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In Reflets et perspectives de la vie économique 2012/3 Tome LI , pages 73 to 83
Publisher De Boeck Supérieur

ISSN 0034-2971
ISBN 9782804175665
DOI 10.3917/rpve.513.0073
Uploaded: 10/10/2012

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Abstract – *The paper compares private returns to education by gender for 14 EU countries. Building on de la Fuente (2003), we define the rate of return as the discount rate equalizing marginal costs and benefits of education. We extend his model by estimating separately the values of the relevant parameters for men and women and introducing variables specifically related to maternity leaves and benefits. Then, we calibrate the model and we evaluate the elasticities of the returns to education with respect to some policies. In the second part of the paper, we provide some further elements of analysis concerning the returns in Italy. The three key contributions are: estimation of the Mincerian coefficients of the wage equation by gender and by region; computation of the returns to education by gender with the same geographical disaggregation; some counterfactual experiments to evaluate the impact and relevance of several public policies.*

Keywords – *economics of education, rate of returns, public policy.*
JEL Code: *I21, I24, I28*

1 INTRODUCTION

Investments in human capital have been one of the most active fields of research in both micro and macroeconomics. While investment in human capital does not reduce to investment in education, formal education is relevant due to the crucial role of public intervention.

Our analysis can be best seen as complementing a stream of literature that has implemented the model originally proposed by de la Fuente (2003) for the computation of the private (and social) returns to education. They are defined as the discount factor which rationalize the average level of education in a given sample of population as the optimal solution to the decision problem of an indivi-

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DOI: 10.3917/rpve.511.0073

dual choosing the length of his/her education taking into account its effects on the wage profile and on the employment perspectives (i.e., the elasticity of employment to education). This framework allows us to assess the comparative statics of the optimal investment with respect to a rich set of parameters which also includes policy variables such us unemployment benefits, earning taxes, and subsidies to the direct costs of education. We extend the results reported in the literature by reformulating the model to take into consideration some additional aspects which enter into the individual optimization problem, and specifically related to maternity. This allows us to disaggregate the analysis in a more meaningful way across genders.

Using estimates of the Mincerian coefficients available in the literature, we compute the private returns for men and women in 14 EU countries. By considering the full set of variables entering into the optimal investment decision of the agents, we are able to identify the impact of the wage premia, and of the other parameters. Then, using the same theoretical specification, we focus on Italy. We provide and use direct estimates of the wage premia by gender and by region. Also, we explicitly provide some results aiming to evaluate the impact of the public policies on rates of return. This is best seen as an empirical estimate of the magnitude of the comparative statics (direct) effects of the policies on the private returns.

2 GENDER AND PRIVATE RETURNS TO EDUCATION IN EUROPE

In the economic literature, human capital accumulation has been identified as one of the most relevant engines of economic growth. In the social sciences literature, human capital and (first of all) the level of formal education have often been seen as one of the most important factors affecting many dimensions of social life, including structure and dynamics of the family and fertility patterns. Moreover, changes in the skill premium affect the income distribution and inequality in the country. From the viewpoint of policy, it suffices to remember the relevance attributed by the meeting of the European Council in Lisbon (2000) to the contribution of education and training toward the stated goal to make "Europe the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion". The subsequent Report of the Education Council to the European Council, *The concrete future objective of education and training systems* (2001), states three main objectives for the 2001-2011 period: "Increasing the quality and effectiveness of education and training systems in the European Union, facilitate the access of all to the education and training systems, opening up education and training systems to the wider world". These are only some of the issues behind the active discussion on levels and dynamics of the investments on education.

Recent work by de la Fuente (2003) provides an important reference point to address these issues in economically advanced countries. The report provides an analysis of private and social returns on education in Europe. The main findings are that educational attainment is an important determinant of individual earnings and

aggregate productivity, and human capital is an attractive investment from both the microeconomic and the macroeconomic point of view. With respect to the policy implications, in all countries, the private premium is significantly larger than the social one, suggesting that an increase in general subsidies is not required.

