

Pereira, Pedro Telhado; Martins, Pedro Silva

Working Paper

Returns to Education and Wage Equations

IZA Discussion Papers, No. 298

Provided in Cooperation with:

IZA – Institute of Labor Economics

Suggested Citation: Pereira, Pedro Telhado; Martins, Pedro Silva (2001) : Returns to Education and Wage Equations, IZA Discussion Papers, No. 298, Institute for the Study of Labor (IZA), Bonn

This Version is available at:

<https://hdl.handle.net/10419/21152>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

IZA DP No. 298

Returns to Education and Wage Equations

Pedro Telhado Pereira
Pedro Silva Martins

June 2001

Returns to Education and Wage Equations

Pedro Telhado Pereira

Universidade Nova de Lisboa and IZA, Bonn

Pedro Silva Martins

Universidade Nova de Lisboa

Discussion Paper No. 298

June 2001

IZA

P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-0
Fax: +49-228-3894-210
Email: iza@iza.org

This Discussion Paper is issued within the framework of IZA's research area *The Future of Work*. Any opinions expressed here are those of the author(s) and not those of the institute. Research disseminated by IZA may include views on policy, but the institute itself takes no institutional policy positions.

The Institute for the Study of Labor (IZA) in Bonn is a local and virtual international research center and a place of communication between science, politics and business. IZA is an independent, nonprofit limited liability company (Gesellschaft mit beschränkter Haftung) supported by the Deutsche Post AG. The center is associated with the University of Bonn and offers a stimulating research environment through its research networks, research support, and visitors and doctoral programs. IZA engages in (i) original and internationally competitive research in all fields of labor economics, (ii) development of policy concepts, and (iii) dissemination of research results and concepts to the interested public. The current research program deals with (1) mobility and flexibility of labor markets, (2) internationalization of labor markets and European integration, (3) the welfare state and labor markets, (4) labor markets in transition, (5) the future of work, (6) project evaluation and (7) general labor economics.

IZA Discussion Papers often represent preliminary work and are circulated to encourage discussion. Citation of such a paper should account for its provisional character.

ABSTRACT

Returns to Education and Wage Equations*

We show why considering a number of education-dependent covariates in the wage equation decreases coefficient of education in the wage equation. We use a meta-analysis of results for Portugal to show, empirically, that this is the case. The coefficient decreases when we use covariates that can be considered post education decisions; it is independent of the sample size, tenure and the fact of using hourly or monthly wages.

At this stage the use of the simple specification of the Mincer equation for the study of total returns to education continues to hold our support.

JEL Classification: C4, I2, J3

Keywords: Human capital, rate of return, educational economics

Pedro Telhado Pereira
Faculdade de Economia
Universidade Nova de Lisboa
Trav. Estevão Pinto
P 1099-032 Lisboa
Portugal
Fax: +351 21 387 11 05
Email: ppereira@fe.unl.pt

* Financial support from the European Commission TSER programme, under contract number SOE2-CT98-2044, is gratefully acknowledged.

1. Introduction

Although the debate over the causality of education in productivity is here to stay, politicians and the public in general have already started basing their decisions regarding amounts or percentages which families should pay for higher education on results derived from the Mincer equation. However, varying results are to be found, based upon differing specifications of the wage equation, and these have brought ever greater confusion to the issue. This paper sheds some light on the problem and addresses simple questions, such as, “why does the Mincer equation point to returns of around 10%, while other wage equations point to figures in the 3-4% range?” and, “why does the inclusion of sectors, for instance, as one of the covariates in the wage equation decrease the return to education so much?”

Education is one of the many investment decisions motivated by the fact that the investment yields a choice that one would not otherwise have. Part of the return to the investment is to be found in the set of options that emerges. An example would be the buying of shares in a firm which introduces the option of buying shares in another company.

When an individual (or his family) decides upon the amount of education to be pursued, it is understood that the education is going to bring a better paid job. The education will introduce options in other matters, as well, such as the sector and/or specific firm where the employment will ultimately be secured. Part of the individual’s return to education will be the return to subsequent choices – choices which are made in response to the options stemming from the education, itself.

An examination of the literature reveals two distinct main lines of research: the “economics of education”, which focuses on the total return to education, and “labour economics”, which seeks to explain wage differentials among individuals.

We see these two lines of research as complements and give a simple example to illustrate their differences, explain the relationship which we expect to exist between them, present the theoretical “state of the art”, and test our findings by means of a meta-analysis using data for Portugal. As our empirical analysis utilizes Portuguese data, we obtain estimates for returns to education in that country, along with a glimpse of the evolution of those estimates over time.

We proceed in the following way: in Section 2 we give a simple example to illustrate how the two lines of research differ; in Section 3 we briefly outline the numerous specification possibilities which have been used by “labour economists”; in Section 4 we show what to expect from the comparison of the results from the “labour economists” and “economics of education”; in Section 5 we present the empirical implementation (describing the characteristics of the data set used in the estimations, the estimation results, the specifications of the 86 regressions which we drew together, and the results of the meta-analysis); and in Section 6 we conclude and outline some directions for further research.

2. The paradigm of the two islands

Let us imagine that there are two islands, one (I1) with a productivity per capita of P and the other (I2) with a productivity per capita of Q, with $P < Q$. The inhabitants of the islands live an eternal life (all are born at the same moment) and maximize the present value of their production.

The inhabitants of I1 can swim to I2 if they spend one period learning to do so. The only cost is the product they forgo during that period. The discount rate is uniformly distributed between (r_1, r_2) ; $f(r) = 1/(r_2 - r_1)$.

