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Democratization of Higher Education and Labour Market Mismatch: The Case of Italy

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Abstract

The aim of this paper is the estimation of the returns to tertiary education in Italy combining the *quantile* decomposition analysis and the instrumental variables methodologies. The results show that the returns to education estimated from the survey in 2010 are lower than those estimated from the survey in 1993. These results apply on average and at all the *quantiles* of the conditional and the unconditional wages distribution. Deepening the analysis on the most recent data available (the survey in 2010), we also estimate the return to tertiary education using an exogenous policy such as the reform of the universities cycles of 1999 as an instrumental variable for education. The results provide evidence of a worsening in the quality of tertiary education on average. Furthermore, deepening the analysis at *quantile* level we found evidence of a reduced social mobility in Italy due to labour market structure. Indeed, as people triggered by the reform to participate in tertiary education (i.e. people who did not enrol in university before the reform because of their budget constraints) have higher returns to education, the concentration of the returns to education at the bottom of the wage distribution means that these people, after having obtained a degree, were recruited for lower paid jobs. Therefore, the results suggest that the reform, on the one hand has prompted the enrolment at university, on the other hand has amplified the mismatch between demand and supply of skilled employees in the labour market.

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1. Introduction

Building the "knowledge society" is a widely-used expression to refer to the reform process of the labour market and of the education system ongoing in several developed countries. According to OECD Secretary-General, Angel Gurría, "the knowledge society is here to stay, and it requires a capable, highly qualified and innovative labour force" (OECD, 2010). As today the human capital is a necessary factor to face international competition, education has become one of the most important strategic sectors in developed national economies[1]. Considering the effects on domestic economy, it was estimated that a man with a degree generates average income taxes and social contribution over his working life almost three times greater than the amount of public investment per student in tertiary education[2]. Therefore, pushing up the average educational attainments through population may be an effective instrument to promote financial stability. Furthermore, education "plays a major role in keeping individuals in the labour force longer (OECD, 2010)", and contributes to facing a troublesome issue such as postponing the retirement age.

In 2009, the Benelux Bologna Secretariat, speaking about the importance of tertiary education for the development of the Euro area, claimed "*today's higher education institutions find themselves juggling new roles and expectations with traditional identities and conceptions. In a most delicate balancing act they have to seek to reconcile academic traditions and identities with new expectations and demands from society*".

Following this philosophy, since the late 90's several reforms of the labour market and of the education system have been implemented in Italy with the purpose of meeting the requirements that come from the society (or from a part of it). In particular in 1999 the then Minister of Education Luigi Berlinguer implemented a reform that changed the organization of the education cycles in Italy. Compulsory education was extended to 18 years, and tertiary education was reorganized into two-tier systems. The first level of tertiary education, which lasts three years, is equivalent to the Anglo-Saxon *Bachelor's Degree* and the second level, which lasts 2 years, corresponds to the *Master's Degree*.

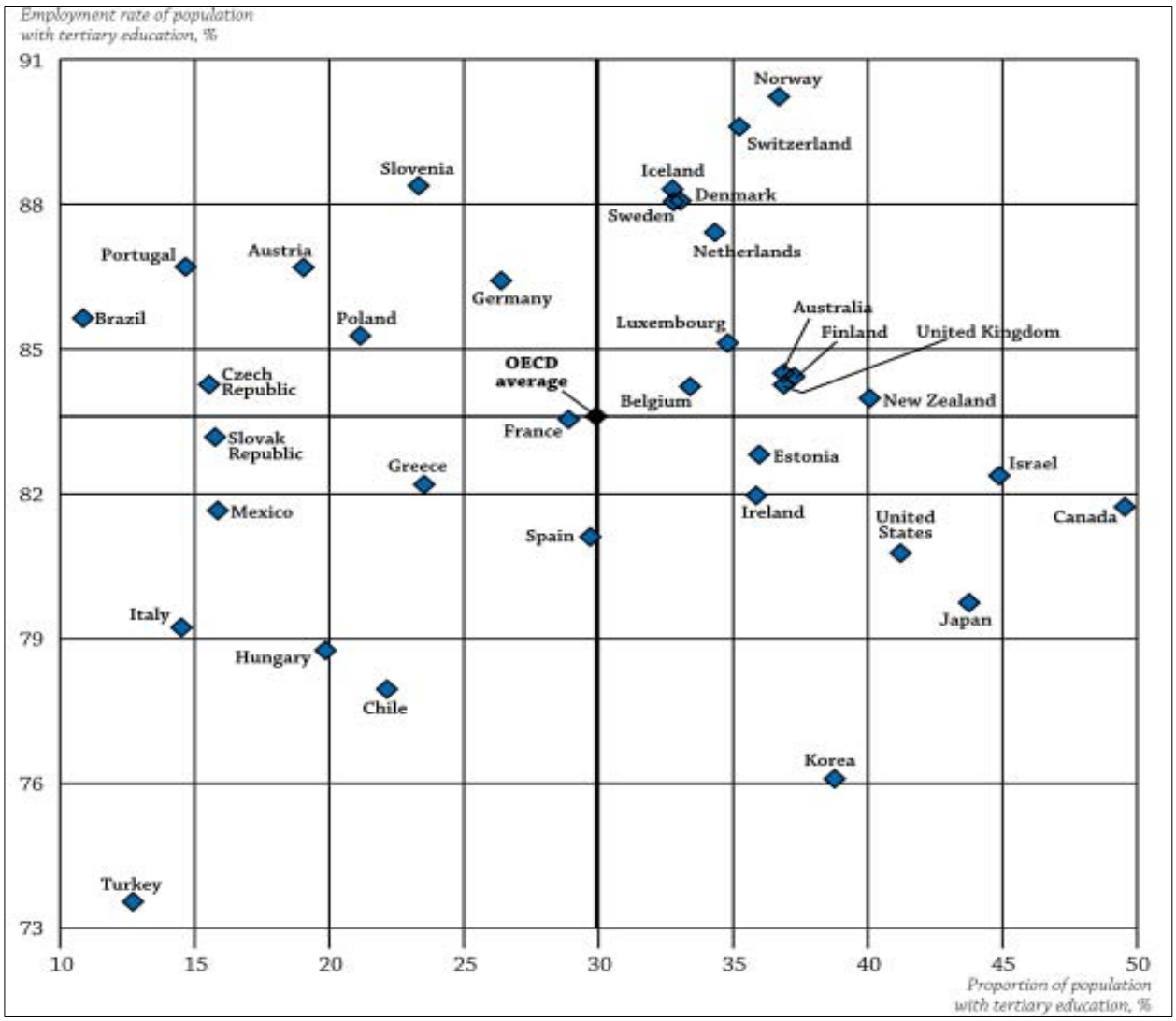
A conventional wisdom about the literature on education system reform in Italy is the *demand-driven assumption*. By way of example, Di Pietro (2011) argued : "*In Italy the latter* (the supply of education) *has traditionally been aimed at accommodating the former* (the demand of education)- *the rate-limiting step, to borrow a term from chemistry, has always been on the demand side*". However, we consider that the educational system reforms implemented in Italy were driven by the

[1] OECD stated "since countries compete to excel in a knowledge-oriented global economy, international benchmarks allow them to track the evolution of the level of skills and knowledge of their own population compared to those of their competitors" (OECD, 2011).

[2] After subtracting the public revenue that has financed the degree

labour market demand for skilled workers rather than by the people's demand for education[3]. Indeed, according to the Bologna declaration, the aim of the most recent reforms is to increase the share of population with tertiary education to build the "knowledge-based economy" just as the aim of the 1960s reforms was to provide skilled workers, who sustained the creation of the "industrial economy". However, ten years after the implementation of the reform, it is clear that in Italy something did not work. The *figure-1* below shows that the proportion of population with tertiary education in Italy is still sizeably smaller than the OECD average. Since we assume that the innate skill distribution does not change across the countries, this result is likely to depend on the different structure of incentives to education in the labour market. Indeed, the employment rate of tertiary educated in Italy is one of the worst amongst OECD countries.

Figure-1: Skills acquisition and use, 25-64 year-olds with a tertiary education (2009).



Source: OECD, Education at Glance 2011, table A7.3(a)

[3]CENSIS foundation (2007) claims that the prologue of the Italian school and university reforms of 1960s was researched and carried out by a board of the Svimez[3], chaired by Gino Martinoli, established by the then minister of education Giuseppe Medici. The aim of this study was to plan changes in the educational institution and its structures on the basis of a forecast of the need for skilled workers in the country's productive system in the successive 15 years.

Since in Italy the probability of finding a job for a graduate is lower than in the other OECD countries, what about the returns to education amongst the graduate who have a job?

