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THE PRIVATE AND SOCIAL RETURN TO SCHOOLING IN ITALY

By Antonio Ciccone* Federico Cingano** and Piero Cipollone**

Abstract

We estimate the private (individual) and social return to schooling in Italy and four macro regions. Our estimates take into account the effects of schooling on employment and wages as well as the key features of the Italian tax and social insurance system. We find that the individual return to schooling compares favorably to the return to financial assets (especially in the South). At the social level, the available infrastructure-capital data indicates that the return to schooling exceeds that to infrastructures in the South.

JEL classification: I2, J31, O18, R11

Keywords: Education, Regional Development, Wages, Employment probability

Contents

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1 Introduction[1]

Is the private (individual) return to human capital low in Italy compared to other countries? And what about the social return? Do education, tax, and welfare policies in place amount to a tax or a subsidy on schooling in Italy? And does the pattern of taxes and subsidies move human capital investment towards the socially desirable level? How should public funds be allocated between infrastructure and human capital investment? Answering these questions requires estimates of the private and social return to schooling in Italy. It is this task of measurement and estimation that lies at the center of our paper.

The private return to schooling is the discount rate that equalizes the present value of the private costs and benefits generated by an increase in the schooling of a representative individual. The private cost of schooling includes directs costs as well as the opportunity cost of schooling; the private benefit includes increased after-tax wages as well as reduced unemployment spells to the extent that such spells are associated with income losses. Our estimation yields a private return to a one-year increase in schooling in Italy of 8.9%, which is considerably larger than the effect of a one-year increase in schooling on after-tax wages (around 6%). The discrepancy is mainly explained by schooling reducing the probability of unemployment.

Across Italian macro regions, the private return to a one-year increase in schooling ranges from 8.4 to 9%. Interestingly, the private return to schooling in the South is larger than the private return in the North, although differences are not statistically significant. This is in spite of the effect of schooling on after-tax wages being significantly lower in the South than the North. These apparently contradictory results are reconciled by our finding that the effect of schooling on employment is significantly larger in the South than the North. We also estimate the private return to upper secondary and university education. For Italy as a whole, we find an annual return to upper secondary schooling of 9.7% and an annual return

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to a university education of 10.3%. Private returns are even higher in the South, where the annual values are 10.2% and 12.3% respectively. All our estimates indicate that the return to schooling in Italy, particularly in the South, compares very favorably to the historical return of the average portfolio of stocks and government bonds.

We also estimate the social return to schooling in Italy and the four macro regions and compare it to the social return to infrastructure. The social return to schooling (infrastructure) is defined as the discount rate that equalizes the present value of social costs and benefits of increased schooling (infrastructure). The key difference with the calculation of the private return to schooling is that the social return depends on the effect of schooling on output (taking into account possible aggregate decreasing returns to schooling), not wages, and that the social return ignores redistribution. Our comparisons between the social return to schooling and that to infrastructure investment indicates that the return to schooling clearly exceeds that to infrastructures in the South. These results should be taken with care however because of the limitations of the existing regional estimates of infrastructure capital (Montanaro, 2002).

Finally, we propose a way to analyze the consequences of increased schooling for public finances under alternative scenarios regarding the (implicit) tuition subsidy, the progressivity of the income tax, and features of the unemployment insurance system.

The paper follows the methodology introduced by de la Fuente and Ciccone (2002), developed further by de la Fuente (2003), and extended to the regional level by de la Fuente, Doménech, and Jimeno (2003) and Ciccone (2004). The key difference with Ciccone (2004) is that our calculations are at the macro-region level instead of the administrative-region level, which increases the size of samples and therefore reduces parameter uncertainty, and that we account for the endogeneity of individual schooling when estimating key parameters.

The remainder of the paper is organized as follows. Section 2 presents estimates of the effects of schooling on individual wages, employment probabilities, and participation rates as well as on aggregate productivity. Sections 3 to 5 contain the core of our analysis. Section 3 constructs measures of the private return to schooling. Section 4 deals with the effects of educational investment on public budgets. And Section 5 estimates the social return to schooling. Section 6 summarizes. The Appendix contains data details and additional results.

2 Econometric estimates of the effects of schooling

In this section we estimate the effects of individual schooling on individual wages and labor market outcomes and the effect of average schooling on aggregate productivity at the regional level.

2.1 The effect of schooling on wages (the Mincerian *return to schooling)*

Our estimates of the effect of schooling on wages, which we will refer to as *Mincerian* returns to schooling, are based on the Bank of Italy's *Survey of Household Income and Wealth* (SHIW) for every second year between 1987 and 1995 plus 1998 and 2000 (for a full description of the data available in SHIW see Brandolini et al. 2002) . Combined, these surveys provide data on earnings, working hours, and personal characteristics (including the administrative region of residence) of over 45 000 individuals.[2] When estimating the effect of schooling on wages at the regional level we face a trade off between the number of regions considered and the number of individuals in each region. The regional classification that we end up using is that of four so-called macro-regions as defined by the National Statistical Institute (ISTAT): *Northwest* (Piemonte, Lombardia, Liguria, Valle d'Aosta), *Northeast* (Friuli-Venezia-Giulia, Veneto, Trentino Alto Adige, Emilia-Romagna), *Center* (Lazio, Toscana, Umbria, Marche), and *South* (Abruzzo, Puglia, Basilicata, Molise, Campania, Calabria, Sicilia, Sardegna). We will also present separate results for all Objective 1 regions combined (Calabria, Campania, Basilicata, Puglia, Sardegna and Sicilia).[3]

The SHIW data is used to estimate the following standard Mincerian wage equation

$$(1) \qquad ln\, w_i = c + \theta S_i + a*exp_i + b*exp_i^2 + d*Dgender_i + Dyear_i + u_i$$

where w is the *net* hourly wage (there is no information on gross earnings in the SHIW; the earnings data is net of withheld income tax and employee social security

[2] Since SHIW includes a panel component the number of actually independent observations is smaller.

[3] Objective 1 regions represent the main priority of the European Union's cohesion policy. They are defined as those regions whose GDP is below 75% of the European Union average and they currently absorb more than 2/3 of the European Union's structural funds.

contributions) and schooling is measured by the number of years of formal schooling (*S*) while experience is captured by potential experience (*exp* which is calculated as age minus six minus years of formal education).[4] The regression also includes dummies for gender *(Dgender)* and the year the worker is observed *(Dyear)*. In addition to (1), we also estimate a specification that replaces years of schooling by dummy variables for secondary school attainment and university attainment.

Table 1 contains the least-squares estimates of the Mincerian returns to schooling across macro-regions (these Mincerian returns are very precisely estimated; standard errors are never larger than 0.1%). The column entitled "years of schooling" contains the percentage increase in wages associated with one additional year of schooling. The columns entitled "upper secondary" and "university" contain the average annual return to secondary schooling and the average annual return to university respectively.

Table 1

EFFECT OF SCHOOLING ON NET WAGES (1987-2000 SHIW WAVES)

	Years of schooling	Upper secondary	University
North West	6.56	5.87	6.76
North East	6.23	5.28	6.97
Center	5.86	5.33	7.33
South	5.80	6.15	8.31
Objective 1	*5.78*	*6.17*	*8.12*
Italy	6.09	5.66	7.40
Italy: male	5.82	5.36	7.37
Italy: female	6.42	6.14	7.38

[4] SHIW does not report the number of years of schooling attended but only the highest degree completed. We coded this information into years of schooling attributing 5 years to primary degrees, 8 years to junior high school, 13 year to secondary school and 18 years to college graduates and post-graduate. Also, in the regressions we only used data regarding individuals aged 15 to 64.

It can be seen that the Mincerian return to schooling is lower in the South. Moreover, the difference between the North and the South is statistically significant at the 1-percent level. Interestingly, the regional ordering of Mincerian returns to schooling is rather different when we focus on upper secondary and university education, where Mincerian returns turn out to be greater in the South than the North.