Starting from these results, several papers have developed the analysis focusing on individual countries (de la Croix and Vanderberghe (2004), Ciccone (2004), de la Fuente et al. (2003)). All these papers provide gender-free estimates. Gender is relevant in many dimensions: disparities in earning profiles for men and women are confirmed in most of the countries; lengths of active lives, unemployment rates, rates of participation and working experience vary by gender (also because of experiences of maternal/parental leaves). Moreover, public policies can affect differently the incentive to invest in education of men and women. All these policies, in particular the initiatives promoting the reconciliation of working and family life, differ across countries, even within the E.U. and emerge as a core concern of EU policy and national governments.

While theoretical analysis has been progressing together with an increasing amount of empirical research, there are still many open issues: How does gender affect returns to education? How do public policies affect education and labour market participation? Do maternity leaves affect the investment in education?

The main purpose of this work is to start addressing some of these issues. Our analysis also tries to clarify the role and the impact of the wage premium. To this aim, we embed the Mincerian coefficients as a parameter affecting the individual optimization problem with several other parameters. Given that we are interested in the differences across gender, the basic model is modified to take into account that the actual female working experience is affected by maternity episodes and, consequently, by maternity leaves and related monetary benefits.

2.1 The model

We consider the after-tax earnings of an individual in full-time employment as an increasing function of schooling. To capture differences in the progressivity of the tax system across countries, we include both average and marginal rates of income tax. Moreover, if unemployed, individuals obtain an unemployment benefits that may be related to their previous earnings and/or to average earnings (it will depend on the unemployment system of the country). We consider the possible changes in the probability of being employed: The higher the education level, the lower the unemployment rate. This is confirmed in the data for all countries independently on the gender. We consider that, while in school, individuals devote a fraction of their time to studying and attending school. Therefore, the potential labour supply of students and their probability of being employed is lower then the one of a full time worker.

The relationship between fertility rates and education is an important component of our analysis. The (presumed) negative relation is confirmed for most countries, with average fertility rates of 1.56%, 1.28% and 1.09% for low, medium and high levels of education. To evaluate "if" and "how" this affect the private returns to

education of women, we explicitly introduce maternity and parental leave and child benefits as follows: We compute the fraction of the working life when the representative woman can spend in maternity leaves. It will depend upon the number of children, if any, and upon the length of (paid or unpaid) maternity leave allowed by law. During this fraction of her active life, a female member of the labour force can, legally, be on maternity leave. During this period, she can be either employed or unemployed. If employed, she will receive a fraction of her previous earning, γ, plus other benefits related to child care, and typically independent of personal income and depending instead on average income of the country, δ. If unemployed, her income will be determined by the unemployment benefits plus the maternity-related benefits which are, however, independent of employment, δ.

Finally, schooling also implies direct private costs. Given that, we can compute the present value of expected net lifetime earning. Then, the private rate of return to education (RRE) is the value r such that the average level of education is the optimal solution to the problem of maximizing the present value of the expected net lifetime earnings, for the representative agent, men or women, who studies for S years and retires at time U:

$$RRE = \frac{Benefits}{Costs} = \frac{\Delta W + \Delta E(+\Delta F)}{\Delta OC + \Delta DC} \quad (1)$$

Equation (1) may be easily interpreted: The denominator can be seen as the sum of the marginal opportunity, ΔOC, and direct costs of education, ΔDC. Similarly, the numerator gives the marginal effect of education on earnings. For men, this effect can be decomposed into two components: One related to the wage profile, ΔW, which is driven by the Mincerian parameter, and a second one related to the effect of education on the probability of employment and unemployment benefits on income, ΔE. A relevant role in determining ΔW is played by the tax system: The more progressive the tax system, the lower the impact of the wage premium on the RRE. In the case of women, there is a third component, ΔF, due to the effect of education on fertility and the benefits that a woman obtains if she is out of work because she is on maternity leave. Once we have obtained the values of the right-hand sides of eq (1), the values of r_w and r_m can be estimated by numerical methods (Mendolicchio and Rhein (2011)).