The aim of this paper is to estimate the returns to education in Italy. Firstly, we will compare the returns to education estimated from two surveys respectively implemented before (1993) and after (2010) the education reform of 1999. Secondly, we will deepen the analysis for the most recent data available (the survey of 2010) using an exogenous policy such as the *Berlinguer reform* of university cycles as instrumental variables to solve the *endogeneity* problem arising for education. Therefore, while most of the previous literature is referred to the average returns in the conditional wages distribution, we will estimate the returns to tertiary education at *quintile* level considering both the conditional and the unconditional wage distributions. In particular, the conditional treatment effect is the effect of the treatment variable (tertiary education) on the conditional wage distribution (i.e. the *quantile* difference between the treated group and the control group) whilst the unconditional treatment effect is unconditioned on other covariates[4].

The paper is organised as follows: the second section reviews the literature on the relationships between human capital and wage distribution and summarizes the main results from the previous empirical literature. The third section illustrates the methodology that underlines the econometric analysis. The fourth section introduces the datasets and shows some descriptive statistics. The fifth section presents the results of quantitative analysis and suggests some possible explanations. The sixth section concludes.

2. Review of literature

2.1 Theoretical framework

The connection between wage inequality and human capital is one of the main topics of labour economics since the beginning of XX century. According to Lovaglio (2004), the first contribution to this debate dates back to 1869 by Sir Francis Galton's *Hereditary Genius* that assumed a normal ability distribution to infer the normal distribution of wages. Until the middle of the 20th century, several models attempted to shed some light on the phenomenon, adding other factors (such as accident or fortune) to the ability. Nevertheless, these models were often contradicted by empirical evidence and "were not functional in the understanding of the process of the formation and distribution of income" (Lovaglio, 1997).

[4] It is worth noting that the latter methodology is not equivalent to controling other covariates excluding them from the models; but it allows the covariates to inform the distribution of the disturbance without changing the interpretation of the estimates.

In 1957, Milton Friedman emphasized the role of individual behaviours such as risk aversions, to explain the income distribution. He supposed that a person's choice to invest in human capital depended on the *skewness* of the expected income individual probability. As a result, the wage differentials offset benefits and costs arising from the process of achieving a given level of income through the investment in education.

In 1958, another exponent of the *Chicago School*, Jacob Mincer, came into the picture, contributing to the empirical foundation of the *human capital theory*. He stated that differentials of education in the workforce determine the wage distribution. As a result, the human capital is the main explicatory variable of the wage distribution asymmetry. According to the author, the occupations are ranked according to the training request, assuming that an additional year of training delays entry into labour market by exactly one year. In a nutshell, some jobs are rewarded more because higher wages offset the individual training costs. In 1975, the *Mincerian* model was revised by another professor from Chicago University, Gary Becker. Starting from the explanation of *Leontief paradox*[5], he recognized a high rate of "*rational capital*" in the U.S. labour market. Thus, he focused on the expected *wage premia*[6] for the human capital investments through the years, i.e. the slopes of the wage profile's curves. As a result, Becker relaxed several constraints of Mincer's model. He stated that the rational capital intensive occupations showed higher rates of income growth - i.e. steeper wage profiles - which are compatible with higher *wage premia* for some jobs. Also, he accepts inequality in the ability distribution and conjectures a positive relationship between academic skills and the time spent in education. Furthermore, Becker took into account professional training - i.e. the training acquired after the start of the working life (lifelong learning). He argued that the subjects who attain a high level of education show a higher probability of both investing in professional training and of migrating.

Another line of research on returns to education tried to connect wage distribution with individual market signals. According to the *signaling* models, education provides a title that influences the probability of obtaining a higher wage. In this theoretical framework, each person possess a bundle of observable attributes "*that collectively constitute the image of the job that the applicant presents; some are immutably fixed, while others are alterable*" (Spence, 1973). Education is an alterable attribute that the "applicant" changes by investing in at some cost in terms of time and money (signaling costs). The model assumes that the employer, at the moment of hire, does not know the

[5] Leontief's paradox is the discrepancy between Heckscher-Ohlin's comparative advantage theory and empirical observation of the US commercial structure. Leontief found that the U.S., despite being the most capital-abundant country in the world, exported labour-intensive commodities and imported capital-intensive commodities.

[6] Naticchioni *et al.* (2007) and Peracchi (2004) distinguish between "return to education, which is a measure of the casual effect of an extra year of schooling on the worker's earning and the wage *premia* which is a measure of statistical association between levels of schooling and wage".

real productivity of applicants but, on the basis of previous experience in the market, knows the conditional probability of productive capacity given by various combinations of signals and indices. "*An equilibrium is defined in the context of a feedback loop, in which the employers' expectation leads to offer wages to various levels of education, which in turn leads to investing in education by individuals*" (Spence, 1973). As result, systematic over-investment in education is a distinct possibility because of the element of arbitrariness in the equilibrium configuration of the market. Furthermore, the necessary, but insufficient, condition for the signaling model efficiency is that the signal costs are negatively correlated with the individual productivity. If this assumption does not apply or there are random changes in the signal cost the signal is ineffective.

2.2 Empirical studies of returns to education in Italy

Since the mid-80s several empirical studies have been carried out in order to estimate a correct measure of returns to education in Italy. The first was Antonelli (1985) who used an OLS estimator and a standard *Mincerian* equation on a regional and heterogeneous dataset to estimate an average increase of 4.6% arising from an extra year of education. Subsequently, empirical analysis was carried out considering specific sub-groups and using more representative datasets. The most used data-set in the Italian literature has been the *Survey of the Household Income and Wealth* (SHIW) of the Bank of Italy.

Cannari e D'alessio (1995) assumed a bias in the education estimate obtained through the OLS analysis; and implemented an instrumental variable regression (IV). This methodological question was econometrically faced, for the first time by Card (1993) who, recovering the results of Griliches (1977), argued three possible reasons on which the bias of the OLS estimator for education depend:

- Omitted variables
- Measurement error
- Heterogeneous returns in the population

The first bias refers to possible omission of relevant features into the models such as the family and social background and the concept of individual ability. The effects of this bias are ambiguous and depend on the triangular relations amongst the omitted variables, the returns to education and the opportunity cost of the formal training. In particular, when relatively more skilled individuals choose a higher level of education, results from OLS are upward biased. On the other hand, when the opportunity costs of education force relatively more skilled people to under-invest in education, the estimates from OLS are downward biased.

The measurement error bias comes from detection error of years of education. The magnitude of bias depends on the variance of the errors but, whether such errors were made, the estimator is certainly downward biased.

Heterogeneous returns in the population occur when the choice of the years of training depends on several characteristics such as ability and income. As result, the estimated correlation between education and wage could be the result of a spurious correlation rather than a causal effect. The direction of this bias is ambiguous: an upward bias stems from a correlation between ability and educational attainment whereas a downward bias arises from differences in the discount rate.

As reported above, the strategy usually used to solve this problem consists of identifying one or more instrumental variables for the education. A correct instrument is correlated with the instrumented variable but not with the dependent one. The research of the correct instruments is the main purpose of the literature that comes from these findings. For example, several individual features like family background characteristics are often used as instruments for education. However, nowadays such instruments are largely criticized because of their influence on the dependent variable i.e. the wage. As a result, other approaches such as the *natural experiment* methodology arose. The aim of this approach is to "*approximate ideal experiment with real data, controlling all the conditions of the model and repeating the experiment in an identical framework*" (Flabbi, 1997). Applying this purpose to the study of wage functions consists in:

- Considering a representative sample of a population of individuals of which several controlling features that approximate the "identical condition" are known;
- Researching exogenous events that modify the educational choices of a sub-group in the population (treatment group), but which doesn't involve another sub- group (control-group);
- Measuring the wage differences between the two groups which are the causal effect of the education (Angrist-Kruger, 1991).

Table-1 synthesizes the main results of the previous works on returns to education for Italy, specifying the dataset, the year of survey, the estimation method, the instruments and the considered sub-group which features each analysis.

Table-1: Selected Previous Empirical Work on the returns to education in Italy based on OLS, IV and Control function estimates.

Authors	*Data-set*	*Sub-Group*	*Estimated marginal return %*			*Instrument*
			OLS	*IV*	*Control Functions*	
Antonelli, 1985	ER*	male	4.6			
Cannari-Pellegrini-Sestito, 1989	SHIW** 1986	male	4.6			
Lucifora- Reilly, 1990	ENI***	female	4.0			
		male	3.6			
Sestito, 1990	SHIW 1987		3.7			
Cannari- D'Alessio, 1995	SHIW 1993	male	4.5	7.0		Parent's education
Colussi, 1997	SHIW 1993	male	6.2	7.6		Parent's education
Flabbi, 1997	SHIW 1991	female	2.2	5.6		School reform and proximity to college
		male	1.7	6.2		
Brunello-Miniaci, 1997[7]	SHIW 1993/1995	Junior high	3.2		5.0	Age, School reform, family background, year dummy.
		Secondary	3.4		4.2	
		Tertiary	6.4		7.2	
Brunello-Comi-Liucifora, 2000	SHIW 1995	female	7.7		7.7	Reform, parent's education, parent's job, age.
		male	6.2		5.9	
Meliciani-Radicchia, 2005[8]	Rdl**** 2003	Secondary	2.9		2.5	Parent's education, family size.
		Tertiary 1°	5.1		3.15	
		Tertiary 2°	5.0			
		Post graduate[9]	5.7			

* Emilia Romagna regional data; ** Survey on Income and Wealth of Italian Household held by Bank of Italy; *** Survey on effective Income held by ENI, **** Survey on labour supply held by ISOFOL.