Mincerian returns to schooling are usually estimates using data on gross wages, and it therefore makes sense to make an attempt to understand what our estimates could imply in gross terms. We therefore take the following approach. Brandolini and Cipollone (2002) estimate the Mincerian return to education using both net and gross wages and find that the gross return exceeds the net return. As their findings indicate that the gross return is at least 13% higher than the net return, we apply a conservative 13% upwards adjustment factor to our after-tax Mincerian returns in Table 1 (Brunello, Comi, and Lucifora (2000) suggest an adjustment factor of similar magnitude). These before-tax Mincerian returns are reported in Table 2.

Table 2

IMPLIED EFFECTS OF SCHOOLING ON GROSS WAGES (1987-2000 SHIW WAVES)

	Years of schooling
North West	7.44
North East	7.07
Center	6.65
South	6.58
Objective 1	6.56
Italy	6.91

Individual levels of schooling are endogenous, which raises the concern that Mincerian returns to schooling obtained using least-squares methods are biased. The direction of the

bias is uncertain, however. In particular, if unobserved factors as innate ability are positively correlated to school attainment then least square estimates would attribute to schooling part of the wage premium due to ability overestimating the true return to education. On the other hand, if schooling and ability are substitutes then Mincerian returns to schooling obtained using least-squares methods would be biased downwards; error in measurement of individual schooling would also lead to attenuation bias. The appropriate way of dealing with these issues is an instrumental-variables methodology. There is a very large literature on this issue and one of the main conclusions of this literature seems to be that the least-squares bias is small in practice (see Angrist and Krueger, 1991; Card, 1999 and 2001). We will nevertheless try an instrumental-variables methodology for the case of Italian macro regions.

The 1993-2000 waves of the SHIW contain information on parents' schooling. We will therefore instrument schooling of each individual in the SHIW with schooling of his or her parents (see Ashenfelter and Zimmerman (1997) for a similar approach and Card (1999) for the set of conditions under which such identification strategy provides consistent estimation of the Mincerian returns to schooling). The results of estimating equation (1) using two-stage least squares (TSLS) are given in Table 3. Table 3 also contains least-squares (LS) estimates.

It can be seen that least-squares estimates are somewhat higher when using the 1993-2000 waves of the SHIW than when using the 1987-2000 waves (as in Table 1). Differences in the return to schooling between the North and the South are however rather similar in the two cases. Moreover, the two-stage least-squares estimates in Table 3 are larger than the least-squares estimates (a pattern often found in the literature). Interestingly from our point of view, the difference between the North and South is similar for those found using least squares (and continues to be statistically significant at the 1-percent level). Our preferred instrumental-variable estimates of the Mincerian return to schooling are obtained by first calculating an instrumental-variables adjustment factor, the ratio between the two-stage least-squares and the least-squares estimate in Table 3, for each region and the applying this factor to the estimates in Table 1.

Table 3

LS AND TSLS ESTIMATES OF EFFECTS OF SCHOOLING ON NET WAGE (1993-2000 SHIW WAVES)

	Years of schooling	Years of schooling
	LS	TSLS
North West	6.9	7.6
North East	6.7	7.5
Center	6.3	7.1
South	6.2	6.9
Objective 1	6.2	6.9
Italy	6.5	7.2

2.2 The effect of schooling on labor force participation and employment

We follow Heckman's (1979) well-known two-step approach to estimate the effect of schooling on labor force participation rates and employment probabilities. The approach consists of first estimating a probit model linking the probability of labor market participation to the individual's schooling as well as other characteristics (listed in Table 4). The second step tries to explain the probability of employment *(p)* by the individual's schooling, a subset of the explanatory variables used in the participation equation (also listed in Table 4), and an estimate of the individual's propensity to participate in the labor market (the so-called inverse Mill's ratio), obtained from the first step. The Mill's ratio is meant to correct for the bias that would arise if one failed to take into account that labor market participation is endogenous. The data used comes from the 2000 and 2001 labor force surveys and the number of observations used is just above 70 000.

Table 4

EXPLANATORY VARIABLES USED IN THE PARTICIPATION AND EMPLOYMENT EQUATIONS (OTHER THAN SCHOOLING)

	participation	employment
gender (male)	X	X
potential experience	X	X
potential experience squared	X	X
university student	X	X
non-university student	X	X
yearly dummies (1996-2000)	X	X
quarterly dummies (Q1-Q3)	X	X
Married	X	
married*male	X	

Tables 5 and 6 report our findings for the two steps (participation and employment probabilities). In particular, we report estimated marginal effects (in %) evaluated at the sample mean. Estimates in the first column of Tables 5 and 6 (entitled "years of schooling") come from the Mincerian specification using years of schooling as the variable capturing formal education. The other two coefficients are constructed using the estimated coefficients of the educational dummies included in the second specification. As in the previous section, they should be interpreted as marginal effects per year of schooling at each level.

In the "Italy" row of Table 5, it can be seen that participation effects are larger for university than secondary school attainment. The participation effect of one additional year of schooling lies between the university and secondary school values. More importantly from our point of view, participation effects are larger in the South than the North whatever the schooling variable used (and these differences are statistically significant at the 1 percent level).

Table 5

EFFECT OF SCHOOLING ON PARTICIPATION (LFS[1])

	Years of Schooling	Upper secondary	University
North West	1.40	2.18	2.14
North East	1.39	2.15	1.00
Center	2.03	2.67	2.23
South	3.21	3.65	3.48
Objective 1	3.24	3.67	3.53
Italy	2.37	2.12	2.49
Italy: male	1.21	2.10	2.28
Italy: female	3.22	4.31	1.35

[1]Based on Labor Force Survey 2000 and 2001

Table 6

EFFECT OF SCHOOLING ON EMPLOYMENT CONDITIONAL ON PARTICIPATION (LFS[1])

	Years of schooling	Upper secondary	University
North West	0.76	0.98	0.51
North East	0.30	0.55	0.00
Center	1.05	1.22	0.89
South	3.02	2.68	3.20
Objective 1	3.10	2.70	3.42
Italy	1.59	1.87	1.40
Italy: male	1.55	1.32	1.13
Italy: female	1.77	1.79	1.40

[1]Based on Labor Force Survey 2000 and 2001

Note: The zero coefficient in bold has been imposed. Point estimates in these cases were negative but not statistically different from zero.

As can be seen from the "Italy" row in Table 6, employment effects follow the same pattern as participation effects at the national level. Moreover, employment effects are larger in the South than the North whatever the schooling variable used (and these differences are statistically significant at the 1 percent level).

Endogeneity of schooling is at least as much of a concern in the participation and employment equations as in the wage equations. We will therefore instrument schooling of each individual with schooling of his or her parents. In order to do so we have to estimate the participation and employment equations using the 1993-2000 SHIW data, as there is not data on parents' schooling in the labor force survey.

Table 7 presents our results for the participation equation. The first column of results indicates that changing the sample but not the estimation method lowers the average effect in Italy (2.09) compared to Table 5 (2.37). Moreover, the South and North are considerably closer in Table 7 than in Table 5. The second column of results shows that the effect of schooling on participation is lower and differences across regions smaller when we use instrumental-variables methods.

Table 7

EFFECT OF SCHOOLING ON PARTICIPATION (1993-2000 SHIW WAVES)

	Years of Schooling	Years of schooling IV
North West	1.61	1.3
North East	1.38	0.3
Center	1.8	0.8
South	2.4	0.8
Objective 1	2.6	1.0
Italy	2.09	1.1

Table 8 repeats the exercise for the employment equation (conditional on participation). The first column of results indicates that changing the sample but not the estimation method does not change the average effect in Italy (1.51) much compared to Table 6 (1.59). Moreover, the difference between the South and North is similar in the two cases. According to the second column of results, the effect of schooling on employment increases when we use instrumental-variables methods. The difference between the North and the South also increases somewhat.