2.2 Comparing private returns and elasticities

To calibrate the model and compute RRE, we use the values of the relevant parameters referring to the male and female population in 14 European countries. From Table 1 we can see that for 10 out of 14 countries, r_W is larger than r_M. For men, r_M range, for most countries, between 6.5% and 11%, with an average of 8.71%. The minimum value, 5.53%, is in Sweden, while r_M exceed 12% in Portugal and UK and are over 10% in France and Ireland.

For most of the countries, r_W lie between 7% and 12%, with an average of 9.50%. They are lower than the average in Sweden (5.70%) and in Netherlands

(5.36%). For Ireland, Portugal and UK, the rates are much higher than the average: 15.55%, 12.44% and 13.85%, respectively.

Table 1: Private rates of return on education by gender, and elasticities, E_γ and E_δ

Country	r_M%	r_W%	E_γ	E_δ
AUSTRIA	8,02	7,64	- 0.0082	- 0.0301
BELGIUM*	6,43	6,64	- 0.0204	- 0.0252
DENMARK	9,27	6,88	- 0.0859	- 0.0211
FINLAND	8,51	8,30	- 0.0022	- 0.0380
FRANCE	10,29	10,92	- 0.0589	- 0.0290
GERMANY	8,29	10,16	- 0.0198	- 0.0193
GREECE	7,34	9,92	- 0.0076	- 0.0043
IRELAND	11,29	15,55	- 0.0012	- 0.0025
ITALY	6,62	7,95	- 0.0184	- 0.0021
NETHERLANDS	7,13	5.36	- 0.0448	- 0.0130
PORTUGAL	12,12	12,44	- 0.0111	- 0.0121
SPAIN	7,88	9,03	- 0.0075	- 0.0180
SWEDEN	5,53	5,70	- 0.0734	- 0.0407
UK	12,06	13,85	- 0.0017	- 0.0038
AVERAGE Coun.	8,71	9,50	- 0.0206	- 0.0133

The maternity-related policy parameters are quite different across countries. Therefore, it is natural to ask what the effect of their changes on female RRE is. Increases in the values of γ and δ, have a direct effect on the RRE, because they decrease the opportunity cost of maternity, and they have also indirect effects. Here, we will just consider the (larger) direct effects [2]. From the model, by direct computation, we obtain that both derivatives have an undefined sign. About E_δ, under weak conditions, the sign is negative, as one would expect, because increases in δ increase the opportunity cost of schooling. The estimated values of E_δ are, indeed, always negative. It turns out that $\mathbf{E}_\gamma$ is always negative too. This is somewhat counterintuitive, because one would expect a positive value for it, given that an increase in the value of $\mathbf{E}_\gamma$ increases the expected future income. However, the opportunity cost of schooling also increases. The impact of a change in the opportunity costs dominates all the others.

To interpret these results in a proper way, notice that the focus of our analysis is just on one of the possible channels for the effectiveness of these policies. In par-

2. The indirect effects depend, among other parameters, on the second derivatives. Unfortunately, the available data do not allow for any sensible conjecture on their values.

ticular, they could possibly have a quantitatively relevant impact on the choice to participate or not to the labour force. Our approach allows us to correct only partially for this endogenous decision. Moreover, the elasticities computed here measure the impact of a *monetary* change in the policy parameters. A change in the *length* of maternity leaves can have different effect.

3 A DISAGGREGATE ANALYSIS OF PRIVATE RETURNS TO EDUCATION IN ITALY

In this part, we focus on Italy and its regions. One of the key building blocks for our analysis is the estimates of the wage premium. From this viewpoint, the estimated coefficient of schooling in a Mincer wage equation has a convenient interpretation: It gives as the average percent increase in wage due to an increase in schooling, in our case an additional year of school.

Italy is characterized by significant differences in the levels of schooling attainments across geographical areas and across genders. Moreover, the peculiarity of the Italian labour market, with higher unemployment rates and lower rates of participation, give as a motivation to study the RRE in a more disaggregates analysis. Differences in participation rates may have an impact because they may introduce a selection bias in the estimates of the Mincerian coefficients. Differences in the unemployment levels may have an impact because, at the optimal solution, they contribute to determine the "weight" of the Mincerian coefficient and of the derivative of the probability to be unemployed (as a function of the level of education). For women, they also contribute to determine the "weight" of the derivative of the fertility rate as a function of education.