[7] In order to make the results comparable with the previous literature, we calculate the coefficients assuming that the marginal return of an educational title is evenly distributed among the regular years of school required to complete the *curriculum*.

[8] *Idem*

[9] We calculated the marginal return of post-graduate title considering the average duration of a PhD in Italy, which is 3 years.

As we have shown, most of the literature on the returns to education in Italy is focused on the average returns. Indeed, both the OLS and the IV approaches take into account the average returns to education, assuming that the wage-conditional distribution is translated in respect to changes in education. However, when this assumption does not apply, the returns to education are different depending on the point of the wage distribution at which the subject is placed. The *quantile* regression methodology, elaborated from Kroenker and Bassett (1978), face this problem. As for Italy, Giustinelli (2004), following this methodology, studied how returns to education change according to the level of conditional wage distribution. According to the author, in this way we will estimate the *quantile treatment effects (QTE)* i.e. the change in wages need, at each *quantile* τ, to remain at same point of the conditional distribution after the treatment (assuming ranking invariance)[10]. The main results of this analysis point out the *U-shaped* returns to education moving from the bottom up to the top of the conditional wage distribution. These results were subsequently confirmed by Naticchioni-Ricci-Rustichelli (2007) who also provided three possible reasons for these figures:

1. The interaction between ability and education. As an example, whether the role of ability is amplified at a higher level of education and assuming that the conditional wage distribution is directly correlated with ability, a relationship of substitutability between ability and education at the bottom of the wage distribution and a complementary one at the top is likely.
2. The quality differences of education. Since the individuals differ for the quality as well as for the quantity of education, the subjects at the bottom of the conditional wage distribution were likely enrolled in lower quality school ;
3. The phenomenon of over-education. The workers are placed at different points of the wage conditional distribution because there are workers with a high education employed in low skilled jobs with low wage.[11]

Table-2 synthesizes the main results of the previous literature on *quantiles* education effects in Italy specifying the source of the data, the year of survey and the considered sub-group

[10] When rank invariance is assumed, the rank of individuals in the wage distribution is unchanged after the treatment.
[11] The concept of over-education was examined by Ghignoni (2001) who estimated a skills stochastic frontier model for each professional position. Subsequently she estimated the return to education separately for both the *request education* and the *over-education*. She also pointed out that the upward shift of the population structure in respect to education is driven by the needs of the demand side of the labour market rather than the supply side.

Table-2: Selected Previous Empirical Work on the returns to education in Italy based on *quantile treatment effects* approach.

Authors	*Data-set*	*Year of survey*	*Sub-Group*		*Quantile*	*Estimated marginal results %*	
			a	*b*		*Sub-Group a*	*Sub-Group b*
Martins-Pereira, 2004	SHIW	1995			0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 **OLS**	6.5 6.3 5.7 5.7 5.6 5.7 6.1 6.5 6.8 **6.2**	
Giustinelli, 2004	SHIW	1993	female	male	0.05 0.10 0.25 0.50 0.75 0.90 0.95 **OLS**	9.2 8.3 7.8 8.3 8.9 9.6 9.7 **8.7**	6.1 5.7 5.4 6.3 7.2 7.9 8.3 **6.8**
		1995	female	male	0.05 0.10 0.25 0.50 0.75 0.90 0.95 **OLS**	7.9 7.0 6.9 7.4 8.3 8.8 8.8 **7.5**	6.5 6.5 6.1 6.0 6.7 7.3 7.7 **6.6**
		1998	female	male	0.05 0.10 0.25 0.50 0.75 0.90 0.95 **OLS**	6.2 5.3 5.3 5.7 7.3 7.5 7.4 **6.2**	5.2 5.2 5.1 5.3 6.2 7.4 8.3 **6.0**
		2000	female	male	0.05 0.10 0.25 0.50 0.75 0.90 0.95 **OLS**	5.5 5.8 5.4 6.0 6.9 7.8 7.7 **6.1**	6.4 5.6 4.9 5.3 6.3 7.2 7.2 **6.0**
Naticchioni-Ricci-Rustichelli, 2007	SHIW	1993	private sector		0.10 0.25 0.50 0.75 0.90 **OLS**	5.4 5.0 5.1 5.8 6.4 **5.7**	
		2004	private sector		0.10 0.25 0.50 0.75 0.90 **OLS**	3.3 3.5 3.9 4.6 5.7 **4.2**	

3. Methodologies

According to Frölich and Melly (2010), 95% of applied econometrics is concerned with mean effect. Nevertheless, even the instrumental variables approach allows us to estimate returns to education correctly when there are *quantile* different effects through the wages distribution.

According to Chernozhukov and Hansen (2005), the *quantile treatment effect* approach allows us to estimate the heterogeneous impacts of some variables on different points of the outcomes distribution, making this methodology appealing for many economic applications. Notwithstanding this, since these estimators do not face the *endogeneity* problem of the explicative variables, different *quantiles* returns to education "*may result from a bias that varies through quantiles of the distribution of wages rather than evidence of actual ability-based differences in the market marginal returns to education*" (Arias, Hallock and Sosa Escudero 1999).

In this paper, on the one hand we will account for heterogeneous impact of treatment variable and on the other we will face the *endogeneity* problem that arises with the education.

Firstly, we use a simple OLS estimator to find the average effect, related to the exogenous education treatment, on wage distribution.

Following Card (1994), the reduced form model of the wage function is a two-equation system:

$$\mathrm{S_i} = \alpha\, H_i + v_i \tag{1}$$

$$\log \mathrm{Y_i} = \beta\, H_i + \gamma\, S_i + u_i \tag{2}$$

Where H is the individual *i* vector of attributes, $\mathrm{S_i}$ is the education attainments and $\mathrm{Y_i}$ is the hourly wage.

Secondly, we have extended the analysis accounting for the heterogeneous impact of treatment on different points of both conditional and unconditional wage distribution. The general models framework is the effect of a *binary* treatment variable *D* on a continuous outcome variable *Y*. We will obtain the potential outcome Y_i^1 when the individual is subject to treatment otherwise the potential outcome is Y_i^0. The observed outcome is Y_i which is $Y_i \equiv Y_i^1 D_i + Y_i^0\,(1 - D_i)$. Through the *quantile* analysis (QTE) we identify and estimate the entire distribution functions of Y^1 *and* Y^0. Furthermore, a vector X encompasses all the other individual characteristics in addition to the treatment and outcome variables. It is worth noting that the QTE can be defined conditionally or unconditionally on these covariates. While we will use a parametric (linear) estimator to estimate

the *conditional* QTE, the *unconditional* treatment effects will be estimated trough a nonparametric weighting estimator[12].

The first estimator was proposed by Koenker and Bassett (1978) and is the most adopted by the literature on *quantile treatment effect* of education in Italy. It assumes that Y is a linear function in X and D. The linear model assumption for the potential outcome is:

$$Y_i^d = X_i\,\beta^\tau + d\delta^\tau + \varepsilon_i \text{ and } Q_{\varepsilon_i}^\tau = 0 \qquad \text{for } i = 1, \dots, n \text{ and } d\,\epsilon\,\{0,1\} \tag{3}$$

Where $Q_{\varepsilon_i}^\tau$ is the τ^{th} quantile of unobserved random variableε_i. β^τ and δ^τ are the unknown parameters of the model. In particular, δ^τ is the conditional treatment effect at the τ^{th} quantile.

We also assume that both D and X are exogenous:

$$E(\varepsilon|\,D, X) = 0 \tag{4}$$

The above assumptions (3 and 4) jointly determine that:

$$Q_{Y|X,D}^\tau = X\,\beta^\tau + D\delta^\tau \tag{5}$$

In this way the unknown parameters are estimated from the joint distribution of the observed variables (*Y*, *X* and *D*).

The estimator is defined by:

$$\left(\hat{\beta}^\tau,\ \hat{\delta}^\tau\right) = argmin_{\beta,\delta} \sum W_i^{KB}\,\rho_\tau\,(Y_i - X_i\beta - D_i\delta) \tag{6}$$ [13]

Even if the weights W_i^{KB} are all equal to one, we use this notation to highlight the correspondence of the different estimators.