The decision of learning to swim is made by comparing

$$\sum_{i=0}^{\infty} \frac{P}{(1+r)^i} \quad (\text{E1})$$

and

$$\sum_{i=1}^{\infty} \frac{Q}{(1+r)^i} \quad (\text{E2})$$

There is a value of r , r_c , such that $E_1 = E_2$. Let us assume that $r_1 < r_c < r_2$.

If $r < r_c$ then $E_1 < E_2$ and the individual decides to learn to swim and thereafter swims from I1 to I2.

If $r > r_c$ then $E_1 > E_2$ and the individual does not learn to swim and stays on I1.

Therefore, there will be S_1 proportion of swimmers, where

$$S! = \int_{r1}^{rc} f(r) dr$$

We end up with three groups of individuals: 1) living on island one, 2) living on island two and born there, and 3) living on island two and born on island one.

If we want to explain the differences in productivity we can do so by examining the place where the person is living (the wage equation approach). This is what the “labour economists” do.

But suppose that we are interested in studying the “returns” to education (learning to swim). We must then look at the persons born on island one and see the differentials in their productivities as the return we are looking for. This is what “economics of education” looks for. We could never find this return if we considered the place of residence as one of the explanatory variables of the productivity differential, the reason being that this covariate is a result of learning to swim for people born on island one.

We hope that this simple example illustrates the difference between wage equations where education is one of the explanatory variables and returns to education where all the indirect effects should be accounted for.

3. Theoretical background

Becker (1962) and Mincer (1974), in their breakthrough contributions for the economics of education,³ advanced a very appealing equation specification, given that it harmoniously matches inductive and deductive evidence. Drawing on moderately weak assumptions, they prove that running the following specification, $\log y = \alpha + \beta \text{educ} + \delta_1 \text{exp} + \delta_2 \text{exp}^2$, with cross-section data,⁴ β will represent the rate of return to education.⁵

The precise definition of the variables to be used remains unclear, however. Income, for instance, might be either net or gross, hourly, weekly, monthly or yearly. Furthermore, the above-mentioned equation specification has been extended on a number of occasions by the addition of several different controls seeking to explain wages differences. The efficiency wages hypothesis (see Dickens and Katz (1987), Krueger and Summers (1987,1988), Murphy and Topel (1987), Groshen (1991, 1996), Gibbons and Katz (1991), Allen (1996), Davis and Haltiwanger (1996) among others) justify the inclusion of sectors of activity, firm size and firm age. The existence of “rents” and trade unions – quasi-rent splitting – or agency models (see Freeman and Medoff (1986), Addison and Hirsch (1989), Pencavel (1991), Hart and Holmstrom (1987) and Sappington (1991) among others) justify the inclusion of the bargaining regimes. Internal wage structures (see Krueger (1993), and Lazear (1998) among others) justify the inclusion of seniority (tenure). Wage equations have been estimated using all or some of these variables in different combination.

³ See also Willis (1986) and Card (1999) for thorough surveys of the returns to education literature and Bjorklund and Kjelstrom (2000) for criticism of the Mincer specification.

⁴ y represents income, educ stands for the total years of education and exp represents labour-market experience.

⁵ The endogeneity of education in the equation has been questioned. Ashenfelter et al. (1999) “find that differences due to estimation method are much smaller than what is sometimes reported “ (abstract).

From Econometric textbooks we know that model mis-specification causes bias in the coefficients estimated (for a detailed analysis in the case of wage equations see Abowd, Kramarz, Margolis (1999)). However, if we want to see the full impact of education on wages, we have to consider the impact of education in other explanatory variables (covariates) and their effects on wages.

Some researchers have stood by the Mincer specification as a way to obtain the full effect of education on wages. But is this the correct procedure? In the next section we discuss this question.

4. Econometric discussion

Let us assume that wages depend on education (S) and other covariates, represented by an indicator (C). To make it as simple as possible, and following the Mincer specification, we have

$$\ln(\text{wage}) = b_0 + b_1 S + b_2 C$$

where $b_1 > 0$ and $b_2 > 0$ or $b_2 < 0$

Let us assume that C depends on schooling, meaning that persons with more schooling can choose the value of the other covariates and in this way choose C .

If $b_2 > 0$, people with more education will choose the largest C , and therefore there is a positive relationship between S and C .

If $b_2 < 0$, people with more education will choose the smallest C and therefore there is a negative relationship between S and C .

If we assume this relationship to be linear, we have

$C = g_0 + g_1S$ and we can then substitute in the expression above, obtaining

$$\ln(\text{wage}) = b_0 + b_1S + b_2(g_0 + g_1S) = b_0 + b_2g_0 + (b_1 + b_2g_1)S$$

and

$$\ln(\text{wage}(S + 1)) - \ln(\text{wage}(S)) = b_1 + b_2g_1$$

where

$b_1 + b_2g_1 > b_1$ under both cases, as b_2 and g_1 both have the same sign.

$b_1 + b_2g_1$ is an approximate value for the return (r) to each additional year of education

(rate of return), or to be more correct

$r = \exp(b_1 + b_2g_1)$ and this is the value that we want to “discover”

To estimate the model above we assume

$$\ln(\text{wage}) = b_0 + b_1S + b_2C + v$$

and

$$C = g_0 + g_1S + u = [1 \ S] \begin{bmatrix} g_0 \\ g_1 \end{bmatrix} + u = Xg + u \text{ where } X = [1 \ S]$$

where v and u are independently distributed random errors with zero mean.