Table 8

EFFECT OF SCHOOLING ON EMPLOYMENT CONDITIONAL ON PARTICIPATION (1993-2000 SHIW WAVES)

	Years of Schooling	Years of schooling IV
North West	0.23	0.42
North East	0.33	0.06
Center	0.22	1.45
South	2.4	2.93
Objective 1	2.5	2.70
Italy	1.51	2.13

2.3 The effects of average schooling on regional productivity5

We now turn to the effects of average schooling on regional productivity using a regional production-function framework (in logs)

$$(2) \qquad q_{it} = a_{it} + \alpha_k * k_{it} + \alpha_x * x_{it} + \beta * se_{it}$$

[5] This section is based on Ciccone (2004).

where q_{it} is the log of output per worker in region i at time t, k and x the logs of non-infrastructure physical capital and infrastructures per worker, se the log of the average number of years of schooling of the working age population and a the log of total factor productivity. Equation (2) is estimated using yearly data for all administrative regions over the period 1970-94.

The data on regional employment, output, and the stock of non-infrastructure physical capital and infrastructure capital are taken from the CRENOS research center at the University of Cagliari. GDP and physical capital are measured in 1985 prices. The data on schooling at the regional level have been derived using the 1971-81-91 issues of the population census. Infrastructure capital includes publicly financed transportation networks (roads and highways, ports, airports and railways), water works, sewage and urban structures. Non-infrastructure physical capital includes private capital and the stock of public capital associated with the provision of education, health and general administrative services. These items are aggregated because our output measure includes government-provided services. We also include common time effects and region-specific time-invariant effects in the regression.

Table 9 contains the results of estimating equation (2) using least squares. The estimated elasticity of output with respect to average schooling is statistically significant and between 0.411 and 0.501. Non-infrastructure physical capital enters equation (2) with a positive and significant coefficient (between 0.247 and 0.288) that is similar to the share of physical capital in income. Infrastructure capital is insignificant (even when we consider growth over 5-year periods in order to allow for productivity improvements due to better infrastructure to set in with lags).

Estimating equation (2) replacing CRENOS infrastructure capital series with those developed by Bonaglia and Picci (2000) leaves the estimate of β basically unchanged. But infrastructure capital is now significant while non-infrastructure physical capital becomes insignificant. In particular, the coefficient on infrastructure capital becomes 0.17 and is significant at the 5-percent level, while the coefficient on non-infrastructure capital halves and becomes insignificant at the 5-percent level.

Table 9

GROWTH ESTIMATES WITH ALTERNATIVE SCHOOLING SERIES AND SPECIFICATIONS

	(1)	(2)	(3)	(4)
α_K	0.256	0.247	0.288	0.287
	(4.66)	(4.76)	(5.30)	(5.48)
α_X	0.0026	0.0023	-0.002	-0.002
	(0.34)	(0.87)	(-0.48)	(-0.79)
β	0.500	0.477	0.411	0.501
	(3.39)	(3.27)	(2.04)	(3.25)
Region controls	All	Macro Regions	Macro Regions	Macro Regions
Period controls	None	None	5-year subperiods	Significant 5-year subperiods
Number of observations	255	255	255	255

Note: t ratios in parentheses below each coefficient.

We further explored the robustness of our estimate of β using industrial (as opposed to total) productivity growth as right-hand side variable in equation (2). This allows us to choose between two alternative non-infrastructure physical capital series: the industrial non-infrastructure physical capital series of Bonaglia and Picci (2000) and the series of CRENOS. Using CRENOS series for both non-infrastructure and infrastructure capital yields a higher effect of average educational attainment on productivity than in Table 6. This remains the case when the two series are replaced with those estimated by Bonaglia and Picci (2000). All in all we conclude that the results shown in Table 9 provide reliable quantification of the effects of schooling on regional productivity.

3 Private returns to schooling

We now calculate the "proper" private return to the financial resources invested in schooling for Italy as a whole and the four macro regions. This return takes into account the private cost of schooling (including the opportunity cost) and the effect of schooling on wages as well as employment probabilities (and hence on unemployment). In particular, the private rate of return to schooling is calculated as the discount rate that equates the present value of the additional costs of schooling to the present value of the stream of net-of-tax earnings generated by an increase in schooling. The methodology we use is developed in de la Fuente and Ciccone (2002) and de la Fuente (2003). Before presenting our results, we briefly summarize the procedures used.

3.1 Methodology

Rates of return are calculated under the assumption that the individual participates in the labor market until retirement and that unemployment spells are due to difficulties in finding a job. This implies that rates of return are conditional on labor force participation. Moreover, our calculations assume that individuals can work 20% of a standard work-year while enrolled in school, although, again, they may not succeed in finding a job. The rate of return estimates also account for labor income taxation and social security contributions as well as unemployment benefits. All tax and benefit parameters will refer to a single individual without children and assume that unemployment spells are sufficiently short to not exhaust contributive benefits.

As already mentioned, the private rate of return to schooling *(r_p)* is calculated as the discount rate that equates the present value of the additional costs of schooling to the present value of the stream of net-of-tax earnings generated by an increase in schooling. De la Fuente (2003) shows that r_p is given by

$$r_p = R_p + g \tag{3}$$

where g is the exogenous growth rate of productivity while R_p is implicitly defined by

$$(4) \qquad \frac{R_p}{1-e^{-R_p H}} = \frac{\left(\frac{p_o+(1-p_o)a}{p_o+(1-p_o)(a+b)}\right)\left(\frac{1-T'}{1-\tau_o}\right)\theta + \left(\frac{(1-a-b)p_o}{p_o+(1-p_o)(a+b)}\right)\varepsilon}{\left(1-\frac{1-\tau_s}{1-\tau_o}\frac{(1-\phi)\eta p_o}{p_o+(1-p_o)(a+b)}\right)+\frac{\mu_s}{(1-\tau_o)[p_o+(1-p_o)(a+b)]}}$$

where θ measures the marginal effect of education to gross wages, p_O the likelihood of employment of an adult with the relevant attainment level, $\varepsilon = p'/p_O$ the employment effects of schooling, Φ the fraction of time taken up by full-time school attendance, μ_S the direct costs of schooling relative to full-time wages and H the number of years the individual is in the labor force. The additional parameters capture taxes and benefits: τ_o and T' are the average and marginal tax paid by the representative full-time worker, τ_S the average tax on income from part-time work and a and b the net replacement ratio for unemployed workers linked and not linked to previous earnings. All definitions and data sources are summarized in Table 10.

The interpretation of (4) is explained in detail in de la Fuente (2003). Summarizing, the right-hand side represents the marginal benefits derived from an increase in schooling relative to its cost. The first term in the numerator is equal to the increase in after-tax earnings for a given probability of employment. The second term in the numerator is the increase in net earnings that works through changes in the probability of employment. The denominator captures the total cost of the increase in schooling, which is the sum of the opportunity cost and the direct costs of schooling born by the individual. Note that educational subsidies or the direct public provision of education raises the return to schooling by lowering its cost to the individual. Unemployment benefits, on the other hand, reduce the return to schooling by lowering the loss of earnings associated with unemployment.

Table 11 shows the actual data used in the rate of return calculations.

Table 10

VARIABLES AND PARAMETERS USED IN THE CALCULATION OF THE PRIVATE RATE OF RETURN TO SCHOOLING AND SOURCES OF THE DATA

parameters

γ = 1.5, rate of exogenous productivity growth. Source: Jones (2002).

ϕ = 0.8, fraction of time taken up by (full-time) school attendance; $1-\phi$ is the potential labor supply while in school. Source: de la Fuente (2003).

U = 59.4 = Average retirement age in 1995 in Italy, constructed by averaging separate estimates for men and women, weighted in proportion to their shares in total employment. Source: de la Fuente (2003).

variables

S_O = average years of school attainment of the adult population (between 25 and 65 years old) in 2001. Source: LFS (2001)

$H = U - Max(6+S_O, 15)$ = estimated length of the (post-school) working life of the representative individual.

θ = microeconomic Mincerian returns to schooling parameter. It measures the average (log) increase in gross wages (wages before income taxes and employee social security contributions are withheld) resulting from an additional year of schooling. Source: Section 2.1.

μ_S = direct cost of schooling born by the individual, measured as a fraction of average gross earnings of full-time salaried workers (weighted average of secondary and tertiary levels with weights 2/3 and 1/3 respectively). Average costs are shown net of direct public subsidies to students for living costs and other non-tuition expenses and will be negative when these subsidies exceed tuition charges. Source: Appendix A1.