Secondly, we analyze the *unconditional* treatment effect. In this case the treatment effect does not change when we change the set of covariates *X*. Thus the *unconditional QTE* is:

$$\Delta^\tau = \ Q_{Y^1}^\tau - Q_{Y^0}^\tau \tag{7}$$

It is worth noting that the covariates X are included in the first step regression, because they increase the consistency and the efficiency of the estimator's function, and then integrated out. The advantages of an *unconditional* estimator are obvious when the treatment has been completely

[12] The proposed nonparametric weighting estimator is $\sqrt{n}$ consistent, asymptotically normally distributed and efficient.
[13]

randomized and the covariates do not help to satisfy either the selection on observed variables or the IV assumptions. Furthermore, *unconditional* treatment (unlike the *conditional*), can be estimated at the root *n* consistence rate without any parametric restrictions. To the extent that *unconditional* estimator recovers the effect for the whole wage distribution[14], it can no longer be estimated by using that assumption (6).

The estimator proposed by Firpo (2007) for exogenous *unconditional treatment* is based on two assumptions:

$$E(Y^0, Y^1 | D, X) = 0 \quad (8)$$

i.e. the selection is on observables

$$0 < Pr(D = 1|X) > 1 \quad (9)$$

i.e. the influence of covariates is independent of the treatment

Thus, the estimator's function for Δ^τ is:

$$(\hat{\alpha}, \hat{\Delta}^\tau) = argmin_{\alpha,\Delta} \sum W_i^F \rho_\tau (Y_i - \alpha - D_i\Delta) \quad (10)$$

In this particular case the weights are: $W_i^F = \frac{D_i}{\Pr(D=1|X_i)} + \frac{(1-D_i)}{1-\Pr(D=1|X_i)}$

To the extent that a preliminary non parametric estimator of some kind of propensity score for $\Pr(D = 1|X_i)$ is required to implement this estimator, we use local logistic likelihood function without any local smoothing proposed by Frölich and Melly (2008) and optimized by Stata11 optimizer algorithm.

Thirdly, we take into account the endogeneity problem that arises when the variable S_i is correlated with the error term,u_i i.e. $Cov(v_i, u_i) \neq 0$. In this case, the OLS estimator is biased and inconsistent. According to Card (1994), this problem can be solved when there are variables in the vector H that influence the educational level but not the hourly wage. Such variables are included in the vector *Z* and the remaining variables in the vector *X*. So, we can rewrite the two-equation system:

$$S_i = \alpha X_i + \delta Z_i + v_i \quad (11)$$

$$\log Y_i = \beta X_i + \gamma S_i + u_i \quad (12)$$

[14] It is worth noting that *conditional* and *unconditional* QTE are equal in the absence of covariates or if the effect does not change as function of covariates and of quantile τ .

We use the components of vector Z to obtain a consistent and unbiased estimator for the returns to education.

Moving in a *quantile* approach framework, when the treatment is endogenous the assumption (4) does not apply and the exogenous *quantile* estimator will be biased. Therefore, we will adopt the estimator proposed by Abadie, Angrist and Imbens (2002) to identify the *conditional* QTE when the treatment D is endogenous. Since we are interested in determining the real effects of the treatment, we need a *binary* variables Z that defines two different potential treatment denoted by D_z. The assumptions of this model for almost all the values of *X* are:

$$\begin{cases} E(Y^0, Y^1, D_0, D_1 |\, Z|X) = 0 \\ 0 < Pr(Z = 1|X) > 1 \\ E\,[D_1|X] \neq E[D_0|X] \\ Pr(D_1 \geq D_0|X) = 1 \end{cases} \tag{13}$$

These assumptions jointly determine conditional independence on instrumental variable, the existence of the group of *compliers* and monotonicity. Assumption (3) is also required to hold for the compliers. The consistent estimator for the conditional endogenous treatment effects is:

$$\left(\hat{\beta}^{\tau},\ \hat{\delta}^{\tau}\right) = argmin_{\beta,\delta} \sum W_i^{AAI}\, \rho_{\tau}\,(Y_i - X_i\beta - D_i\delta) \tag{14}$$

The weights are: $W_i^{AAI} = 1 - \frac{D_i(1-Z_i)}{1-\Pr\,(Z=1|X_i)} - \frac{(1-D_i)Z_i}{\Pr\,(Z=1|X_i)}$

Also in this case, a preliminary estimator for $\Pr(Z = 1|X_i)$ is required. The optimization problem is solved by Frölich and Melly (2008) who estimate only the positive weights W_i^{AAI+}.

Finally, we deal with *unconditional* endogenous treatment using the estimator proposed by Frölich and Melly (2008). Also in this case, a *binary* instrumental variables Z is required. When the assumptions (13) apply the estimator is:

$$\left(\widehat{\alpha_{IV}},\ \widehat{\Delta_{IV}}^{\tau}\right) = argmin_{\alpha,\Delta} \sum W_i^{FM}\, \rho_{\tau}\,(Y_i - \alpha - D_i\Delta) \tag{15}$$

The weights are: $W_i^{FM} = \frac{Z_i - \Pr\,(Z=1|X_i)}{\Pr(Z=1|X_i)(1-\Pr(D=1|X_i))}\,(2D_i - 1)$

Also this estimator requires some kind of propensity score for identifying the probability distribution of the treatment i.e. $\Pr\,(D = 1|X_i)$.

4. Data

The data comes from two waves of the Surveys of Household Income and Wealth (SHIW). Since 1977 these surveys are carried out by the Bank of Italy roughly biyearly. They are based on a random sample of approximately 8,000 households and they have been used massively for the vast majority of the empirical work on return to education in Italy. According to Brunello and Miniaci, "*they are the only national data-set that include information both on wages and on individual characteristics*"(Brunello and Miniaci, 1997). Relevant information includes the highest individual educational attainment, gender, age, net yearly wages, employment status (employee or self-employed), average weekly working hours, number of months of employment per year, type of the work (full-time or part-time), family background information (parents' highest educational attainment and occupation), place of birth and residence, kind of employer (government or private company and the size of the firm) are available. Furthermore, only for the most recent survey, year of graduation (only for the people with at least upper secondary education) and type of employment contract (permanent contract or fixed-term contract) are available too.

5. Descriptive statistics

We have worked on cross-sectional data for 1993 and 2010. The samples were restricted to employees to avoid the problem of under-reporting typically observed for the self-employed workers in Italy. As expected, the relative frequencies of educational attainments in relation to age, an over-representation of more highly-educated individuals in the older group of workers is shown. Therefore, more educated people tend to remain in the job market for longer. For this we have further reduced the samples, cutting out individuals older than 60. Thus, we have utilized at least 6136 observations in 1993 and 5,318 in the 2010 corresponding to about 30% of the original sample in both surveys.

The complete summary statistics for the main variables entering in the comparative analysis are reported in the appendix A. However, below are reported several important comparisons between variables in the two periods of reference: Firstly the employees in 2010 earned on average less despite being on average more educated and older. In fact, the average hourly wage decreased by about 22,4% (from 13.152 euro in 1993 to l0.209 euro in 2010); the share of Masters graduates increases by 46.3% (from 10.8% in 1993 to 15.8% in 2010) and the employees' average age increases by 10.6% (from 38.3 years to about 42.4 years). It is also worth noting that from 1993 to 2010 the share of female employees (+18.5%), the share of part-time employees (+139%) and the number of employees resident in a small town (+10%) also increase. Furthermore, in 2010 the

economic system was more privatized and made more tertiary. Indeed, the share of public employees in a sector different from the tertiary decreases respectively by 19% and 87%.

The frequencies of educational attainments in relation to professional qualification highlight a correlation between higher education and prestigious employment status: the majority of blue-collar workers do not have the *diploma* although their percentage decreases from about 87% in 1993 to about 60% 2010. The majority of managers are graduates, their percentage increasing from 60% in 1993 to about 85% in 2010. These figures provide some evidence for a shift in the boundaries of the workers' competence in several jobs and for an increase in over-education among skilled workers. These concerns were further investigated in the comparative analysis below. As expected, in both surveys the wage increases with the level of education. However, in 2010 the wage also increases substantially for post-graduates while in 1993 post-graduate individuals earned almost the same as graduate ones. As for the relationship between wage and potential experience (approximated with age), both surveys highlight an increase in the average hourly wage during the working life as expected. Even if the average wage decreases from 1993 to 2010 for all age classes, the average wage gap between the oldest and the youngest group is more or less unchanged (+50%). The gender bias mainly concerns the average annual wage. Indeed, the gender differences drastically decrease when we look at average hourly wage (from – 24% to -2.5% in 1993 and from -20% to -7% in 2010). The frequencies of gender in relation to professional qualifications point out that the share of women increases from about 37.89% in 1993 to 44.89% in the 2010. Notwithstanding this, in 2010 as in 1993 about 80% of part-time contracts were for female employees. The family background, as expected, is an important determinant of the wage distribution both in 1993 and in 2010. The descriptive statistics have pointed out that the hourly wage increases according to professional status and educational attainments of both the parents. As an example, in 1993 the average wage of employees whose father is a college graduate is about 16% higher relatively to those whose father has a *diploma*. This percentage increases in 2010 to 19.5%. These figures have highlighted the fact that Italy is concerned with reduced social mobility and that this has increased over time. These issues were further investigated in the IV quantile treatment effects analysis section below. Other important control variables concern the worker's geographical location and his area of birth. The descriptive analysis points out that people who worked in the south of Italy earned less than people who worked in the north. This difference increases from 1993 to 2010. As an example, in 1993 employees resident in the south earned about 5.5% less than those resident in the north in terms of annual wage. These differences increased up to -13% in 2010. However, when we consider the hourly wage, the gap almost disappears in 2010 and turns slightly positive in 1993.