We regress $\ln(\text{wage})$ on X

$$\ln(\text{wage}) = r_0 + r_1S + w = [1 \ S] \begin{bmatrix} r_0 \\ r_1 \end{bmatrix} + w = Xr + w$$

The estimated value is

$$\hat{r} = (X'X)^{-1} X' \ln(\text{wage})$$

and the expected value is

$$E(\hat{r}) = E[(X'X)^{-1} X' \ln(\text{wage})] = E\left[(X'X)^{-1} X' \left(X \begin{bmatrix} r_0 \\ r_1 \end{bmatrix} + Cb_2 + v \right)\right] = \begin{bmatrix} b_0 + g_0 b_2 \\ b_1 + g_1 b_2 \end{bmatrix}$$

We therefore obtain an unbiased estimator of the rate of return.

If we regress the $\ln(\text{wage})$ on X and C we obtain an unbiased estimator of b_1 , which is smaller than the rate of return.

Main conclusions:

- 1) To obtain the full effect of education on wages, one should be careful not to include in the wage equation covariates whose value can depend on the education. In the extreme case we should only regress the $\ln(\text{wage})$ in education.
- 2) If we include covariates that depend on education in the regression the coefficient of education decreases (at least in the expected value of the estimators).

4. Applied discussion

Instead of doing some data mining, in the sense of using different wage equation specifications to see what happens to the coefficient of the schooling equation, we prefer to use a meta-analysis with the results from previous studies.

A meta-analysis is basically a regression that takes as dependent variable the outcomes from different studies that focus on the same topic and employ the same general methodology. The regressors describe the characteristics (in terms of equation specification, in sample size, in year of estimation, and so on) underlying those different results and/or studies. A

meta-analysis is a useful tool then for summarizing several results on a given topic,⁶ allowing a researcher to have a global and quantifiable view on the link between the setting-up stage of a research project and its results and in the present study to see the sign of the influence of covariates in the return to education (or better, the coefficient of the education in the wage equation).

We use data for Portugal not only because the authors are Portuguese, but also, because Portugal is arguably one of the countries in Europe where wage equations have been more thoroughly researched over the last two decades. From the first known paper published on the issue -Psacharopoulos (1981)- until the recently finished 'PuRE -Public funding and private returns to education' project (Pereira and Martins (2001)),⁷ many estimates have been produced focusing on the average pay rise which rewards an extra year of schooling.

We used a stepwise estimation to choose the variables to include in the meta-analysis regression. The use of an estimated value as the dependent variable makes the model heteroskedastic, so in the regressions we corrected the estimated standard errors.

As stated previously, we are not interested in discovering the particular effect of a certain covariate in the coefficient of education (a topic for future research), but rather in seeing if including covariates decreases the value of the coefficient.

We consider only coefficients obtained from the Ordinary Least Squares methods, as the evidence from other estimation methods (for instance, Instrumental Variables) is rather rare and unstable in Portugal. We use results for males as a way of avoiding sample selection issues.

⁶ For instance, Harmon and Walker (1995) – returns to education in the U.K., Ashenfelter et al. (1999) – estimates of the schooling/earnings relationship, Groot and Brink (2000) – overeducation in the labour market.

⁷ This is a policy-focused project, tackling the relationship between education systems differentiation and labour-market outcomes. It draws together research teams from 15 European countries. The authors are members of the Portuguese team. More information at www.etla.fi/PURE.

4.a. Data description

A meta-analysis uses two kinds of data, which we label here as foreground and background data. The former is the directly-used information, which includes the coefficients of education that were obtained in different studies, and the presumably relevant characteristics of those studies. By such characteristics, we mean the regressors used, sample size, and so on. Background data, on the other hand, is simply the primary sources (data sets) used for computing the returns to education (or better, a coefficient to education). In this section, we describe both types of data.

Table 1 present the different papers/projects from which we extracted the information we used. These papers cover the main available results on returns to education in Portugal.⁸ Here one realises the overwhelming amount of varied evidence that has resulted from the PuRE project, accounting for more than half of the estimates used – 68 out of a total of 86.

---Table 1 here –

Table 2 presents descriptive statistics of the data we gathered from the above-mentioned studies. Coefficient of education – coeff - (in percentage terms⁹) range between 3.2 and 11.5 and average 9. Bearing in mind that these estimates were obtained by OLS methods, and comparing them to similar results from other European countries, these are substantially high estimates.

⁸ We restricted our attention to those results that use a single regressor for education. We disregarded those regressions that instead used dummies (each standing for a different educational level).

⁹ We mean by this, that we have multiplied the regression coefficients by 100.

---Table 2 here –

The number of explanatory variables – *explvar* - in the background regressions - (see Table 3) corresponds to the number of regressors used besides education and a constant. Two is the most common number (66%) since in most occasions only experience and experience squared were added in the regression. The maximum was 37 in the sample used.

---Table 3 here –

In the remainder of this section, we present the variables that we think can influence the results obtained in the different regressions.

First we start by the year of estimation – *year* - (see Table 4). Regressions are distributed in a balanced way, 1985 being the year which was submitted to more regressions. Attention should be drawn to the long period (19 years) which was covered by the different papers surveyed. Portuguese research in returns to education is remarkable not only in terms of the number of estimations available, but also in terms of the spread of the years covered.¹⁰

---Table 4 here --

Sample size – *ssize* - (see Table 5) is the number of observations used in each regression. Even if the smallest number is 392, 98% of the samples had more than 1000 observations and more than 80% were larger than 10,000, the largest having more than 40,000.

---Table 5 here --

The remaining controls had a qualitative nature and appear in a dummy format equal to one if the control is accounted for in the wage equation; for instance, if there was control for sectors, the dummy sector appears with the value 1 and we can see in Table 2 that almost 6% of the regressions controlled for it.