μ = total (private + public) cost of schooling per student measured as a fraction of average gross earnings of full-time salaried workers (weighted average of secondary and tertiary levels with weights 2/3 and 1/3 respectively). It excludes an estimate of research expenditures by universities. Source: Section 2.1 and Appendix A1.

p_O , p_S; the former is the probability of employment after leaving school, conditional on participation in the labor force. Following de la Fuente, Doménech, and Jimeno (2003), this is the predicted value of the second-stage employment equation evaluated at the average value of the explanatory variables. The employment probability of students is approximated by adding to this average prediction a weighted average of the coefficients of the dummies for non-university and university students (with weights 2/3 and 1/3) respectively. Estimated using the results in section 2.2.

p_S = probability of employment while attending school, conditional on participation in the labor force. Estimated using the results in section 2.2.

$\eta = p_S/p_O$, correction factor capturing the greater difficulty of finding part-time employment while attending school.

$\varepsilon = p'(S)/p(S)$ measures the responsiveness of the probability of employment of active workers to a marginal increase in their level of schooling. Estimated using the results in section 2.2.

τ_O = average tax rate on labor income (including national and regional income taxes and employee social security contributions) applicable to the single worker with no children with average full-time earnings in 2002. Source: *Agenzia delle Entrate* (www.agenziaentrate.gov.it) and Appendix A1.

T' = marginal tax rate on labor income (including national and regional income taxes and employee social security contributions) applicable to a single worker with no children with average full-time earnings in 2002. Source: *Agenzia delle Entrate* and Appendix A1.

τ_S = average tax rate on labor income (including national and regional income taxes and employee social security contributions) applicable to the single worker with no children earning 20% of average full-time earnings in 2002 (i.e. tax rate on average student income). Source: *Agenzia delle Entrate* and Appendix A1.

a = first component of the net replacement ratio (ratio of net after-tax earnings out of work to net after-tax earnings while employed) for a single individual with no children whose previous earnings were equal to the average production worker's salary. This parameter captures the effects of unemployment benefits that are linked to previous earnings (it is assumed that unemployment spells are sufficiently brief so that contributory benefits are not exhausted). Source: de la Fuente (2003).[6]

b = second component of the net replacement ratio, calculated under the same assumptions as *a*. It captures the effects of unemployment and housing benefits whose amount is not linked to previous earnings. Source: de la Fuente (2003).

[6] The parameters de la Fuente (2003) uses for Italy are based on the OECD publication *Benefit Systems and Work Incentives 1999.*

Table 11

DATA USED IN THE CALCULATION OF THE PRIVATE RATE OF RETURN TO SCHOOLING

	S	H	θ	μs	μ	p_o	p_s
North West	59.4	45.3	7.44%	3.26%	23.93%	96.08%	61.28%
North East	59.4	45.3	7.07%	2.13%	21.86%	96.78%	77.60%
Center	59.4	45.3	6.65%	1.82%	19.85%	93.85%	64.84%
South	59.4	45.3	6.58%	2.28%	20.33%	80.88%	31.64%
Objective 1	59.4	45.3	6.56%	1.83%	20.01%	79.63%	27.79%
Italy	59.4	45.3	6.91%	2.20%	20.79%	91.55%	56.15%

	η	ε	τ_o	T'	τ_s	a	b
North West	63.78%	0.79%	30.41%	42.69%	9.19%	39.28%	2.29%
North East	80.18%	0.31%	30.79%	42.69%	9.19%	39.28%	2.29%
Center	69.09%	1.12%	30.44%	42.69%	9.19%	39.28%	2.29%
South	39.12%	3.74%	30.34%	42.69%	9.19%	39.28%	2.29%
Objective 1	34.90%	3.90%	30.37%	42.69%	9.19%	39.28%	2.29%
Italy	61.33%	1.73%	30.83%	42.69%	9.19%	39.28%	2.29%

3.2 Average (across attainment levels) private return to schooling

Table 12 contains our results for the average (across all attainment levels) private return to one additional year of schooling for Italy and all macro regions. The private return for Italy as a whole is 8.9% and the return varies between 8.4 and 9% across macro regions. The private return to schooling in Objective 1 regions is 9.1% and therefore above the average for the entire country.

Table 12

PRIVATE RATE OF RETURN TO SCHOOLING

	Years of schooling
North West	8.6%
	(0.8%)
North East	8.5%
	(0.3%)
Center	8.4%
	(0.6%)
South	9.0%
	(0.2%)
Objective 1	*9.1%*
	(0.2%)
Italy	8.9%
	(0.2%)
Italy: male	8.6%
	(0.2%)
Italy: female	9.4%
	(0.3%)

Note: The standard errors in parenthesis have been obtained based on a bootstrap procedure with 1000 replications.

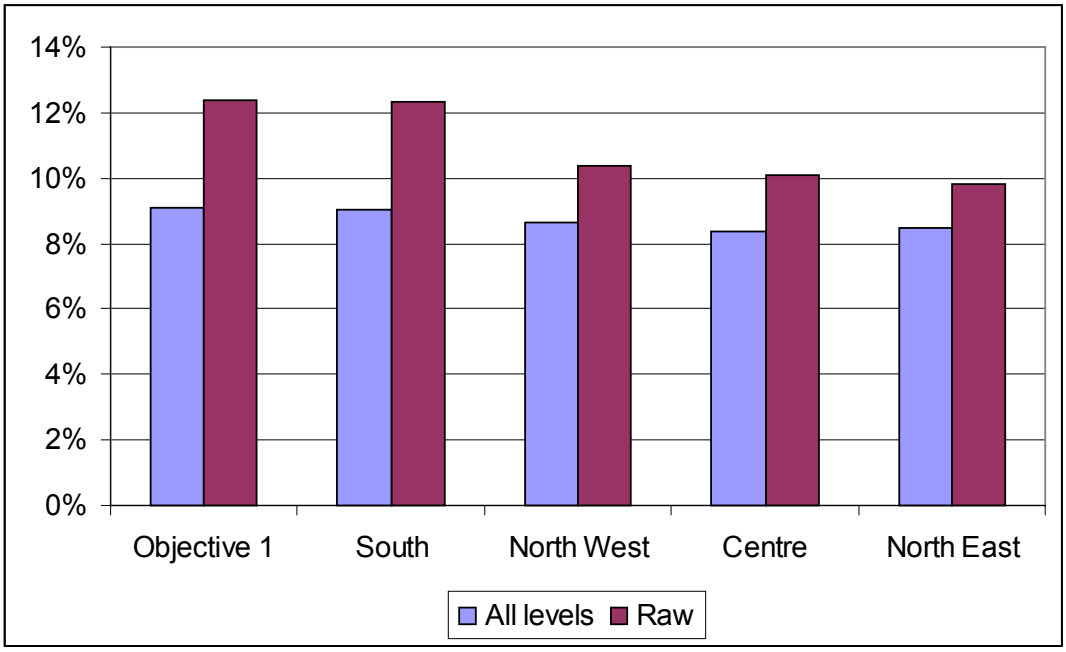
The private rate of return to schooling at the macro region level should be seen as an approximation to the rate of return of individuals who acquire their schooling and work in the macro region. It is an approximation only because, while the effect of schooling on wages and employment are estimated using residents in the macro region, these residents may not have obtained their schooling in the region (our data does not contain this information). This could bias the results in Table 12 if, as seems likely, the quality of schooling in the North is higher than in the South.[7] As long as the share of workers educated in the North is higher in the North than in the South, this bias would lead us to understate the gap in returns to schooling between South and North if both had the same quality of schooling. Or, to put it differently, it is extremely unlikely that our finding that private returns to schooling in the South are greater than in the North is explained by our data not allowing us to account for differences in educational quality.