Since the mid-1990s several reforms affected the labour market and the educational system in Italy: In June 1997 a set of legislative measures so called "*pacchetto Treu"* were approved. It introduced

and regulated the fixed-term and temporary contracts in the Italian labour market in order to promote so-called "flexibility". In 2010, these types of contracts affected about 16% of the employees of which 68% are blue-collar workers. Furthermore, despite the lower employment protection, the "flexible workers" in 2010 earned an average hourly wage 23% lower than permanent workers.

In 1999 the reform of universities cycles was implemented. The most important features introduced in the education system by the reform were the reorganization of tertiary education in two-tier systems. The descriptive statistics point out that in our sample about 11% of the population obtained their education title after 2000 and then it is considered to be involved in the reform. Among the people involved, 7.39% obtained the equivalent of a "*bachelor's degree*" and then chose to interrupt their education at the first *tier* as allowed by the reform. The average hourly wage of people involved in the reform is about 12% lower than those who were not[15]. We have deepened the analysis of these issues in the section "IV models of quantile treatment effects" below.

6. Comparative analysis

The aim of this section is to estimate the returns to education in 1993 and in 2010 and to compare the results. For this purpose, we have firstly compared the results from the OLS estimation. Secondly, we have compared the results from the *quantile conditional* and the *quantile unconditional* exogenous approaches. According to Naticchioni *et al*. (2010) we cannot utilize endogenous approaches because, since the group of the compliers may change over time, we are not able to use an exogenous event as an instrument for both surveys. However, assuming that the distribution of individual ability does not change over time, the relation between unobserved ability and education and the effect of their interaction on the conditional distribution of wage does not affect temporal comparison.

The empirical strategy consists of performing the *OLS*, the *conditional exogenous*, and the *unconditional exogenous* estimation methods at the five quantile τ ($\tau = .1, .25, .5, .75, .9$) of the log hourly wage distribution both in 1993 and 2010. The dependent variable is the logarithm of the hourly wage and the objective of the analysis is to identify the returns to education through coefficients associated with the *dummy* variables for tertiary education. While the complete results are reported in Appendix B, *table-3* synthesizes the main results of the OLS and the conditional QTE regressions and reports their variations between 1993 and 2010:

[15] The difference was tested through a two-sample t-test with unequal variance and it results significant at 1% .

Table-3: OLS and *Exogenous Conditional* QTE estimates for 1993 and 2010.

Dependent variable: **Log Hourly Wage** / Independent variable: **Tertiary Education**	1993	2010	Variation % over time
q10	0.152	0.160	5.26%
q25	0.207	0.171	-17.39%
q50	0.245	0.181	-26.12%
q75	0.241	0.205	-14.94%
q90	0.232	0.216	-6.90%
OLS	0.229	0.187	-18.34%

Note: All coefficients are significant at 1%. All the variations over time are statistically at 5%.[16].

We found a decrease in the returns to education between 1993 and 2010, across all the wage distributions except at the first *quantile* i.e. for the low-paid jobs. Furthermore, the comparison of the results from the OLS regressions highlights that the average returns to education are 18.34% lower in 2010.

We explain these results, according to Ghignoni (2001), by hypothesizing that during the 1990s there was a shift in the boundaries of the workers' competence in several jobs. This shift has determined an increase in the demanded competencies for jobs that before were carried out by relatively lower-skilled workers. The shortage of specialized jobs and the increasing supply of skilled workers forced a number of new graduates to accept less qualified and lower paid jobs compared to those they might have found given their skills. It is worth noting that the gap between the two periods is larger in the middle of the distribution compared to the tails. Therefore, we conjecture that the shift in the boundaries of the workers' competences has affected the high paid jobs less.

Although falling returns to education over time question the empirical literature available for most developed countries, our results are consistent with those found in other similar recent studies on Italy such as Naticchioni *et al.* (2010). In a nutshell, we suppose that these results are likely to arise from a higher increase in the supply of skilled workers relative to demand. Therefore, we conjecture that, unlike other developed countries, the Italian productive system was not sufficiently dynamic. As a result, nowadays the phenomenon of *over-education* is a widespread problem. In fact, since the supply of skilled workers increased in spite of the enhancement of the production potential this triggered a mismatch in the Italian labour market.

The interpretation of the results obtained from the *unconditional quantile* regression is slightly different from those obtained through the *conditional* one. Indeed, while the results from the latter summarize the effect at the *quantile* of belonging for the relative wage distribution of the individuals with the same characteristics, the results from the former approach identify the

[16] We tested the equality of coefficients across independent areas; therefore, we assume that the population in 1993 is independent from the population in 2010.

treatment effects of people who belong to the same *quantile* of the whole wage distribution. As a result, including covariates increases the consistency and efficiency of *unconditional* estimator but does not influence the coefficient.

The complete results of the *unconditional* QTE regressions and their variations between 1993 and 2010 are reported in *table-4*:

Table-4: *OLS* and *Exogenous unconditional* QTE estimates for 1993 and 2010.

Dependent variable: **Log Hourly Wage** / Independent variable: **Tertiary Education**	1993	2010	Variation % over time
q10	0.339**	0.146**	-56.93%
q25	0.300***	0.166***	-44.67%
q50	0.300***	0.182***	-39.33%
q75	0.431***	0.282***	-34.57%
q90	0.248***	0.275***	10.89%

Note: Coefficients significance levels = ***(p<0.01), **(p<0.05), *(p<0.10). All the variations over time are statistically different from zero at 5%.

These figures point out an even more dramatic decrease in the returns to education at all *quantile* of the distribution except at the upper tail. It is also worth noting that the decline is higher at the bottom of the distribution and decreases moving toward the top. Therefore, when we do not condition the relation between the wage and the education on others covariates, our results show that the individuals who lose more in terms of return to education, between 1993 and 2010, are the poorest employees.

7. IV models of *Quantile* Treatment Effects

Deepening the analysis for the 2010 survey we perform a Durbin-Wu-Hausman to test the hypothesis that the independent variables are exogenous. As expected the test rejected the hypothesis and this allowed us to use an instrumental variable for education. Relying on the findings of some recent studies on the effects of the reform and on several similar examples in the previous literature[17], we identified an exogenous policy such as the *Berlinguer reform*[18] as a consistent instrumental variable. As an example, Cappellari and Lucifora (2009) show that high-school leavers are approximately 15% more likely to attend university since the implementation of the Bologna agreements and the consequent creation of the two-tier tertiary education system in 2000. Therefore, since the reform has exogenously increased tertiary education enrolment, we can use it as an instrumental variable. The aim of this section is twofold: firstly we aim to identify

[17] Flabbi (1997), Brunello & Miniaci (1997) and Brunello, Comi & Lucifora (2000) used the school reform of 1969 as instrument for education.

[18] We implemented a dummy variable to identify the subjects who graduated after 2000, and thus the people involved in the reform.

unbiased returns to tertiary education. Secondly, we want to obtain some indication of social mobility observing the distribution of the return to tertiary education across the population.

The analysis concerns only the most recent dataset available i.e. the 2010 SHIW. The empirical strategy consists of estimating the *endogenous* treatment effect on average and at the five quantile τ ($\tau = .1, .25, .5, .75, .9$) for the *conditional* wage distribution and only at the five quantile τ for the *unconditional* ones. We have also estimated the *exogenous* treatment effect[19] using the same methodology in order to audit the bias. The dependent variable is the logarithm of the hourly wage and the objective of the analysis is to identify the coefficients associated with the dummy variables for tertiary education.

Before proceeding with the econometric estimation, it is worth noting that, as Blaise and Melly (2010) stated, "*the implemented IV procedures estimate the causal effects for the sub-population of the compliers*", thus using such an instrumental variable we will refer to the people who have been subjected to the reform[20]. Furthermore, according to Card (1993), since the earning gains are concentrated among people with a tighter budget constraint – people who would otherwise stop schooling at relatively low levels - we expect that the exogenous model is downward biased and thus we expect to estimate higher returns to education for the *compliers*. In fact, since people graduated after the reform could have obtained a degree in three years, the reform has lowered the cost of tertiary education choice and has relaxed the budget constraint for poorer people.

While the complete results are reported in the Appendix C, *table-5* synthesizes the main results of the exogenous and the endogenous conditional QTE regressions and reports their mutual percentage differences.