The base of comparison is a regression of a Mincer equation with hourly wages as the dependent variable and education in years and computed experience (age minus years of education minus 6) and its squared as explanatory variables, for the year of 1995.

The characteristics include: 1) Public/Private - priv, public¹¹ - (whether samples are for the individual who works in a public or in a private firm); 2) Monthly wages with control for hours - hours; 3) Monthly wages without control for hours - monthly; 4) Age instead Computed Experience (the type of labour-market participation control used); 5) PURE (if the estimates were produced in our own research);¹² 6) Interact (if the regressions took into account the possibility of interaction between education and experience).

Other controls included in the studies are: regions (regs), bargaining regime (barg), firm age (fage), firm size (fsize), firm ownership (fowner), tenure (ten) and sector. We tried to use each of these variables independently but the results were very unstable due to the high correlation between them, as authors tend to maintain a certain specification in all the regressions they present.

¹⁰ We would also like to point out that this variable was recoded, so that the intercept could have a more interesting interpretation: 0 replaced 1995, -1 was used instead of 1994, and so on.

¹¹ As we did not reject that the coefficients of these two variables were different, we created a variable privpub as the sum of the two.

¹² This is due to the fact that we made a correction in the number of years of education of one of the grades. When following up the same worker in different years we noticed that for a certain technological degree the majority of people had nine years of education and not eleven as previously considered.

As a solution to the problem of correlation we created six variables, as there are studies where: 1) only one of them appears (regs1 - if regions and ten1 - if tenure), 2) three of them appear (sum3 - regs, ten and sector), 3) four of them appear (sum4 - regs, fsize, ten, sector); 4) five of them appear (sum5 - regs, barg, fsize, fowner and ten) and 5) (sum6 - regs, barg, fage, fsize, ten, sector). As mentioned above we are interested in the sign of the effect of the use of the covariates in the coefficient of education and not in the effect of a particular control.

We now direct our attention to the so-called background data. Studies of the returns to education in Portugal draw overwhelmingly on a comprehensive Portuguese dataset: *Quadros de Pessoal* (QP, hereinafter). Every year, Portuguese firms have to submit to the Ministry of Employment information on both firm characteristics and those of their employees. This information is very rich, providing well over 25 relevant regressors.

Another attractive feature of this data set is its very large size, which obviously ensures more precise estimates. Researchers work, in most cases, with 2.5% samples (some 50,000 workers) but this figure has risen to 25% or even 100% (approximately 500,000 or 2 million observations). The main drawbacks of this data set lie in the lack of household information and the non-representative nature of workers, given that public servants, self-employed and people outside the labour market are not represented.

4.b. Results

We used a stepwise procedure to select the model, as we were interested in seeing what variables significantly affected the coefficient of education. We tested for the equality of the coefficients of public and private ownership and could not reject H_0 . The forward and backward procedure gave the same result.

The fact of considering the interaction of education with experience, monthly wages with or without control for hours, sample size and tenure (as the only additional explanatory variable) do not seem to influence significantly the coefficient of education. This is what we expected as the value of these variables are not dependent of choices due to education.

--- Table 6 here--

Interpretation of the results :

Constant. Our regression produced an intercept of 9.7%, which can be roughly interpreted as the value one would get with 1995 data considering all the other relevant variables which appear in the table equal to 0 and independent of the value of the variables which were dropped from the estimation.¹³

The 95% interval for the constant is from .0919 to .0102, more or less 0.006 around the mean. All the other coefficients are (in absolute terms) higher than this value with the exception of the coefficient of year95.

Sample Year. There is a positive relationship between the year of the data which was used and the size of the coefficient of education. In fact, all the studies that have undertaken an analysis of returns to education in different years in Portugal have come up with a clearly increasing trend. According to our results, returns increase by an average of .0009 each year, increasing almost 1% per decade. We have also tested for possible non-linearity in the evolution of returns by adding a squared year term to the equation. We did not reject the hypothesis that the coefficient is equal to zero at any reasonable significance level, so we retained the linear specification.

This result contrasts with the general idea that returns to education fall along with a country's development (on account of less-binding liquidity constraints or more generous public support schemes, for instance). In fact, this would increase the supply of skilled individuals, thus decreasing the reward of such qualification in the labour market. Of course, demand-side considerations must also be taken into account: as a country develops, one would expect that higher qualifications become more rewarded by businesses. Taking both explanations together, it would ensue that the price of labour skills would depend on the relative shifts of both the demand and the supply curves, and such a price could either fall or rise.

This scenario of having both the demand and the supply curves of skilled workers shifting outward fits the recent Portuguese economic history. On the one hand, we witness a somewhat pronounced movement of workers from labour-intensive industries to capital-intensive sectors. On the other hand, there has been a significant increase in the human capital endowments of the Portuguese workers, albeit the (still) very low average

¹³ This value is very similar to the one obtained in the sample used in the PURE study (9.6) for the 1995

educational attainment (less than seven years of schooling). It might thus be the case that the increase in demand for skilled workers whas been relatively more powerful than the corresponding increase in supply.

Age. As expected, this variable appears with a negative sign, as people do get older as they go on studying. The value of the coefficient is almost symmetric of the one obtained for experience in the Mincer equation (see Pereira and Lima 1999).¹⁴

Privpub. Usimg samples that use only public firms or only private firms has a negative effect in the coefficient of education in both cases. Further studies are needed, but a possible explanation is that the intercept (the constant) is different for both samples and compensating for different work conditions and risk of unemployment.

PURE. The positive coefficient comes as no surprise as we consider nine years of education for a group of workers for which the previous studies considered 11 years. This was only possible because we could construct panel data and after 1994 the technological degree was divided, so we could know who had 9 and 11 years of education. We saw that the large majority had only 9 years of education, so we considered 9 years for this type of education instead of the 11 years, as in other studies.