Figure 1 shows the estimates of the private rates of return to schooling as well as the so-called raw returns across regions. The raw returns are obtained by setting all tax and benefit parameters in (4) equal to zero. Comparing the private returns and the raw returns to schooling therefore allows for a simple assessment of how policies affect the return to schooling. It can be seen that the raw returns exceed the private returns in each region. The average gap is approximately 3%. Thus the pattern of taxes and subsidies in Italy tends to *lower* the private return to schooling. The reason is that, while the (mostly) public provision of schooling in Italy raises the private return to schooling, the progressivity of the income tax reduces it. This result becomes clearest when we calculate the private return to schooling assuming that individuals bear the full social cost of schooling but that income taxation is proportional instead of progressive. This calculation yields a private return to schooling of 10%, more than a percentage point higher than the actual private return to schooling (8.9%).

[7] For example, according to the year 2000 results of the OECD "Program for International Student Assessment" (PISA), students in the North performed better than students in the South in all the assessment domains considered by the program (reading literacy, mathematical literacy and scientific literacy).

Figure 1

PRIVATE AND RAW RATES OF RETURN TO SCHOOLING



3.3 Instrumental variables estimates of average return to schooling

Table 13 shows the parameters used in the instrumental-variables calculations of the rate of return. They are obtained by adjusting the parameters in Table 11 using the instrumental-variables estimates of the effect of schooling on wages and employment conditional on participation. In particular, we follow two adjustment procedures. "Adjustment 1" is obtained by adjusting the least-squares parameter estimates in each macro area obtained using the largest possible sample according to the discrepancy between least-squares and instrumental-variables estimates in (the same) smaller samples in each macro area. "Adjustment 2" follows the same approach but applies the same (national) adjustment factor to all regions (because the discrepancy between least-squares and instrumental-variables estimates at the macro-area level may be noisy due to the smaller number of observations).

Table 13

DATA USED IN THE IV CALCULATIONS OF THE PRIVATE RATE OF RETURNS TO SCHOOLING

Adjustment 1

	θ	P_O	P_S	η	ε
North West	8.3%	96.1%	61.2%	63.7%	1.0%
North East	8.0%	96.8%	77.9%	80.4%	0.0%
Center	7.5%	94.0%	69.2%	73.6%	2.4%
South	7.4%	81.0%	30.4%	37.5%	4.4%
Objective 1	7.4%	80.0%	26.8%	33.5%	4.1%
Italy	7.8%	91.6%	54.8%	59.7%	2.4%

Adjustment 2

	θ	p_O	P_S	η	ε
North West	8.3%	96.2%	59.6%	61.9%	1.4%
North East	7.9%	96.9%	75.9%	78.3%	0.9%
Center	7.5%	93.9%	63.1%	67.2%	1.8%
South	7.5%	81.0%	29.9%	37.0%	4.5%
Objective 1	7.4%	79.7%	26.1%	32.7%	4.7%
Italy	7.8%	91.7%	54.5%	59.4%	2.4%

Table 14 summarizes the private return to one additional year of schooling for all regions and the entire country using an instrumental-variables approach. It can be seen that the average for the entire country is greater than in Table 12 whatever the instrumental-variables adjustment used. The difference between the North and the South is however similar in all cases (around 1 percent).

Table 14

PRIVATE RATE OF RETURNS TO SCHOOLING. IV CALCULATIONS

	IV Adjustment 1	IV Adjustment 2
North West	9.7%	10.0%
North East	9.3%	9.9%
Center	10.3%	9.6%
South	10.2%	10.3%
Objective 1	10.0%	10.3%
Italy	10.2%	10.2%

3.4 Results by educational level

We now turn to the estimation of rates of return for upper secondary education and university education.

3.4.1 Metodology and data

The definitions of the variables entering the rate of return formula given in Table 10 in the previous section continue to be valid with the following minor changes. First, when calculating the marginal returns to upper secondary attainment it will be assumed that the opportunity cost of a student enrolled is determined by the average wage and employment

probability of full-time workers who have completed lower secondary schooling and by the corresponding tax and benefit parameters. This implies that calculation of the rates of return requires estimating the average wage and employment probability of a representative individual for each attainment level and region. Second, calculation of the rates of return now requires level-specific estimates of the (annual) marginal wage and employment effects obtained. Third, the private and total direct costs of schooling are allowed to be different for upper secondary and university education. Finally, the length of post-school working lives will now be higher for the representative worker with only upper secondary education attainment than for the worker with university attainment.

3.4.2 Results

Table 15 shows the private return to upper secondary and university attainment for all regions and the entire country. It can be seen that both the return to university and the return to upper secondary school for the whole of Italy are higher than in the previous exercise.

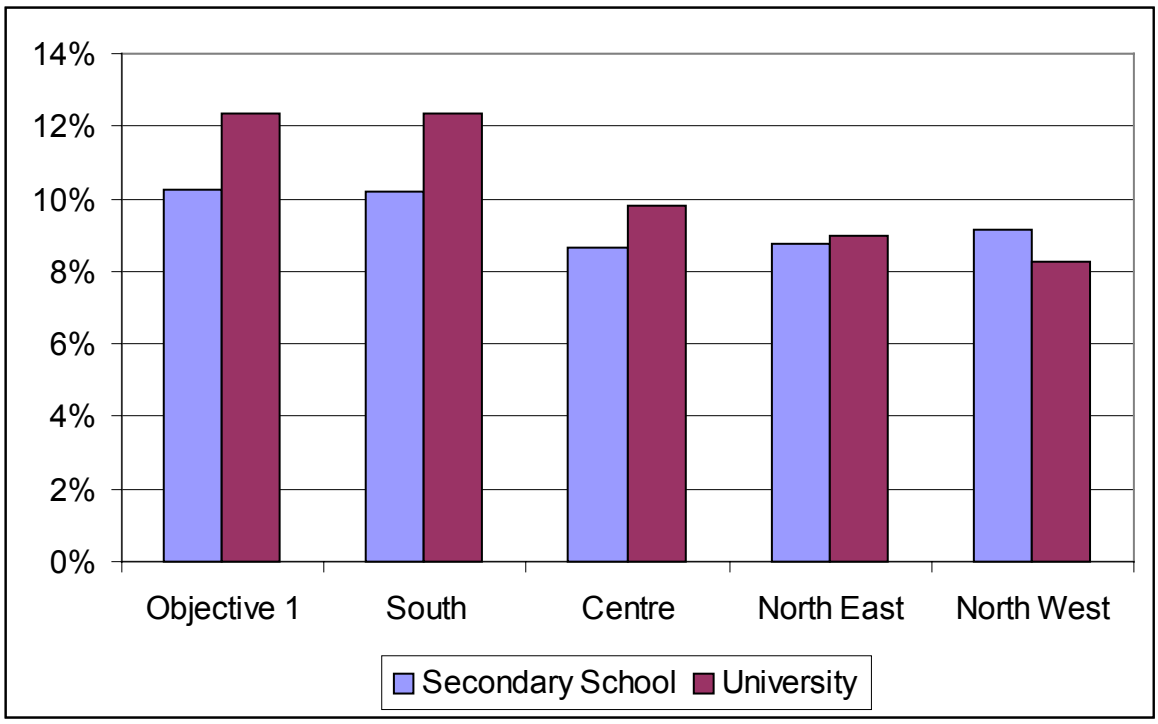
Table 15

PRIVATE RATE OF RETURN TO UPPER SECONDARY AND UNIVERSITY ATTAINMENT

	Upper secondary	University
North West	9.2%	8.3%
North East	8.8%	9.0%
Center	8.7%	9.8%
South	10.2%	12.3%
Objective 1	*10.2%*	*12.4%*
Italy	9.7%	10.3%

Figure 2

PRIVATE RATE OF RETURN TO UPPER SECONDARY AND UNIVERSITY



ATTAINMENT

3.5 The private return to schooling compared with that on alternative assets

According to Dimson, Marsh and Staunton (2002), the real before-tax average annual return to equity in Italy over the 1950-2000 period was 5.2%. The real before-tax average annual return to bonds over the same period was 1.9% and to the average portfolio 3.6%. Hence, schooling appears as a very attractive investment from an individual point of view. For example, the return to upper secondary schooling exceeds the return to holding the average portfolio by 6.1% for Italy as a whole. In the South, the average return to schooling exceeds the return to the average portfolio by nearly seven percentage points. The education premium is even larger for university attainment. Accounting for taxes on capital income would increase the schooling premium further.