Table-5: *Exogenous and Endogenous Conditional* QTE estimates.

Dependent variable: **Log Hourly Wage** / Independent variable: **Tertiary Education**	Exogenous	Endogenous[+]
q10	0.152***	0.212***
q25	0.175***	0.2***
q50	0.176***	0.165***
q75	0.209***	0.204***
q90	0.211***	0.208***
AVERAGE (OLS, IV)	0.190***	0.136***

Note: [+]Tertiary education attainment was instrumented with Berlinguer reform. All coefficients are significant at 1%.

[19] It is worth noting that the coefficients which arose from the exogenous regressions are slightly different from the previous analysis because this time we consider people who achieve the bachelor's degree as well as master's degree graduates.

[20] Hereafter defined as compliers.

Surprisingly, the results of the analysis do not confirm on average our expectations. Indeed, the coefficient which arose from the IV regression is about 28.4% lower than that obtained through the OLS. Therefore, we conjecture that another unobserved variable correlated with the instrument offset the reduction of the cost of tertiary education. In agreement with Bratti et al. (2010), we suppose that the group of *compliers* experienced a reduction in student workload and a simplification of the curriculum in several subject areas. Since the lower academic standards are likely to make tertiary education more attractive for those whose academic skills and returns to education are lower, the exogenous estimators may be upward biased.

However, the results from the *endogenous* quantile treatment effect give us a slightly different picture: the *exogenous* estimates are downward biased at the bottom and slightly upward biased from the median up to the top of the conditional wage distribution. Therefore, the explanations given for the mean effect apply only for a part of the conditional wage distribution. We suppose that the individuals who have higher returns to education - i.e. people who previous to the reform would not have enrolled in tertiary education because of their tighter budget constraints - are likely to join the poorer *quintiles* of the wages distribution once they have found a job. This means that the reform had an effect of democratization in access to tertiary education but this effect disappeared in the labour market. This proof that Italy was characterized by a reduced social mobility; in fact, people who were relatively poorer before obtaining a degree are likely to obtain relatively lower paid jobs.

Finally, *table-6* reports the results which came up in the exogenous and endogenous unconditional QTE:

Table-6: *Exogenous and Endogenous Unconditional* QTE estimates.

Dependent variable: **Log Hourly Wage** / Independent variable: **Tertiary Education**	Exogenous	Endogenous[+]
q10	0.129**	0.491*
q25	0.166***	0.381***
q50	0.179***	0.240*
q75	0.262***	0.243*
q90	0.277***	0.319

Note: [+]Tertiary education attainment was instrumented with Berlinguer reform. Coefficients significance levels = ***(p<0.01), **(p<0.05), *(p<0.10).

The results confirm the concentration of the returns to education at the bottom of the wage distribution as in the *conditional* analysis above. However, the bias direction turns after the median suggesting that when the distribution is not conditioned on other covariates, the social ladder put by tertiary education is interrupted exclusively for the highest paid jobs.

8. Conclusions

In this paper we have investigated the structure of the returns to education in Italy. The comparison of the results which came up in the exogenous models has pointed out decreasing returns to tertiary education between 1993 and 2010. These results are confirmed both when we consider the conditional and the unconditional wage distribution. We have explained these figures conjecturing a mismatch between the supply and the demand of skilled workers that have determined an increase in the labour force's *over-education*. Subsequently, using the most recent dataset available i.e. SHIW 2010, we have taken education to be an endogenous variable. To face this problem, we have used an exogenous policy such as the Berlinguer reform as an instrumental variable. Since the two-tier system lowers the costs of tertiary education, we expected that the reform provides an incentive for the enrolment of individuals who have a tighter budget constraint, and higher returns to education. Therefore, we expected that the exogenous estimates are downward biased. Surprisingly, these expectations were not confirmed on average. Thus, the literature on instrumental variables suggests that another unobserved variable correlated with the instrument to offset the reduction of the cost of tertiary education. We conjecture, for example, that the results arise from a worsening in the education quality experienced by the group of the compliers.

However, the results from the *endogenous* quantile treatment effect give us a slightly different picture: the *exogenous* estimates are downward biased at the bottom and slightly upward biased from the median up to the top of the conditional wage distribution. We have explained these results conjecturing that people who have higher returns to education, i.e. people who previous to the reform would not have enrolled in tertiary education because of their tighter budget constraints, are likely to join the poorer *quintiles* of the wages distribution once they have found a job.

These results are also confirmed by the *unconditional enodogenous* quantile treatment effects, although in this case the downward bias of the *exogenous* at the bottom of distribution is even sharper and changes direction after the median. Therefore, when the distribution is not conditioned on other covariates, the social ladder put by tertiary education is interrupted exclusively for highest paid jobs.

Final remarks concern the tertiary education role in promoting social mobility after the reorganization of the cycles of tertiary education implemented since 1999. We conclude that despite the effect of the *democratization* of tertiary education, there is a reduced social mobility for the people who, once graduated, enter the labour market as employees. This means that, in Italy, the social mobility that should be guaranteed by tertiary education is undermined by the structure of the labour market. Furthermore, our results suggest the reforms of the education system implemented since the ratification of the "Bologna agreement" have amplified the mismatch between demand and supply of skilled labour.

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Appendix A

-Selected variables summary statistics in SHIW 1993 and 2010.

Variables	1993					2010				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Hourly wage	**6136**	13.152	8.290	0	288	**5318**	10.209	6.406	0	161
University graduate worker	**6168**	0.108	0.310	0	1	**5429**	0.158	0.365	0	1
Age	**6168**	38.286	10.617	15	60	**5429**	42.368	10.462	17	60
sex	**6168**	0.379	0.485	0	1	**5429**	0.449	0.497	0	1
Household head	**6168**	0.499	0.500	0	1	**5429**	0.581	0.493	0	1
Unmarried employee	**6168**	0.286	0.452	0	1	**5429**	0.296	0.456	0	1
Public employee	**6168**	0.337	0.473	0	1	**5429**	0.272	0.445	0	1
Part-time employee	**6168**	0.054	0.227	0	1	**5429**	0.129	0.335	0	1
No tertiary sector	**6168**	0.318	0.466	0	1	**5429**	0.040	0.195	0	1
No manager employee	**6168**	0.830	0.376	0	1	**5429**	0.843	0.364	0	1
No seasonal employee	**6168**	0.128	0.334	0	1	**5429**	0.121	0.326	0	1
Wage supplements	**6168**	0.935	0.247	0	1	**5429**	0.883	0.322	0	1
Born in the south	**6052**	0.405	0.491	0	1	**4858**	0.398	0.490	0	1
Living in the south	**6168**	0.308	0.462	0	1	**5429**	0.312	0.463	0	1
Poor background	**6168**	0.513	0.500	0	1	**5429**	0.517	0.500	0	1
High educated mother	**6168**	0.008	0.091	0	1	**5429**	0.012	0.107	0	1
Working in a small town	**6168**	0.410	0.492	0	1	**5429**	0.451	0.498	0	1
Temporary work	**6168**	0.000	0.000	0	0	**5429**	0.159	0.366	0	1

Hourly net income is calculated as: (yearly net income)/(months worked) (average weekly hours worked)*4. ** P.A. = Public Administration. *** n.a = not available