Regions. The positive coefficient of regions appears to be puzzling if we assume that the choice of the region is only based in terms of best paid jobs and people choose the region to live only after they finish their education. As there are costs of moving from region to

estimates with the standard Mincer equation.

¹⁴ It should equal if the specification was linear in experience instead of squared.

region and family ties, the sign of the coefficient can somehow explain this lack of flexibility as well as the fact that not only monetary factors influence people's decisions.

Other variables. All the other coefficients are negative, which supports the conclusion at we arrived in the previous section. They range in absolute value from 0.019 to 0.056. The highest value is obtained when the sector of activity is among the controls used in the wage equation and can reduce the coefficient of education to half of its size. This leads us to question if the choice of the sector should not be considered as part of the returns to education, and what the nature of this education/sector link is.

5. Conclusion

The use of the Mincer equation in its simpler form seems to give an approximate value for the total return to education and has been used on numerous occasions. If more covariates are used in this equation and these covariates are choice variables that depend on education, then it is shown that the coefficient of the education should go down.

This is what occurs in the meta-analysis we performed using data for Portugal. The coefficient decreases with all combinations of variables used and can drop to half of its size, especially when the sector of activity is one of the covariates used. The education-choice of sector link is an aspect that we shall investigate in the future and should reflect itself in over-education in the better paying sectors.

The increase of the return to education when regions is used as one of the covariates needs further research, as it seems to show that in the Portuguese case the mobility due to job opportunities is rare.

Sample size, the use of monthly wages instead of hourly wages, the interaction between education and experience and tenure do not seem to influence the coefficient, which shows its robustness to sample size, specification of the simple Mincer equation and variables that are independent of education.

We also find that the return to education in Portugal in 1995 is around 9.7% and increases 1% every 11 years. This increase in the returns has been going on at the same time that there is a large increase in the average education of the new workers in the labour market, perhaps indicating a large increase in the demand for skills.

There are a number of future research directions. As pointed out above the influence of education in the choice of sectors and other decisions taken after school are a starting point when we want to study the full add-up education brings to the individual. As in the case of the two islands returns to education and changes in productivity can be very distinct realities. Both worth studying but we must be able to distinguish between them.

For the time being, the use of the coefficient of education in the simpler Mincer equation as an indicator of the return to education continues to have our support as an upper bound in public discussions.

References

Abowd, J. M., F. Kramarz and D. N. Margolis (1999). High Wage Workers And High Wage Firms. *Econometrica* 67(2), 251-333.

Addison, J. T. and B. T. Hirsch (1989). Union Effects on Productivity, Profits, and Growth: Has the Long Run Arrived?. *Journal of Labor Economics* 7(1), 72-105

Allen, S. G. (1996). Technology and the Wage Structure. National Bureau of Economic Research Working Paper: 5534.

Ashenfelter, O., C. Harmon and H. Oosterbeek (1999). A Review of estimates of the Schooling/Earnings relationship, with Tests for Publication Bias. *Labour Economics* 6(4), 453-470.

Becker, G. (1962). Investment in human capital: a theoretical analysis. *Journal of Political Economy* 70 9-49.

Bjorklund, A. and C. Kjellstrom (2000). Estimating the return to investments in education: How useful is the standard Mincer equation?. *Economics of Education Review* forthcoming.

Card, D. (1999). The causal effect of education on earnings, In: O. Ashenfelter and D. Card, eds, *Handbook of Labour Economics*, vol. 3, Amsterdam: North-Holland.

Davis S. J. and J. Haltiwanger (1996). Employer size and the wage structure in the United States. *Annale d' Économie et de Statistique* 41/42, 323-368.

Dickens, W. and L. Katz (1987). Inter-industry wage differences and industry characteristics. In: K. Lang and J. S. Leonard, eds, *Unemployment and the Structure of Labor Market*, Oxford: Basil-Blackwell.

Freeman, R. B. and J. L. Medoff, (1986). The Two Faces of Unionism. In: L. G. Reynolds, S.H. Masters and C. H. Moser, eds., *Readings in labor economics and labor relations*, Fourth edition, Englewood Cliffs, N.J.: Prentice Hall.

Gibbons, R. and L. Katz (1991). Layoffs and lemons. *Journal of Labor Economics* 9(4), 351-380.

Groot, W. and H. M. van den Brink (2000). Overeducation in the Labor Market: a Meta-Analysis. *Economics of Education Review* 19(2), 149-158.

Groshen, E. (1991). Sources of intra-industry wage dispersion: how much do employers matter. *Quarterly Journal of Economics* 106(3), 869-884.

_____ (1996). American employer salary surveys and labor economics research: issues and contributions. *Annales d'Économie et de Statistique* 41/42, 413-442.

Harmon, C. and I. Walker (1995). Estimates of the economic return to schooling for the United Kingdom. *American Economic Review* 85(5), 1278-86.

Hart, O. and B. Holmstrom (1987). A theory of contracts. In: T. F. Bewley, *Advances in Economic Theory, Fifth World Congress*, Cambridge: Cambridge University Press.

Hartog, J., P. T. Pereira and J. C. Vieira (1999). Changing returns to education in Portugal during the 1980s and early 1990s: OLS and quantile regression estimators, Faculdade de

Economia da Universidade Nova de Lisboa, Working Paper 336 (forthcoming in *Applied Economics*).

Kiker, B., M. Santos and M. Oliveira (1997). Overeducation and undereducation: evidence for Portugal. *Economics of Education Review* 16(2), 111-25.