Our main results are provided in section 3.1, where, using the Bank of Italy dataset of 2002, we directly estimate the Mincerian equations for men and women, for arge areas and regions. On the basis of the theoretical model described in section 2.1, we use these estimates to evaluate the gender specific RRE for the same geographic areas, therefore extending previous work by Ciccone (2004) and Ciccone, Cingano and Cipollone (2006). As a result we obtained that also in our richer specification of the model, the wage premium plays, by large, the key role in determining the returns. While the impact of education, through its effects on the probability of unemployment and maternity, on the rates is fairly small. Finally, we compare the actual RRE with the artificial values computed in several hypothetical scenarios, obtained by varying the values of the policy instruments affecting the returns, therefore providing some intuition on the magnitude (and direction) of the effects of these public policies.

3.1 Estimation of the wage equation

The preliminary ingredient to evaluate the RRE is the estimation of the effect of education on the wage profile. The standard approach has been developed building on Mincer (1974). Our estimates of the Mincerian coefficients are based on

the Survey on Household Income and Wealth of 2002 (SHIW), collected by the Bank of Italy. The dataset is based on a random sample of about 8,000 households composed by 22,148 individuals and contains information about households' financial behavior and fundamental individual socio-demographic characteristics. We restrict the sample to men and women 25-65 years old, full-time, full-year employees and such that information about earnings are available. The estimation of the wage equation faces a technical difficulty related to endogeneity in the schooling variable, i.e., this variable is not exogenous and it is correlated with the error term in the earning function. The use of Instrumental Variable (IV) estimation is considered the most appropriate solution to this problem. The main difficulty is to find instruments satisfying the requirements [3]. Given the information available in the data, we couldn't find an IV satisfying the requirements (tests are available on request).

A second approach to get rid of the endogeneity bias is to introduce a proxy of the unobserved variable in the original regression. The Proxy Variable (PV) should be redundant in the structural equation, i.e., it should be irrelevant for the dependent variable in a conditional mean sense. We use the number of years of schooling of parents, i.e. father and mother education, as PV of the individual's ability. Given a sample of individuals, denoted by the subscript i, observed at time t, we proceed to estimate the econometric model

$$\log w_i(.) = \beta_0 + \theta S_i + \beta_1 x_i + \beta_2 x^2{}_i + \beta_3 S^F{}_i + + \beta_4 S^M{}_i + \beta_5 D^A{}_i + e_i \qquad (2)$$

where w_i is an earnings measure for individual i, and S_i represents a measure of his/her schooling while x_i is measure of his/her work experience, S_i^F is the education level of individual i's father, S_i^M the one of his/her mother and D_i^A is a dummy variable (equal to 0 if the individual lives in a rural area, to 1 otherwise). As usual, e_i is a zero mean error term. Most of the estimation details are available on request, while in the text we just report and discuss the main results (see Table 2).

The education effects evaluated using a PV approach are lower, or equal, to the ones obtained using the OLS. In each area the coefficient of schooling is highly significant. However, they are much less satisfactory at the level of single regions, maybe due to the (occasionally) small size of the selected samples. In order to test the sensitivity of the results, we will calibrate the model using the estimations obtained from both, OLS and PV, approaches.

A second common problem is that there may be a selection bias related to the lower participation of female to the labour market. Indeed, in Italy the rates of participation are lower for women, especially in the South of Italy. To check for the presence of a selection bias problem, we have introduced a dummy variable, D_i^A, derived using the EU definition of rural area. The intuition is that differences in the structure of the labour markets in the two different kinds of areas should induce differences in the female rates of participation [4]. While the introduction of this addi-

3. The assumption under which this method is consistent is that there exists some variable z correlated with the endogenous variable S but uncorrelated with the residual.

tional variable cannot solve the selection bias problem, our results suggest that its actual relevance is probably small. To conclude, we have also estimated the Mincerian coefficients by age cohorts. The differences in the estimated values are quite large. This could probably be explained by the increasing job opportunities for women and the differences in the experience profile across school attainments.