Appendix B

Variable	1993				2010		
	Coefficient	**Std. Err**	**P-value**		**Coefficient**	**Std. Err**	**P-value**
	OLS						
University graduate worker	0.229	0.018	0.000	**OLS AVERAGE EFFECT**	0.187	0.016	0.000
Age	0.047	0.004	0.000		0.022	0.004	0.000
Age squared	0.000	0.000	0.000		0.000	0.000	0.000
sex	-0.099	0.012	0.000		-0.072	0.012	0.000
Household head	0.040	0.013	0.002		0.123	0.012	0.000
Unmarried employee	-0.063	0.014	0.000		-0.072	0.015	0.000
Public employee	0.140	0.012	0.000		0.109	0.013	0.000
Part-time employee	0.050	0.022	0.020		0.026	0.018	0.136
No tertiary sector	-0.046	0.011	0.000		-0.078	0.028	0.006
No manager employee	-0.371	0.015	0.000		-0.287	0.016	0.000
No seasonal employee	-0.089	0.015	0.000		0.022	0.021	0.304
Wage supplements	-0.157	0.019	0.000		-0.084	0.016	0.000
Born in the south	-0.054	0.015	0.000		-0.069	0.019	0.000
Living in the south	-0.049	0.016	0.003		-0.015	0.020	0.452
Poor background (father's job)	-0.057	0.010	0.000		-0.031	0.011	0.004
High educated mother	0.061	0.052	0.238		0.027	0.047	0.574
Working in a small town	-0.023	0.010	0.016		-0.007	0.011	0.528
Temporary work	(omitted)	(omitted)	(omitted)		-0.164	0.019	0.000
_cons	2.209	0.085	0.000		2.064	0.095	0.000
	CONDITIONAL EXOGENOUS QTE						
University graduate worker	0.152	0.029	0.000	**QUANTILE 10**	0.160	0.023	0.000
Age	0.069	0.006	0.000		0.039	0.007	0.000
Age squared	-0.001	0.000	0.000		0.000	0.000	0.000
sex	-0.139	0.016	0.000		-0.069	0.014	0.000
Household head	0.019	0.018	0.285		0.105	0.015	0.000
Unmarried employee	-0.043	0.021	0.043		-0.065	0.017	0.000
Public employee	0.209	0.017	0.000		0.134	0.014	0.000
Part-time employee	-0.092	0.046	0.047		-0.084	0.032	0.008
No tertiary sector	-0.016	0.018	0.393		-0.070	0.058	0.227
No manager employee	-0.256	0.022	0.000		-0.147	0.023	0.000
No seasonal employee	-0.253	0.030	0.000		-0.093	0.041	0.024
Wage supplements	-0.126	0.026	0.000		-0.084	0.017	0.000
Born in the south	-0.035	0.021	0.097		-0.059	0.021	0.004
Living in the south	-0.175	0.027	0.000		-0.112	0.026	0.000
Poor background (father's job)	-0.047	0.014	0.001		0.020	0.013	0.134
High educated mother	0.100	0.110	0.363		0.031	0.060	0.602
Working in a small town	-0.042	0.014	0.003		0.032	0.013	0.018
Temporary work	(omitted)	(omitted)	(omitted)		-0.154	0.037	0.000
_cons	1.469	0.142	0.000		1.341	0.170	0.000

University graduate worker	0.207	0.024	0.000		0.171	0.016	0.000
Age	0.053	0.004	0.000		0.024	0.004	0.000
Age squared	-0.001	0.000	0.000		0.000	0.000	0.000
sex	-0.104	0.013	0.000		-0.079	0.011	0.000
Household head	0.023	0.013	0.000		0.088	0.011	0.000
Unmarried employee	-0.048	0.015	0.000		-0.060	0.013	0.000
Public employee	0.171	0.013	0.089		0.113	0.011	0.000
Part-time employee	-0.025	0.035	0.002		-0.024	0.024	0.000
No tertiary sector	-0.008	0.013	0.000		-0.059	0.024	0.000
No manager employee	-0.303	0.020	0.479		-0.210	0.019	0.315
No seasonal employee	-0.169	0.024	0.528		-0.073	0.025	0.014
Wage supplements	-0.144	0.024	0.000		-0.090	0.015	0.000
Born in the south	-0.023	0.014	0.000		-0.054	0.017	0.004
Living in the south	-0.085	0.017	0.000		-0.051	0.019	0.000
Poor background (father's job)	-0.049	0.010	0.093		0.001	0.010	0.001
High educated mother	0.051	0.069	0.000		0.072	0.051	0.006
Working in a small town	-0.049	0.010	0.000		0.009	0.010	0.959
Temporary work	(omitted)	(omitted)	(omitted)		-0.157	0.023	0.157
_cons	1.928	0.104	0.000		1.904	0.100	0.345
University graduate worker	0.245	0.021	0.000		0.181	0.016	0.000
Age	0.043	0.004	0.000		0.017	0.004	0.000
Age squared	0.000	0.000	0.000		0.000	0.000	0.000
sex	-0.079	0.012	0.000		-0.070	0.010	0.000
Household head	0.046	0.012	0.000		0.094	0.010	0.000
Unmarried employee	-0.071	0.014	0.000		-0.081	0.012	0.000
Public employee	0.137	0.012	0.000		0.100	0.011	0.000
Part-time employee	0.027	0.024	0.259		0.045	0.018	0.013
No tertiary sector	-0.034	0.012	0.004		-0.082	0.025	0.001
No manager employee	-0.369	0.018	0.000		-0.307	0.018	0.000
No seasonal employee	-0.119	0.017	0.000		-0.047	0.022	0.035
Wage supplements	-0.155	0.018	0.000		-0.087	0.014	0.000
Born in the south	-0.050	0.013	0.000		-0.049	0.015	0.001
Living in the south	-0.022	0.015	0.143		-0.008	0.017	0.608
Poor background (father's job)	-0.055	0.009	0.000		-0.038	0.009	0.000
High educated mother	0.034	0.058	0.552		0.079	0.045	0.077
Working in a small town	-0.029	0.009	0.002		-0.008	0.009	0.368
Temporary work	(omitted)	(omitted)	(omitted)		-0.123	0.018	0.000
_cons	2.343	0.089	0.000		2.273	0.082	0.000

QUANTILE 25

QUANTILE 50

University graduate worker	0.241	0.021	0.000		0.205	0.017	0.000
Age	0.044	0.005	0.000		0.015	0.004	0.000
Age squared	0.000	0.000	0.000		0.000	0.000	0.010
sex	-0.067	0.014	0.000		-0.063	0.012	0.000
Household head	0.057	0.015	0.000		0.125	0.012	0.000
Unmarried employee	-0.061	0.015	0.000	**QUANTILE 75**	-0.081	0.015	0.000
Public employee	0.089	0.014	0.000		0.092	0.012	0.000
Part-time employee	0.048	0.029	0.104		0.099	0.021	0.000
No tertiary sector	-0.059	0.013	0.000		-0.059	0.027	0.031
No manager employee	-0.424	0.019	0.000		-0.392	0.019	0.000
No seasonal employee	-0.054	0.020	0.008		-0.002	0.029	0.958
Wage supplements	-0.128	0.019	0.000		-0.089	0.015	0.000
Born in the south	-0.066	0.016	0.000		-0.059	0.022	0.006
Living in the south	0.029	0.018	0.103		0.011	0.022	0.611
Poor background (father's job)	-0.069	0.011	0.000		-0.064	0.011	0.000
High educated mother	0.063	0.061	0.298		-0.014	0.032	0.654
Working in a small town	-0.018	0.010	0.085		-0.015	0.011	0.148
Temporary work	(omitted)	(omitted)	(omitted)		-0.120	0.021	0.000
_cons	2.408	0.103	0.000		2.481	0.101	0.000
University graduate worker	0.232	0.031	0.000		0.216	0.034	0.000
Age	0.032	0.006	0.000		0.012	0.007	0.090
Age squared	0.000	0.000	0.000		0.000	0.000	0.345
sex	-0.092	0.017	0.000		-0.060	0.018	0.001
Household head	0.079	0.018	0.000		0.165	0.020	0.000
Unmarried employee	-0.037	0.020	0.062	**QUANTILE 90**	-0.056	0.026	0.034
Public employee	0.043	0.019	0.022		0.095	0.022	0.000
Part-time employee	0.137	0.054	0.011		0.154	0.032	0.000
No tertiary sector	-0.101	0.018	0.000		-0.119	0.033	0.000
No manager employee	-0.468	0.028	0.000		-0.423	0.032	0.000
No seasonal employee	0.022	0.034	0.519		0.151	0.047	0.001
Wage supplements	-0.124	0.030	0.000		-0.096	0.025	0.000
Born in the south	-0.088	0.017	0.000		-0.075	0.027	0.006
Living in the south	0.049	0.019	0.010		0.056	0.030	0.061
Poor background (father's job)	-0.094	0.013	0.000		-0.084	0.017	0.000
High educated mother	0.019	0.072	0.789		-0.060	0.064	0.344
Working in a small town	-0.018	0.013	0.171		-0.054	0.016	0.001
Temporary work	(omitted)	(omitted)	(omitted)		-0.120	0.033	0.000
_cons	2.769	0.140	0.000		2.560	0.172	0.000
	UNCONDITIONAL EXOGENOUS QTE						
Quantile 10	0.339	0.139	0.014		0.146	0.062	0.018
Quantile 25	0.300	0.067	0.000		0.166	0.032	0.000
Quantile 50	0.300	0.107	0.005		0.182	0.042	0.000
Quantile 75	0.431	0.050	0.000		0.282	0.051	0.000
Quantile 90	0.248	0.045	0.000		0.275	0.045	0.000