Kiker, B. and M. Santos (1991). Human capital and earnings in Portugal. *Economics of Education Review* 10(3), 187-203.

Krueger, A. (1993). How computers have changed the wage structure: evidence from microdata, 1984-1989. *Quarterly Journal of Economics* 108(1), 33-60.

Krueger, A. and L. Summers (1987). Reflections on the interindustry wage structure. In: K. Lang and J. S. Leonard, eds, *Unemployment and the Structure of Labor Market*, Oxford: Basil-Blackwell.

____ (1988). Efficient wages and the inter-industry wage structure. *Econometrica* 56(2), 259-293.

Lazear, E. P (1998). *Personnel Economics for Managers*, New York: John Wiley and Sons.

Machado, J and J. Mata (1998). Earnings functions in Portugal, 1982-1994: evidence from quantile regressions. Banco de Portugal, Working Paper 2-98.

Martins, A. (1991). Human capital earnings functions: the Portuguese case. Faculdade de Ciências Económicas e Empresariais da Universidade Católica Portuguesa, Working Paper.

Mincer, J. (1974). *Schooling, experience and earnings*. New York: National Bureau of Economic Research.

Murphy, K. M. and R. H. Topel (1987). Unemployment, risk and earnings: testing for equalizing wage differences in the labor market. In: K. Lang and J. S. Leonard, eds, *Unemployment and the Structure of Labor Market*, Oxford: Basil-Blackwell.

Pencavel, J. (1991). Higher Education, Productivity, and Earnings: A Review. *Journal of Economic Education* 22:4, 331-359.

Pereira, P. T. and F. Lima (1999). Wages and human capital: evidence from the Portuguese data. In: R. Asplund and P. T. Pereira, eds, *Returns to Human Capital in Europe – a literature review*, Helsinki; ETLA.

Pereira, P. T. and P. Martins (2001). Portugal. In: C. Harmon, I. Walker and N. W. Nielsen, eds, *Education and Earnings in Europe - a Cross Country Analysis of Returns to Education* forthcoming, Edward Elgar.

Psacharopoulos, G. (1981). Education and the structure of earnings in Portugal'. *De Economist* 129(4), 532-545.

Sappington, D. (1991). Incentives in principal-agent relationships. *Journal of Economic Perspectives* 5, 45-66.

Vieira, J. C., J. Hartog and P. T. Pereira (1997). A look at changes in the Portuguese wage structure and job level allocation during the 1980s and early 1990s. Tinbergen Institute, Discussion Paper TI 97-008/3;

Vieira, J. C. (1999). Returns to education: a comparison of alternative estimators. *Labour Economics* 6(4), 535-541.

Willis, R. J. (1986). Wage determinants: a survey and reinterpretation of human capital earnings functions. In: O. Ashenfelter and R. Layard, eds, *Handbook of Labour Economics*, Amsterdam: North-Holland,.

Tables and graphs to be inserted in the text

Table 1 – Summary of papers/projects for Portugal	
Author	Year of data used
Hartog et al. (1999)	1982,86,92
Kiker et al. (1997)	1991
Kiker and Santos (1991)	1985
Machado and Mata (1998)	1982, 94
Martins (1991)	1977
Psacharopoulos (1981)	1977
PuRE project (1998-2000)	1982-1995
Vieira et al (1997)	1982,86,92
Vieira (1999)	1986, 92

Table 2 - Descriptive statistics					
Variable	Obs	Mean	Std. Dev.	Min.	Max.
coeff	86	0.090	0.014	0.032	0.115
explvar	86	4.023	7.754	0	35
ssize	86	20333.650	9847.250	392	42347
priv	86	0.163	0.371	0	1
public	86	0.163	0.371	0	1
privpub	86	0.326	0.471	0	1
interac	86	0.047	0.212	0	1
age	86	0.058	0.235	0	1
monthly	86	0.523	0.502	0	1
hours	86	0.105	0.308	0	1
pure	86	0.791	0.409	0	1
year95	86	-7.395	4.633	-18	0
barg	86	0.186	0.391	0	1
regs	86	0.233	0.425	0	1
fage	86	0.035	0.185	0	1
fsize	86	0.198	0.401	0	1
fowner	86	0.151	0.360	0	1
ten	86	0.302	0.462	0	1
sector	86	0.058	0.235	0	1
regs1	86	0.023	0.152	0	1
ten1	86	0.093	0.292	0	1
sum3	86	0.012	0.108	0	1
sum4	86	0.012	0.108	0	1
sum5	86	0.151	0.360	0	1
sum6	86	0.035	0.185	0	1

Table 3 - Distribution of explanatory variables			
var	Freq.	Percent	Cum.
2	57	66.28	66.28
3	1	1.16	67.44
4	2	2.33	69.77
5	4	4.65	74.42
6	2	2.33	76.74
7	2	2.33	79.07
15	13	15.12	94.19
26	3	3.49	97.67
37	2	2.33	100.00

Table 4 - Distribution of years of estimates			
Year	Freq.	Percent	Cum.
1977	4	4.65	4.65
1982	6	6.98	11.63
1983	5	5.81	17.44
1984	5	5.81	23.26
1985	13	15.12	38.37
1986	8	9.30	47.67
1987	5	5.81	53.49
1988	5	5.81	59.30
1989	5	5.81	65.12
1991	7	8.14	73.26
1992	7	8.14	81.40
1993	5	5.81	87.21
1994	5	5.81	93.02
1995	6	6.98	100.00