4 The long-term budgetary impact of schooling expenditures

Higher schooling raises future tax revenues and reduces social insurance payments. It is therefore interesting to ask about the long-term budgetary implication of public financing of schooling. Following de la Fuente, Doménech, and Jimeno (2003) we therefore calculate a *fiscal rate of return to schooling* at the macro region level. This rate of return is defined as the discount rate that equates the present value of public schooling expenditures (including an opportunity cost component as school attendance reduces current tax payments by reducing current wage income) with the present value of the increase in tax revenues and the reduction of social protection payments. It is therefore the maximum real rate of interest at which the government can borrow to finance educational expenditures without increasing the present value of future deficits. We also calculate the difference in present value terms between incremental net fiscal revenues and educational expenditures, which will be referred to as the *net present fiscal value of schooling*. Our calculations account for the effects of education on labor force participation and attempt to approximate the marginal effects of schooling on wages and employment probabilities (and therefore on tax revenues) in general equilibrium.

4.1 Methodology

De la Fuente, Doménech, and Jimeno (2003) show that the fiscal rate of return to schooling is given by

(5) $$r_f = R_f + g$$

where g is the exogenous growth rate of productivity and R_f is implicitly defined by

(6) $$\frac{R_f}{1-e^{-R_f H}} = R' \equiv \frac{D\varepsilon_q + N_1\theta + N_2\varepsilon}{(D-N_3)+\dfrac{\mu_g}{q_o}} \equiv$$

$$\frac{\left[p_o\tau_o-(1-p_o)(a+b)(1-\tau_o)\right]\varepsilon_q+\left[p_oT'-(1-p_o)a(1-T')\right]\theta+p_o\left[\tau_o+(a+b)(1-\tau_o)\right]\varepsilon}{\left[p_o\tau_o-(1-p_o)(a+b)(1-\tau_o)\right]-\left[\eta_q\eta p_o\tau_s(1-\phi)\right]+\dfrac{\mu_g}{q_o}}$$

where μ_g is public expenditures per student as a fraction of the gross wage of the representative worker and $q(S)$ the probability that a worker will be active as a function of school attainment. In particular, $q_O = q(S_O)$ is the participation rate of adult workers, $\varepsilon_q = q'(S_O)/q(S_O)$ measures the sensitivity of the participation rate to schooling and $\eta_q = q_S/q_O$ the ratio between the participation rates of full-time workers and students of the relevant attainment level. All other variables are defines as in section 3.

De la Fuente, Doménech, and Jimeno (2003) also show that the net present fiscal value of a year of schooling at a given discount rate, r_O, is approximately equal to

$$(7) \qquad NPFV(r_o) = \left[R' \frac{1 - e^{-(r_o - g)H}}{r_o - g} - 1 \right] \left[(D - N_3) + \frac{\mu_g}{q_o} \right] W_o$$

where R' is defined in equation (6) and W_O is the average gross salary of a representative full-time worker. For a detailed interpretation of (6) and (7) see de la Fuente, Doménech, and Jimeno (2003).

Our calculations maintain the assumptions of previous sections, with three exceptions. First, calculations account for the effects of schooling on labor force participation. Second, calculations will not account for pension benefit issues (and therefore eliminate social security contributions from the analysis). Finally, to approximate the general equilibrium effects of increasing educational attainment levels on wages and employment probabilities, we follow de la Fuente, Doménech, and Jimeno (2003) in multiplying the estimated value of θ by one minus the share of capital in national income and in introducing ad-hoc adjustment for the employment and participation parameters. The adjustment consists of a two-thirds reduction of the original estimates of employment and participation effects.

4.2 Results

The estimates of the fiscal rate of return and the net present fiscal value per student (which assume a real discount rate of 3%) are shown in Table 16. Both refer to a one-year increase in average educational attainment in each macro region. The calculations are done under two different scenarios: Column (1) assumes that private expenditures increase in step

with public expenditures, while column (2) assumes that all required new expenditures come from the public sector.

Table 16

FISCAL RATE OF RETURN AND NET PRESENT FISCAL VALUE PER STUDENT OF AN ADDITIONAL YEAR OF SCHOOLING BY MACRO REGION

	fiscal rate of return		net present fiscal value	
Financing =	priv	pub	priv	pub
	(1)	(2)	(1)	(2)
North West	4.3%	3.8%	3251	2191
	(0.2%)	(0.2%)		
North East	3.9%	3.6%	2102	1393
	(0.2%)	(0.2%)		
Center	4.1%	3.8%	2642	1953
	(0.4%)	(0.4%)		
South	4.8%	4.3%	3890	3018
	(0.2%)	*(0.2%)*		
Objective 1	*4.8%*	*4.4%*	*3736*	*3028*
	(0.2%)	(0.2%)		
Italy	4.6%	4.2%	3734	2937
	(0.2%)	(0.2%)		

Note: The standard errors in parenthesis have been obtained based on a bootstrap procedure with 1000 replications.

For Italy as a whole, the fiscal rate of return ranges between 4.2 and 4.6% and the net fiscal values between 2937 and 3734 euros per student, depending on the scenario.[8] Assuming that all educational expenditures are publicly financed yields regional fiscal rates of return between 3.6 (in the North East) and 4.3% in the South.

[8] De la Fuente et al. (2003) find similar results for the case of Spain.

5 The social rate of return to schooling and the optimal investment pattern

We now calculate the social return to schooling as well as infrastructure and non-infrastructure capital across macro regions . The main difference with the calculation of the private return is that the social return considers the effect of schooling on output (not wages) and ignores taxes and social benefits, as these are resource flows between the public and private sector.

The model of growth with human capital employed in the calculation is that of Ciccone (2001), which is a simplified version of the model in de la Fuente and Ciccone (2002). The simplification consists in elimination of the so-called "rate" effects, which capture the effect of schooling on technological catch-up, as there is no evidence for such effects and technological catch-up at the *regional* level in Italy. As shown in de la Fuente and Ciccone (2002), the social rate of return is given by

(8) $$r_S = R_S + g$$

where g is the rate of exogenous productivity growth at the frontier and R_S solves the following implicit equation

(9) $$\frac{R_S}{1-e^{-R_S H}} = \frac{\varepsilon + \rho}{(1-(1-\phi)\eta) + \frac{\mu}{p_o}}$$

where μ is the total direct cost of a year of schooling measured as a fraction of average output per worker and ρ is the aggregate Mincerian returns coefficient. All other parameters have the same interpretation as in the previous sections.

Our calculation of the social return to schooling assumes that the aggregate capital intensity does not respond to increased schooling (this is because our estimates of the aggregate Mincerian returns coefficient is the effect of a one-year increase in schooling on aggreate output holding the aggregate capital intensity constant, see (2)). Clearly this is an extreme scenario as increased schooling will raise the return to capital and therefore the equilibrium capital intensity in the medium and long run. We will account for this effect of aggregate schooling on the aggregate capital intensity later.

5.1 Data and sources

Tables 17 and 18 define the variables that enter the social rate of return formula and summarize the parameter values used in the calculation. As already mentioned, the social rate of return calculations account for the total effect of schooling on employment. The values of p_O, ε and η used in this section are therefore not conditional on labor force participation. Also, μ now refers to total expenditure relative to average labor productivity (rather than private relative to average full-time earnings).

Table 17

VARIABLES USED IN THE CALCULATION OF THE SOCIAL RATE OF RETURN TO SCHOOLING AND SOURCES OF THE DATA

ρ, ρ_{min} = macroeconomic Mincerian returns to schooling parameter. It measures the average (log) increase in output per employed worker resulting from an additional year of schooling of the adult population. It is obtained by dividing the estimated elasticity of output with respect to the stock of human capital *(□)* by average attainment in each region. Source: Section 2.3.

U = 59.4 = Average retirement age in 1995 in Italy, constructed by averaging separate estimates for men and women, weighted in proportion to their shares in total employment. Source: de la Fuente (2003).