3.2 Calibration of the model and returns to education

Calibrating the model, we introduce different policy variables. In particular, we consider two different kinds of benefits. The first one is related to the unemployment status. The rates of unemployment enter eq (1) contributing to determine the weights of ΔE. Therefore, significant differences in the rates of unemployment for men and women and by areas could induce differences in the RRE. This problem is potentially important in Italy, due to the dis-homogeneity of the labour market conditions. Indeed, in all the regions, female rates of unemployment are larger than the male ones. In average the difference is 5%. In the regions of the South, it increases to 12%.

The second group of policy variables is specific for women and include categories: Cash benefits, δ, and maternity leave benefits, γ. We compute the total and by education fertility rate using the SHIW (2002): A negative relationship is confirmed for most of the regions (but Trentino and Toscana), with an average fertility rate of 1.62%, 1.32% and 1.09% for low, medium and high levels of education.

To include the tax system, we consider average and marginal, national and regional income taxes. We ignore the (fairly small) city additional taxes because of lack of data (see Mendolicchio (2006)).

Table 2: Wage equation estimations and private rate of returns to education

	MEN		WOMEN	
REGIONE	Wage premium	r_M%	Wage premium	r_W%
Piemonte	0,037***	4,25	0,058***	6,15
Lombardia	0,061***	7,20	0,075***	7,74
Trentino	0,056***	6,62	0,045**	5,30
Veneto	0,053***	6,28	0,070***	8,36
Friuli	0,071***	8,42	0,083***	9,83
Liguria	0,054***	6,46	0,060***	6,33
Emilia	0,063***	7,44	0,059***	7,14

4. If the problem of selection were relevant, we should observe a significant value of the coefficient of the D_i^A. However, the dummy coefficients are either not significant or significant but very small, for men and women and for all regions.

Toscana	0,062***	7,18	0,073***	8,61
Umbria	0,033***	3,29	0,066***	7,50
Marche	0,054***	6,03	0,060***	6,83
Lazio	0,057***	7,02	0,070***	7,70
Abruzzo	0,035***	3,56	0,043***	4,71
Molise	0,075***	8,47	*0,001*	-
Campania	0,046***	5,30	*0,060*	-
Puglia	0,043***	4,76	0,096***	10,59
Basilicata	0,061**	6,94	0,093**	10,43
Calabria	0,083***	9,22	0,167***	17,95
Sicilia	0,047***	5,64	0,092***	11,17
Sardegna	0,085***	9,82	0,058***	7,73
NORTH	0,055***	6,59	0,066***	7,89
CENTER	0,053***	6,30	0,067***	7,92
SOUTH	0,050***	5,75	0,068***	8,22
ITALY	0,053***	6,27	0,065***	7,81

Significant at 10%; ** significant at 5%; *** significant at 1%.
Note: The coefficients in italic are not statistically significant.
Valle d'Aosta is excluded because her coefficients are not significant for both genders.

Table 2 presents the wage equation estimations (PV) and the regional returns, by gender. Our main conclusions are that r_W% are higher for most of the Italian regions; the minimum value for men is in the South, while in this area we observe the maximum return for women. The results show that there are large variations in the effects of education across regions and across genders. While it is beyond the scope of this work to provide an in depth analysis of the factors determining the regional differences in the RRE, and the opposite behavior of men and females rates, we may at least formulate some observations.