Appendix C

Variable	EXOGENOUS MODEL				ENDOGENOUS MODEL		
	Coefficient	**Std. Err**	**P-value**		**Coefficient**	**Std. Err**	**P-value**
	OLS				IV		
University graduate worker	0.190	0.015	0.000	**AVERAGE EFFECT**	0.136	0.041	0.001
Age	0.020	0.004	0.000		0.021	0.004	0.000
Age squared	0.000	0.000	0.000		0.000	0.000	0.000
sex	-0.073	0.012	0.000		-0.071	0.012	0.000
Household head	0.123	0.012	0.000		0.123	0.012	0.000
Unmarried employee	-0.074	0.014	0.000		-0.070	0.015	0.000
Public employee	0.104	0.013	0.000		0.110	0.013	0.000
Part-time employee	0.023	0.018	0.189		0.023	0.018	0.185
No tertiary sector	-0.077	0.028	0.006		-0.080	0.028	0.005
No manager employee	-0.283	0.016	0.000		-0.303	0.022	0.000
No seasonal employee	0.018	0.021	0.391		0.018	0.021	0.386
Wage supplements	-0.083	0.016	0.000		-0.085	0.016	0.000
Born in the south	-0.068	0.019	0.000		-0.068	0.019	0.000
Living in the south	-0.014	0.020	0.499		-0.014	0.020	0.500
Poor background (father's job)	-0.030	0.011	0.004		-0.035	0.011	0.002
High educated mother	0.018	0.047	0.698		0.039	0.049	0.435
Working in a small town	-0.008	0.010	0.430		-0.010	0.011	0.326
Temporary work	-0.162	0.019	0.000		-0.162	0.019	0.000
_cons	2.081	0.097	0.000		2.103	0.099	0.000
	CONDITIONAL QTE						
University graduate worker	0.152	0.023	0.000	**QUANTILE 10**	0.212	0.059	0.000
Age	0.040	0.007	0.000		0.047	0.038	0.221
Age squared	0.000	0.000	0.000		-0.001	0.000	0.293
sex	-0.071	0.014	0.000		-0.091	0.131	0.484
Household head	0.111	0.015	0.000		0.107	0.099	0.277
Unmarried employee	-0.059	0.017	0.001		-0.069	0.108	0.525
Public employee	0.135	0.014	0.000		0.153	0.103	0.139
Part-time employee	-0.080	0.032	0.011		-0.057	0.232	0.806
No tertiary sector	-0.071	0.060	0.242		-0.117	0.281	0.677
No manager employee	-0.147	0.023	0.000		-0.061	0.136	0.655
No seasonal employee	-0.096	0.040	0.016		-0.150	0.305	0.623
Wage supplements	-0.077	0.018	0.000		-0.051	0.047	0.274
Born in the south	-0.061	0.021	0.003		-0.037	0.215	0.864
Living in the south	-0.110	0.026	0.000		-0.214	0.229	0.351
Poor background (father's job)	0.018	0.014	0.181		0.015	0.086	0.861
High educated mother	0.032	0.050	0.524		0.053	0.292	0.856
Working in a small town	0.034	0.014	0.012		-0.004	0.074	0.956
Temporary work	-0.149	0.036	0.000		-0.190	0.472	0.687
_cons	1.304	0.166	0.000		1.135	1.022	0.267

University graduate worker	0.175	0.016	0.000		0.200	0.047	0.000
Age	0.023	0.004	0.000		0.027	0.025	0.284
Age squared	0.000	0.000	0.000		0.000	0.000	0.342
sex	-0.080	0.011	0.000		-0.069	0.128	0.590
Household head	0.085	0.011	0.000		0.073	0.119	0.536
Unmarried employee	-0.063	0.013	0.000	**QUANTILE 25**	-0.086	0.113	0.446
Public employee	0.107	0.011	0.000		0.148	0.148	0.316
Part-time employee	-0.026	0.024	0.269		-0.020	0.113	0.858
No tertiary sector	-0.059	0.024	0.013		0.002	0.174	0.990
No manager employee	-0.206	0.020	0.000		-0.057	0.107	0.595
No seasonal employee	-0.071	0.025	0.005		-0.068	0.161	0.675
Wage supplements	-0.087	0.015	0.000		-0.063	0.132	0.631
Born in the south	-0.058	0.017	0.001		-0.064	0.119	0.592
Living in the south	-0.044	0.019	0.024		-0.110	0.151	0.467
Poor background (father's job)	0.000	0.010	0.986		0.009	0.117	0.939
High educated mother	0.028	0.053	0.603		0.082	0.094	0.379
Working in a small town	0.011	0.010	0.256		-0.004	0.185	0.982
Temporary work	-0.157	0.023	0.000		-0.190	0.198	0.339
_cons	1.903	0.101	0.000		1.666	0.603	0.006
University graduate worker	0.176	0.014	0.000		0.165	0.031	0.000
Age	0.018	0.004	0.000		0.025	0.014	0.071
Age squared	0.000	0.000	0.000		0.000	0.000	0.126
sex	-0.070	0.010	0.000		-0.068	0.079	0.391
Household head	0.096	0.010	0.000		0.080	0.085	0.349
Unmarried employee	-0.081	0.012	0.000	**QUANTILE 50**	-0.099	0.070	0.157
Public employee	0.097	0.011	0.000		0.124	0.067	0.064
Part-time employee	0.044	0.018	0.015		0.035	0.061	0.565
No tertiary sector	-0.078	0.026	0.002		-0.067	0.068	0.324
No manager employee	-0.307	0.019	0.000		-0.191	0.077	0.013
No seasonal employee	-0.054	0.023	0.019		-0.082	0.069	0.239
Wage supplements	-0.087	0.014	0.000		-0.077	0.083	0.352
Born in the south	-0.046	0.015	0.003		-0.058	0.062	0.344
Living in the south	-0.010	0.017	0.562		-0.048	0.103	0.639
Poor background (father's job)	-0.037	0.009	0.000		-0.031	0.067	0.643
High educated mother	0.068	0.046	0.140		0.077	0.169	0.650
Working in a small town	-0.009	0.009	0.312		-0.019	0.095	0.843
Temporary work	-0.127	0.019	0.000		-0.135	0.090	0.135
_cons	2.262	0.085	0.000		2.051	0.332	0.000

University graduate worker	0.209	0.017	0.000	QUANTILE 75	0.204	0.046	0.000
Age	0.016	0.005	0.000		0.022	0.020	0.275
Age squared	0.000	0.000	0.011		0.000	0.000	0.374
sex	-0.068	0.012	0.000		-0.061	0.108	0.575
Household head	0.125	0.012	0.000		0.106	0.119	0.369
Unmarried employee	-0.078	0.015	0.000		-0.090	0.060	0.133
Public employee	0.087	0.013	0.000		0.120	0.067	0.073
Part-time employee	0.090	0.021	0.000		0.060	0.051	0.236
No tertiary sector	-0.055	0.027	0.044		-0.012	0.088	0.891
No manager employee	-0.386	0.019	0.000		-0.264	0.092	0.004
No seasonal employee	0.000	0.029	0.987		-0.029	0.056	0.610
Wage supplements	-0.085	0.015	0.000		-0.071	0.061	0.239
Born in the south	-0.057	0.021	0.007		-0.076	0.083	0.359
Living in the south	0.010	0.022	0.663		0.001	0.114	0.993
Poor background (father's job)	-0.060	0.011	0.000		-0.047	0.060	0.437
High educated mother	-0.007	0.036	0.851		0.009	0.157	0.956
Working in a small town	-0.022	0.011	0.039		-0.035	0.085	0.679
Temporary work	-0.121	0.021	0.000		-0.129	0.055	0.018
_cons	2.444	0.106	0.000		2.207	0.356	0.000
University graduate worker	0.211	0.031	0.000	QUANTILE 90	0.208	0.084	0.013
Age	0.013	0.007	0.063		0.017	0.063	0.788
Age squared	0.000	0.000	0.274		0.000	0.001	0.836
sex	-0.063	0.018	0.001		-0.055	0.303	0.857
Household head	0.164	0.020	0.000		0.129	0.267	0.630
Unmarried employee	-0.047	0.027	0.086		-0.090	0.057	0.116
Public employee	0.082	0.022	0.000		0.151	0.214	0.481
Part-time employee	0.141	0.030	0.000		0.116	0.060	0.054
No tertiary sector	-0.123	0.032	0.000		-0.026	0.243	0.914
No manager employee	-0.415	0.031	0.000		-0.334	0.194	0.086
No seasonal employee	0.145	0.048	0.003		0.049	0.082	0.551
Wage supplements	-0.101	0.026	0.000		-0.042	0.092	0.649
Born in the south	-0.075	0.027	0.006		-0.056	0.073	0.442
Living in the south	0.054	0.030	0.067		-0.023	0.405	0.955
Poor background (father's job)	-0.087	0.017	0.000		-0.048	0.148	0.748
High educated mother	-0.055	0.070	0.430		-0.062	0.224	0.782
Working in a small town	-0.052	0.016	0.001		-0.062	0.125	0.620
Temporary work	-0.128	0.033	0.000		-0.181	0.086	0.036
_cons	2.538	0.171	0.000		2.375	0.858	0.006
	UNCONDITIONAL QTE						
Quantile 10	0.129	0.051	0.012		0.491	0.262	0.061
Quantile 25	0.166	0.029	0.000		0.381	0.094	0.000
Quantile 50	0.179	0.040	0.000		0.240	0.143	0.092
Quantile 75	0.262	0.045	0.000		0.243	0.136	0.073
Quantile 90	0.277	0.042	0.000		0.319	0.399	0.423