S_O = average years of school attainment of the adult population (between 25 and 65 years old) in 2000. Source: LFS (2000)

H = $U - Max(6+S_O, 15)$ = estimated length of the (post-school) working life of the representative individual.

μ = total (private + public) cost of schooling per student measured relative to output per worker (weighted average of secondary and tertiary levels with weights 2/3 and 1/3 respectively). Source: Appendix A1 and Italian Institute of Statistics (www.istat.it).

p_O = total probability of employment after leaving school, taking into account the probabilities of employment and labor force participation. Estimated using the results in section 2.2.

η = correction factor capturing lower student labor force participation and employment rates. Estimated using the results in section 2.2.

$\varepsilon = p'(S)/p(S)$ = general equilibrium sensitivity of the total probability of employment to the level of schooling. Estimated using the results in section 2.2.

Table 18

DATA USED IN THE CALCULATION OF THE SOCIAL RATE OF RETURN TO SCHOOLING

	So	ρ	ρmin	μ	*po*	η	ε
North West	9.44	5.3%	4.4%	10.7%	73.1%	0.56%	0.55%
North East	9.31	5.4%	4.4%	10.9%	75.8%	1.09%	0.40%
Center	9.70	5.2%	4.2%	10.8%	69.5%	1.45%	0.96%
South	8.95	5.6%	4.6%	11.3%	54.9%	1.94%	2.49%
Objective 1	8.91	5.6%	4.6%	11.2%	53.7%	1.84%	2.58%
Italy	9.30	5.4%	4.4%	10.6%	66.3%	1.53%	1.34%

5.2 Results

Table 19 shows two alternative estimates of the social rate of return to schooling *(r_S)* across regions. The only difference between the two figures has to do with the assumed value of the level effects parameter *(β)*, which is 0.501 in the first case (baseline) and 0.411 in the other (min). According to the baseline estimates, the social rate of return to schooling ranges from 5.9% in the North to nearly 8% in the South. Under the more pessimistic assumption regarding β, the social return drops by 1% in all regions.

It is important to recall at this point that calculation of the social return to schooling in Table 19 assumes a constant aggregate capital intensity (a rather extreme scenario), which implies that these social returns should not be compared directly to private returns to schooling. To compare social and private returns to schooling, it is necessary to make assumptions about how the aggregate capital intensity responds to the increase in aggregate schooling. One such assumption would be to postulate perfect international capital markets

(another extreme scenario). In this case the calculation of the social return to schooling would have to include the effect of the induced increase in the aggregate capital intensity on output. This calculation (assuming the same parameter values as above and a physical capital income share of 30 percent) yields a social return to schooling in Italy of 9.5%.[9] Averaging the social returns of the two extreme scenarios (9.5% and 6.8%, see Table 19) yields a social return to schooling of around 8.2%. Hence, the social return to schooling in Italy does not seem to be higher than the private return to schooling. This could change of course if we were to include additional aspects of the return to schooling, like the effects of schooling on health or social capital, in the calculation (these returns are hard to quantify however, see de la Fuente and Ciccone, 2002).

Table 19

SOCIAL RATE OF RETURN TO SCHOOLING IN ITALY
(HOLDING THE AGGREGATE CAPITAL INTENSITY CONSTANT)

	Baseline	Min
North West	5.9%	4.8%
	(1.8%)	(2.5%)
North East	5.9%	4.7%
	(1.7%)	(2.7%)
Center	6.2%	5.1%
	(1.5%)	(2.1%)
South	7.8%	6.9%
	(1.8%)	(2.5%)
Objective 1	*7.9%*	*7.0%*
	(1.7%)	*(2.2%)*
Italy	6.8%	5.8%
	(1.6%)	(2.4%)

Note: The standard errors in parenthesis have been obtained based on a bootstrap procedure with 1000 replications.

[9] This value is obtained by repeating the calculation of the social returns to schooling using a macroeconomic Mincerian returns to schooling parameter $\rho^* = \rho/(1-\alpha)$ where α is the capital income share.

5.3 The relative returns to investment in schooling and in physical capital

This section compares the social return to schooling (using the *baseline* and *min* estimates) with the returns to non-infrastructure physical capital and to infrastructures (r_K and r_X). The two rates of return are calculated as $r_i = MP_i - \delta_i + g$, where MP_i is the marginal product of factor i, δ_i its rate of depreciation and g the rate of technical progress (which is assumed to be 1.5% as in the previous sections). The marginal products are calculated using the estimates of the production function in equation (2).

The main difficulty when assessing the marginal products to non-infrastructure physical capital and to infrastructures is that estimating (2) using the CRENOS infrastructure series yields different results than using the Bonaglia and Picci (2000) infrastructure series. In particular, the Bonaglia and Picci (2000) infrastructure series yields statistically significant effects of infrastructures on productivity but insignificant effects of non-infrastructure capital, while the CRENOS series produces the opposite results. To identify upper bounds on the social return to non-infrastructure capita and infrastructure, we will rely on the Bonaglia and Picci (2000) infrastructure series for the social return to infrastructure and on the CRENOS series for the social return to non-infrastructure capital.

With the Bonaglia and Picci (2000) infrastructure series and the CRENOS non-infrastructure physical capital series we find that average returns to infrastructures are larger in the North than in the South. We also find that in the South the social return to schooling exceeds that to infrastructure by more than 5% even under the most conservative (*min*) scenario. In the North and the Center the social return to infrastructures exceeds that to schooling.

Using the CRENOS infrastructure and non-infrastructure physical capital series yields an average return to non-infrastructures physical capital in Italy of 4.7%. Hence, the social return to schooling exceeds the social return to non-infrastructures physical capital even under the most conservative (*min*) scenario. We also find that the social return to schooling exceeds that to non-infrastructure physical capital by more than 4% in the South.

6. Summary

We have estimated the private (individual) and social return to schooling in Italy as a whole and four macro regions. While our contribution is centered on this (rather complex) task of measurement and estimation, there are some conclusions that seem worthwhile emphasizing (and exploring further) at this point:

1. The private (individual) return to schooling in Italy increases by around 50% when the calculation accounts for schooling reducing unemployment spells (which given Italy's low replacement rates lead to substantial income losses) in addition to increasing wages. This continues to be the case when we control for the endogeneity of individual schooling.
2. There is no evidence that the private return to schooling is lower in the South than in the North of Italy.
3. Estimates of the private return to schooling compare favorably to the return to financial assets (especially in poorer regions) suggesting that financial incentives to invest in schooling are adequate.
4. While the (mostly) public provision of schooling in Italy raises the private return to schooling, this effect is more than offset by the progressivity of the income tax. Our calculations suggest that the private return to schooling in Italy would rise if tuition reflected the social cost of schooling and taxes were proportional to income.
5. At the social level, the return to schooling exceeds the return to infrastructures for poorer regions.

Appendix[10]

A1. Expenditures on secondary and university education in 2000

Private and public expenditures per student in formal education at the upper secondary and university level can be estimated using data from different publications of the Ministry of Education, University and Research (MIUR) and the National Statistical Institute (ISTAT) (details on the data sources and the calculations can be found in Table A2). Secondary schooling includes general academic programs as well as programs that combine general academic and a more vocational education. Public expenditures are the sum of operating costs of public educational institutions (net of research expenditures by universities), indirect costs (general administration and support programs) and two types of subsidies to households: tuition waivers at the university level and subsidies to cover living expenses and other costs at the university level. Private expenditures are defined as tuition fees paid by households plus expenditures on books and school materials minus non-tuition subsidies received by them. Total expenditures are calculated as the sum of public and private expenditures.

Table A1 shows expenditures per student at the upper secondary and university level for the year 2000, combining students enrolled in private and public centers. These figures are relative to average expenditures per student in the entire country. Following de la Fuente, Doménech, and Jimeno (2003), the last three columns (under the heading Combined) approximate the cost per student of an increase in upper secondary attainment under the assumption that half of those graduating from upper secondary school will go on to university (they are weighted averages of expenditures per student at the upper secondary and university level with weights of 2/3 and 1/3 respectively). The last row of the table contains average expenditures for the whole of Italy in Euros.