Let's consider men. To stay on the safe side, we have better to focus the analysis on the largest regions. Among them, the highest RRE are in Emilia, Lombardia and Toscana. In Italy as a whole, men with a lower level of education are more likely to be unemployed. The average rates of unemployment in Italy are 7%, 6% and 3% respectively for low, medium and high levels of education. However, looking at the regional values, this relationships fails to hold in several regions of the North and of the Center (basically, the North-East and the regions along the Adriatic coast), where highly educated individuals actually have a lower probability to be employed. This suggests the presence, in these regions, of a mismatch between labour supply and demand at the high level of education and the possibility of over education phenomena. This is a consequence of the fact that the private industry

in Italy has been (and is) characterized by low intensity of education and this has limited the demand for highly educated worker. The picture is different when we consider women: the highest RRE are in the South. The effect of education on the probability of employment is generally positive: The unemployment rate decreases from 14% to 11% and to 7% when education increases. The obvious conjecture is that, for women, relatively high RRE are correlated with lower rates of employment. As already observed, women RRE are typically higher than the ones of men. Moreover, the difference between female and male rates is larger in the South of Italy. The rates of participation of women decrease "geographically" if we move from the North to the South: 55.7%, 50.8% and 36.8% respectively in the North, Center and South, with an average value of 47.9%. This is of interest for two reasons: First, these results could suggest the presence of some selection; second, the higher RRE for women could be due to fact that potentially less productive individuals are screened (or, given the labour market conditions, self-screen themselves) out of the labour force. However, the results that we have presented suggest that the selection bias (if any) in not strong. An alternative explanation could be the rate of employment in the public sector. Up to a very large degree, wages level and wages profiles in the public sector are determined by centralized bargaining, and are not necessarily related to the local labour market characteristics. Given that a significant share of the educated labour force is composed by public employees (for instance, teachers, health professionals, etc.), it is natural to ask if part of the differences in Mincerian coefficients (and, indirectly, in the RRE) can be explained by this factor. To explore this issue, we have run a last set of estimates introducing a dummy variable for the public sector. The relevance of the sector of employment is much higher for women than for men in all the macro areas, even more so in the South of Italy. The coefficient is still higher for women in the South of Italy but they become almost identical at the national level, 5.6% for men and 5.7% for women. his can be reinterpreted as suggesting that the selection bias problem is, in fact, not relevant. Indeed, what it appear to be more important is the composition (by sector of the employer, public vs private) of the labour demand.

3.3 Counterfactual experiments

A final exercise is to asses the impact of public policies on the rates of return to education. To do that, we run five "experiments". Firstly, we compute the RRE assuming as counterfactual the absence of unemployment benefits. Even if their effects are not very large, unemployment benefits, by increasing the opportunity cost to be employed, decrease the RRE of about 0.2% for men and 0.4% for women. Not surprisingly, this negative effect is stronger in the South. Secondly, we compute the impact of income taxes, by comparing the actual RRE to the ones obtained if there were no income taxes on wage. Income taxes turn out to decrease the RRE of about 1.2% for men and 1.1% for women. This result is intuitive and its quantitative magnitude is clearly related to the degree of progressivity of the tax system: The more progressive the tax system, the larger the negative impact on RRE. Next, we compute the impact of public financing of education, by comparing the actual RRE

with the ones that would prevail if the individuals had to bear the total cost of education. Given the structure of financing of education in Italy, the impact is high: RRE would decrease of 1.7% for men and of 2.6% for women. Considering just women, we also compute the impact of childcare policies, by comparing the actual RRE to the ones computed setting equal to zero cash and maternity benefits: The decrease of the RRE is approximately - 0.064%. Finally, we compute the RRE if there were no public intervention at all. Comparing the RRE of this "basic scenario" with the actual ones, we obtain that the second ones are higher, suggesting that the positive effects of education spending is more important than the negative effect of taxes and unemployment benefits. The full results from the counterfactual experiments are available on request. To sum up, we can conclude that an increase in unemployment benefits has a negative impact on RRE, for both genders. Concerning the tax system variables, an increase in the marginal and average tax rates has a negative impact on RRE. Finally, increase in maternity leaves and childcare benefits imply a weak decrease in women's RRE. Notice that our analysis considers just one dimension of maternity related policies: The effect on RRE and on their differences across gender. These policies may also have aims which are beyond the scope of this work, for instance to promote an increase in fertility. From this viewpoint, the small values of the elasticities presented above are reassuring in that since they suggest that they can be implemented at a fairly small cost in terms of returns to education, hence of investment in human capital.

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