Table 5 - Distribution of sample sizes			
Size	Freq	Percent	Cum.
0-9,999	16	18.60	18.60
10-19,999	10	11.63	30.23
20-29,999	53	61.63	91.86
30-39,999	4	4.65	96.51
>40,000	3	3.49	100.00
Total	86	100.00	

Table 6 – Regression results

Regression with robust standard errors					Number of obs = 86	
					F(7, 76) = 1096.92	
					Prob > F = 0.0000	
					R-squared = 0.8561	
					Root MSE = .00547	

coeff	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	

sum4	-.0565876	.0025434	-22.249	0.000	-.0616531	-.0515221
sum3	-.0298561	.0025596	-11.664	0.000	-.034954	-.0247583
sum6	-.0319844	.0025408	-12.588	0.000	-.0370448	-.026924
age	-.0213322	.0020636	-10.337	0.000	-.0254423	-.0172221
sum5	-.0190584	.0013552	-14.064	0.000	-.0217574	-.0163594
year95	.0008781	.0001484	5.917	0.000	.0005825	.0011737
privpub	-.0106821	.0014716	-7.259	0.000	-.013613	-.0077512
regsl	.0073823	.0031376	2.353	0.021	.0011332	.0136313
pure	.0105021	.0025631	4.097	0.000	.0053972	.0156069
_cons	.0973685	.0027364	35.583	0.000	.0919185	.1028186

IZA Discussion Papers

No	Author(s)	Titel	Area	Date
221	C. Grund	Wages as Risk Compensation in Germany	5	12/00
222	W.P.M. Vijverberg	Betitt: A Family That Nests Probit and Logit	7	12/00
223	M. Rosholm M. Svarer	Wages, Training, and Job Turnover in a Search-Matching Model	1	12/00
224	J. Schwarze	Using Panel Data on Income Satisfaction to Estimate the Equivalence Scale Elasticity	3	12/00
225	L. Modesto J. P. Thomas	An Analysis of Labour Adjustment Costs in Unionized Economies	1	12/00
226	P. A. Puhani	On the Identification of Relative Wage Rigidity Dynamics: A Proposal for a Methodology on Cross-Section Data and Empirical Evidence for Poland in Transition	4/5	12/00
227	L. Locher	Immigration from the Eastern Block and the former Soviet Union to Israel: Who is coming when?	1	12/00
228	G. Brunello S. Comi C. Lucifora	The College Wage Gap in 10 European Countries: Evidence from Two Cohorts	5	12/00
229	R. Coimbra T. Lloyd-Braga L. Modesto	Unions, Increasing Returns and Endogenous Fluctuations	1	12/00
230	L. Modesto	Should I Stay or Should I Go? Educational Choices and Earnings: An Empirical Study for Portugal	5	12/00
231	G. Saint-Paul	The Economics of Human Cloning	5	12/00
232	E. Bardasi M. Francesconi	The Effect of Non-Standard Employment on Mental Health in Britain	5	12/00
233	C. Dustmann C. M. Schmidt	The Wage Performance of Immigrant Women: Full-Time Jobs, Part-Time Jobs, and the Role of Selection	1	12/00
234	R. Rotte M. Steininger	Sozioökonomische Determinanten extremistischer Wahlerfolge in Deutschland: Das Beispiel der Europawahlen 1994 und 1999	3	12/00

235	W. Schnedler	Who gets the Reward? An Empirical Exploration of Bonus Pay and Task Characteristics	5	12/00
236	R. Hujer M. Caliendo	Evaluation of Active Labour Market Policy: Methodological Concepts and Empirical Estimates	6	12/00
237	S. Klasen I. Woolard	Surviving Unemployment without State Support: Unemployment and Household Formation in South Africa	3	12/00
238	R. Euwals A. Börsch-Supan A. Eymann	The Saving Behaviour of Two Person Households: Evidence from Dutch Panel Data	5	12/00
239	F. Andersson K. A. Konrad	Human Capital Investment and Globalization in Extortionary States	5	01/01
240	W. Koeniger	Labor and Financial Market Interactions: The Case of Labor Income Risk and Car Insurance in the UK 1969-95	5	01/01
241	W. Koeniger	Trade, Labor Market Rigidities, and Government-Financed Technological Change	2	01/01
242	G. Faggio J. Konings	Job Creation, Job Destruction and Employment Growth in Transition Countries in the 90's	4	01/01
243	E. Brainerd	Economic Reform and Mortality in the Former Soviet Union: A Study of the Suicide Epidemic in the 1990s	4	01/01
244	S. M. Fuess, Jr. M. Millea	Pay and Productivity in a Corporatist Economy: Evidence from Austria	5	01/01
245	F. Andersson K. A. Konrad	Globalization and Human Capital Formation	5	01/01
246	E. Plug W. Vijverberg	Schooling, Family Background, and Adoption: Does Family Income Matter?	5	01/01
247	E. Plug W. Vijverberg	Schooling, Family Background, and Adoption: Is it Nature or is it Nurture?	5	01/01
248	P. M. Picard E. Toulemonde	The Impact of Labor Markets on Emergence and Persistence of Regional Asymmetries	2	01/01
249	B. M. S. van Praag P. Cardoso	"Should I Pay for You or for Myself?" The Optimal Level and Composition of Retirement Benefit Systems	3	01/01
250	T. J. Hatton J. G. Williamson	Demographic and Economic Pressure on Emigration out of Africa	1	01/01