[10] For the administrative-region-level data see Ciccone (2004).

Table A1

AVERAGE EXPENDITURES PER STUDENT, 2000
(WEIGHTED AVERAGE OF ALL REGIONS, ITALY= 100)

	Upper secondary			*University*			*Combined*		
	private	*Public*	*total*	*Private*	*public*	*total*	*private*	*public*	*total*
North West	111	103	104	166	112	122	141	106	110
North East	89	108	107	104	104	104	97	107	106
Center	86	103	102	91	106	103	89	104	102
South	118	94	96	83	88	87	99	92	93
Objective 1	*99*	*95*	*95*	*63*	*90*	*85*	*79*	*93*	*92*
Average, Euros	388	4999	5387	929	4408	5338	568	4802	5370

Table A2

SOURCES USED TO ESTIMATE EDUCATIONAL EXPENDITURES PER STUDENT BY REGION

Total public expenditures on secondary school for the year 1999 are taken from Ministry of Education, University and Research (MIUR) 2001, *Indicatori della spesa pubblica per l'istruzione scolastica. Anno finanziario 1999* (www.miur.it). The estimate for the year 2000 is obtained by applying the increase in aggregate education expenditures between 1999 and 2000 in MIUR 2002, *Spesa pubblica per l'istruzione, anni 1991-2000* to the 1999 figure. Regional expenditures are estimated based on the number of teachers at the regional level available in MIUR 2003, *Alunni, classi, docenti. Dalla scuola materna alle scuole superiori in Italia, 1996-2003*.

Sub-regional expenditures on secondary school for the year 2000 are taken from MIUR 2002, *La spesa per l'istruzione delle province e dei comuni, anno finanziario 2000*.

The number of enrolled secondary school students is taken from MIUR 2003, Department of Statistics, *Alunni iscritti alle scuole secondarie superiori per regione, anni 1999-2000 e 2000-2001*.

Total public expenditures on universities are calculations made by the National Committee for the Evaluation of the University System (www.cnvsu.it) based on data from MIUR 2003, Department of Statistics, *Indagine sull'istruzione universitaria anno 2000 e 2001*.

R&D expenditures are taken from Italian Institute of Statistics (ISTAT) 2003, *Lo stato dell'Università. I principali indicatori. Anno accademico 1999-2000* (www.istat.it).

Private secondary school expenditures (private secondary school, books etc.) are estimates based on ISTAT 2003, *Indagine sui consumi delle famiglie, Anno 2000*.

Private university expenditures (university fees paid at private and public universities, etc.) are taken from three different sources. Fees paid to public universities are taken from MIUR 2003, Department of Statistics, *Indagine sull'istruzione universitaria anno 2000 e 2001*. Fees paid to private universities are taken from MIUR 2003, Department of Statistics, *La contribuzione studentesca e delle altre entrate da parte degli studenti. Rilevazione 2000*. Other expenditures (books etc.) are estimated based on ISTAT 2003, *Indagine sui consumi delle famiglie, Anno 2000.*

Enrolled university students are taken from MIUR 2003, Department of Statistics, *Studenti iscritti per Ateneo. Valori assoluti, anni 1999-2000 e 2000-2001*.

Living subsidies for university students are taken from ISTAT 2003, *Lo stato dell'Università. I principali indicatori. Anno accademico 1999-2000.*

Public upper secondary school expenditures

The starting point is total public spending on upper secondary education in Italy in 2000 less public spending on upper secondary education by sub-regional administrations (*comuni* and *provincie*). These expenditures are distributed across regions in proportion to the number of secondary school teachers in each region. These regional expenditures plus upper secondary education expenditures by sub-regional administrations are equal to public secondary school expenditures at the regional level. Note that this procedure treats total public spending by regional governments like public spending by the national government. While it would have been preferable to differentiate between the two types of expenditures, this is not feasible as reliable information of public upper secondary school expenditures by regional governments seems to be unavailable. The resulting inaccuracy is likely to be very small however as public spending by regional governments amounted to only 2.3% of total public spending in 1999, the latest year for which information is available (MIUR 2001, *Indicatori della spesa pubblica per l'istruzione scolastica. Anno finanziario 1999*).

Private upper secondary school expenditures

Private expenditures on upper secondary school consist of expenditures on books and other school materials and tuition fees of students at private upper secondary schools. These are estimates using ISTAT 2003, *Indagine sui consumi delle famiglie, Anno 2000.*

Public expenditures on university education

The starting point is expenditures at the university level obtained from balance sheet data for the year 2000. These figures are aggregated to the regional level. Subtracting university R&D expenditures at the regional level and adding scholarships and non-tuition subsidies from public sources other than universities (housing and food subsidies) yields public expenditures on university education.

Private expenditures on university education

Private expenditures on university education consist of expenditures on books and other university materials and tuition fees of students at private and public universities. The starting point is income from tuition fees obtained at the university level from balance sheet data of all public universities in 2000. To these we add an estimate of fees paid to private

Universities (in this case the latest available year for which information is available is 1999). These figures are aggregate to the regional level and combined with estimates of expenditures of books and other university material obtained using ISTAT 2003, *Indagine sui consumi delle famiglie, Anno 2000.* The final figure is obtained by subtraction non-tuition subsidies from public sources other than universities (housing and food subsidies)

A2. Data used to calculate the private return to upper secondary school attainment and university attainment

Table A3

TAX AND SOCIAL SECURITY DATA USED TO CALCULATE THE PRIVATE RETURN TO UPPER SECONDARY SCHOOL AND UNIVERSITY ATTAINMENT

	Upper Secondary		*University*	
	T	τ_0	T	τ_0
North West	33.40%	29.03%	42.69%	30.85%
North East	33.50%	31.18%	42.69%	32.35%
Center	33.50%	30.80%	42.69%	32.27%
South	33.50%	30.54%	42.69%	31.79%
Objective 1	*33.50%*	*30.33%*	*42.69%*	*31.62%*
Italy	33.5%	29.22%	42.69%	30.75%

Table A4

DATA USED IN THE CALCULATION OF THE PRIVATE RATE OF RETURN TO UPPER SECONDARY SCHOOL ATTAINMENT

	μ_S	μ	p_O	p_S	η	ε
North West	2.2%	28.8%	94.6%	68.7%	72.58%	1.03%
North East	1.6%	26.5%	96.0%	84.4%	87.90%	0.57%
Center	1.5%	25.2%	92.1%	58.5%	63.58%	1.32%
South	2.3%	26.5%	77.9%	32.8%	42.08%	3.44%
Objective 1	*2.0%*	*26.1%*	*76.6%*	*30.3%*	*39.62%*	*3.53%*
Italy	1.9%	26.0%	89.50%	58.47%	65.33%	2.09%

Table A5

DATA USED IN THE CALCULATION OF THE PRIVATE RATE OF RETURN TO UNIVERSITY ATTAINMENT

	μ_S	μ	p_O	p_S	η	ε
North West	6.6%	27.5%	97.6%	76.0%	77.83%	0.52%
North East	3.9%	22.4%	97.7%	84.3%	86.22%	-0.01%
Center	3.3%	21.2%	95.6%	67.4%	70.53%	0.93%
South	3.3%	19.8%	88.1%	54.4%	61.77%	3.64%
Objective 1	*2.5%*	*19.4%*	*87.1%*	*53.0%*	*60.78%*	*3.92%*
Italy	3.8%	21.7%	95.00%	70.46%	74.17%	1.48%

A3. Average full-time earnings by regions and educational attainment

Calculations of average full-time earnings by regions and educational attainment are based on SHIW net earnings data. Gross earnings are obtained using the lower bounds of the Brandolini and Cipollone (2003) adjustment factors.[11]

Table A6

AVERAGE FULL-TIME EARNINGS BY REGIONS AND EDUCATIONAL ATTAINMENT IN 2000. EUROS.

	All Levels	Upper Secondary	University
North West	24111	23548	26766
North East	24331	24760	28392
Center	24563	26030	31004
South	23260	23377	26987
Objective 1	*23365*	*23400*	*27024*
Italy	24224	24622	28229

[11] See Section 2.1 for details.

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