeeding *et al.*, 1993). There are also several studies on the redistributive impact of Italian personal income tax (Russo, 2005; Sonedda and Turati, 2005) and the most recent fiscal reforms (among others, Pellegrino 2007; Gastaldi *et al.*, 2008; Baldini and Pacifico, 2009). However, the present paper differs from these empirical investigations in two ways. First, the existing work does not take account of the net incidence of fiscal policy, that is, the incidence of both taxes and public expenditures. Second, our analysis adopts a structural econometric approach, which allows us to control for the determinants of the amounts of in-kind transfers received and taxes paid by households. However, despite these methodological differences, our results are in line with previous findings that emphasize the weak distributional effects of in-kind provisions in Italy, and the greater distributional effects of personal income taxation.

5.1. *An Evaluation of the Public Economic Policies Using Counterfactuals*

Italy experienced a major reform to personal income tax in 2003, which established a complex system of tax deductions (to replace tax credits) based on the size and source of the taxpayer's income. This scheme was designed such that deductions are linearly decreasing with gross income, and introduced a mass of tax-exemption income thresholds depending on the source of income. In this section, we replicate the previous quantile regressions by using counterfactuals instead of actual 2004 tax rates. We simulate the value of personal taxation by applying the structure of the 2000 taxation system to 2004 incomes, thus calculating a "counterfactual" taxation. The idea is that since households are likely to modify their optimal choices, adapting them to the taxation structure in order to minimize their taxation liabilities, "counterfactual" taxation provides a measure, which, by definition, should not depend on the household's choices. However, our measure of counterfactual taxation still suffers from potential endogeneity due to measurement error and reverse causality. Therefore, in this case too, we apply the control variate method suggested by Ma and Koenker (2006). The selected instruments are now the expected maximum tax credits, which, according to the law in force in 2000, benefit the three main potential income earners in the family (MAXALL2000), and the difference between the expected maximum and the minimum tax credit that accrues to the third income earner of the family (GAP_THIRD).

The estimated coefficients of the counterfactual tax reported in the lower part of Table 7 are always positive and statistically significant. Compared to the results obtained using actual taxation values, a unit increase in counterfactual taxation, in most cases, is associated with a higher increase in the family's gross equivalent income. This result suggests a stronger redistributive power of Italian personal taxation when the counterfactual tax indicator is chosen, which is consistent with the fact that by using counterfactuals we can eliminate behaviors aimed at reducing tax liability. The estimated increase, however, is not uniform along the distribution of the unobservable τ_C. This suggests that the reaction to the 2003 taxation reform depends on households' unobservable abilities: it is stronger in the lower quantiles of τ_C.

To calculate the Gini indexes of the gross income (pre-state intervention) distribution generated using our estimates, we find that the gross income obtained after a 1 percent increase in the counterfactual taxation is (slightly) more unequally distributed than the gross income obtained by an equivalent change in the effective taxation structure. Finally, as before, we provide a measure of the redistributive effect of the potential fiscal reform involving a 1 percent change in the counterfactual taxation, by comparing the difference between the pre-state and post-state intervention Gini coefficients, after and before the potential reform. The results suggest that a 1 percent increase in counterfactual taxation does not modify this difference, which confirms the findings in the previous section for actual taxation. It seems then that the absence of a redistributive effect of the potential fiscal reforms of interest in 2004, is not due to the 2003 fiscal reform.

6. Conclusions

This paper proposed and applied a new method to investigate the distributional impact in Italy of income taxation and non-cash income transfers, the latter being related to health and education services. To our knowledge, this paper represents the first attempt to evaluate heterogeneity in the potential effects of the two fiscal policies of interest on the gross income distribution, using structural quantile treatment effects regression. We interpret the presence of this heterogeneity among quantiles as a necessary, but not sufficient condition for redistribution. The redistributive power of Italian fiscal policies is measured by calculating the difference between pre-state and post-state intervention Gini indexes, pre- and post-potential fiscal reforms. Our estimates suggest that although heterogeneous, the redistributive effects of the potential fiscal reforms are almost zero in 2004.

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