251	R. Yemtsov	Labor Markets, Inequality and Poverty in Georgia	4	01/01
252	R. Yemtsov	Inequality and Income Distribution in Georgia	4	01/01
253	R. Yemtsov	Living Standards and Economic Vulnerability in Turkey between 1987 and 1994	4	01/01
254	H. Gersbach A. Schniewind	Learning of General Equilibrium Effects and the Unemployment Trap	3	02/01
255	H. Gersbach A. Schniewind	Product Market Reforms and Unemployment in Europe	3	02/01
256	T. Boeri H. Brücker	Eastern Enlargement and EU-Labour Markets: Perceptions, Challenges and Opportunities	2	02/01
257	T. Boeri	Transition with Labour Supply	4	02/01
258	M. Rosholm K. Scott L. Husted	The Times They Are A-Changin': Organizational Change and Immigrant Employment Opportunities in Scandinavia	1	02/01
259	A. Ferrer-i-Carbonell B. M.S. van Praag	Poverty in the Russian Federation	4	02/01
260	P. Cahuc F. Postel-Vinay	Temporary Jobs, Employment Protection and Labor Market Performance	1/3	02/01
261	M. Lindahl	Home versus School Learning: A New Approach to Estimating the Effect of Class Size on Achievement	5	02/01
262	M. Lindahl	Summer Learning and the Effect of Schooling: Evidence from Sweden	5	02/01
263	N. Datta Gupta N. Smith	Children and Career Interruptions: The Family Gap in Denmark	5	02/01
264	C. Dustmann	Return Migration, Wage Differentials, and the Optimal Migration Duration	1	02/01
265	M. Rosholm M. Svarer	Structurally Dependent Competing Risks	1	02/01
266	C. Dustmann O. Kirchkamp	The Optimal Migration Duration and Activity Choice after Re-migration	1	02/01

267	A. Newell	The Distribution of Wages in Transition Countries	4	03/01
268	A. Newell B. Reilly	The Gender Pay Gap in the Transition from Communism: Some Empirical Evidence	4	03/01
269	H. Buddelmeyer	Re-employment Dynamics of Disabled Workers	3	03/01
270	B. Augurzky C. M. Schmidt	The Evaluation of Community-Based Interventions: A Monte Carlo Study	6	03/01
271	B. Augurzky C. M. Schmidt	The Propensity Score: A Means to An End	6	03/01
272	C. Belzil J. Hansen	Heterogeneous Returns to Human Capital and Dynamic Self-Selection	5	03/01
273	G. Saint-Paul	Distribution and Growth in an Economy with Limited Needs	5	03/01
274	P. J. Pedersen N. Smith	Unemployment Traps: Do Financial Disincentives Matter?	3	03/01
275	G. S. Epstein T. Lecker	Multi-Generation Model of Immigrant Earnings: Theory and Application	1	03/01
276	B. Amable D. Gatti	The Impact of Product Market Competition on Employment and Wages	5	03/01
277	R. Winter-Ebmer	Evaluating an Innovative Redundancy-Retraining Project: The Austrian Steel Foundation	6	03/01
278	T. M. Andersen	Welfare Policies, Labour Taxation and International Integration	2	04/01
279	T. M. Andersen	Product Market Integration, Wage Dispersion and Unemployment	2	04/01
280	P. Apps R. Rees	Household Saving and Full Consumption over the Life Cycle	7	04/01
281	G. Saint-Paul	Information Technology and the Knowledge Elites	5	04/01
282	J. Albrecht A. Björklund S. Vroman	Is There a Glass Ceiling in Sweden?	5	04/01

283	M. Hagedorn A. Kaul V. Reinthaler	Welfare Analysis in a Schumpeterian Growth Model with Capital	7	04/01
284	H. Rapoport A. Weiss	The Optimal Size for a Minority	1	04/01
285	J. Jerger C. Pohnke A. Spermann	Gut betreut in den Arbeitsmarkt? Eine mikroökonomische Evaluation der Mannheimer Arbeitsvermittlungsagentur	5	04/01
286	M. Fertig C. M. Schmidt	First- and Second-Generation Migrants in Germany –What Do We Know and What Do People Think	1	04/01
287	P. Guggenberger A. Kaul M. Kolmar	Efficiency Properties of Labor Taxation in a Spatial Model of Restricted Labor Mobility	3	04/01
288	D. A. Cobb-Clark	Getting Ahead: The Determinants of and Payoffs to Internal Promotion for Young U.S. Men and Women	5	04/01
289	L. Cameron D. A. Cobb-Clark	Old-Age Support in Developing Countries: Labor Supply, Intergenerational Transfers and Living Arrangements	3	04/01
290	D. A. Cobb-Clark M. D. Connolly C. Worswick	The Job Search and Education Investments of Immigrant Families	1	04/01
291	R. T. Riphahn	Cohort Effects in the Educational Attainment of Second Generation Immigrants in Germany: An Analysis of Census Data	1	05/01
292	E. Wasmer	Between-group Competition in the Labor Market and the Rising Returns to Skill: US and France 1964-2000	5	05/01
293	D. Cobb-Clark T. F. Crossley	Gender, Comparative Advantage and Labor Market Activity in Immigrant Families	1	05/01
294	Š. Jurajda	Estimating the Effect of Unemployment Insurance Compensation on the Labor Market Histories of Displaced Workers	3	05/01
295	F. Duffy P. P. Walsh	Individual Pay and Outside Options: Evidence from the Polish Labour Force Survey	4	05/01
296	H. S. Nielsen M. Rosholm N. Smith L. Husted	Intergenerational Transmissions and the School-to-Work transition of 2 nd Generation Immigrants	1	05/01

297	J. C. van Ours J. Veenman	The Educational Attainment of Second Generation Immigrants in The Netherlands	1	05/01
298	P. Telhado Pereira P. Silva Martins	Returns to Education and Wage Equations	5	06/01

An updated list of IZA Discussion Papers is available on the center's homepage www.iza.org.