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RETURNS TO HUMAN CAPITAL IN EUROPE

A Literature Review

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Preface

“Public Funding and Private Returns to Education – PURE” is a two-year EU–TSER financed research project that started on November 1, 1998. It involves as many as 15 European countries: Austria, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

The overarching objective of PURE is to study the impact of different systems of public financial support on school attendance and of differences in educational differentiation and school admission rules on observed outcomes in the labour market, in particular, in terms of private returns to education and education-related inequality in earnings. More information on the project is available at PURE’s web-site www.etla.fi/PURE

This volume is the first product of PURE. It provides a comprehensive review of the current state of knowledge in each partner country concerning rates of return to human capital in general and education in particular. This review of the existing empirical evidence on these topics thus draws a baseline for the results that will be produced within the framework of PURE.

On behalf of all partners we would like to thank DGXII of the European Commission and the TSER programme for providing funds (out of grant PL980182) to carry out the PURE project. We also want to thank Antton Lounasheimo and Pedro Martins for friendly assistance in the editorial work and Tuula Ratapalo for her excellent work in preparing the final layout of this volume for publication.

Helsinki and Lisbon, October 1999

Rita Asplund and Pedro Telhado Pereira

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CHAPTER 1

An Introduction to the Reviews

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&

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The main purpose of this book is to provide a comprehensive overview of the current state of knowledge in Europe concerning returns to human capital in general and to education in particular. The country-specific reviews cover as many as 15 European countries: Austria, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. Moreover, each review is structured in much the same way in order to facilitate cross-country comparisons.

A notable advantage of the country-specific reviews compared with previous international state-of-the-art reviews within this particular field is that they include results also from non-English-language studies, both published and unpublished. Indeed, many of the results covered in the reviews have not been previously brought before an English-speaking audience.

Needless to say, the country-specific reviews cannot aim at a "total coverage" of the area, that is, they do not necessarily report on all empirical evidence on returns to education and other forms of human capital existing for the country in question. Instead the reviewed studies largely reflect the choices and priorities of the authors. This is one reason, but definitely not the only one, for the highly varying number of studies reviewed in the 15 country-specific chapters. Another crucial reason is simply the fact that the available research results, especially on returns to education, are very rich in some countries and still very sparse in others.

1 The Mincerian wage equation

The common point of departure in the empirical research undertaken in the 15 countries is the well-established wage equation specification that was put forward by Becker (1962) and Mincer (1974)[1] and that harmoniously matches inductive evidence and deductive reasoning. Drawing on some assumptions, they prove that β will represent the rate of return to education if we run the following specification, $lnY = \alpha + \beta S + \delta_1 EXP + \delta_2 EXP^2$, with

1 See also Willis (1986) and Card (1999) for thorough surveys of the returns to education literature.

cross-section data, where S is the total years of schooling, Y measures individual wage and EXP stands for labour market experience.

Some assumptions underlying the basic Mincerian wage equation should be stressed when comparing returns to education in different countries. To our view, these assumptions are:

(1) individuals live/work for an infinite number of years;

(2) the natural logarithm of $(1+r)$ is equal to r;

(3) the only cost that people face during their studies is forgone earnings (or, alternatively, that the student pays the extra cost of studying by working part-time).

While the second and the third assumption may hold, the first assumption is definitely wrong, as people do not work for an infinite period of time. So what would the implications be of breaking each of the above assumptions?

Individuals live/work for an infinite number of years

If we assume that people work up to the same age, i.e. that individuals with one year more of study also work for one year less, this would lead to the outcome that appears in Table 1. The actual rate of increase in wages for one extra year of schooling is given by r while *iir* is the internal rate of return when people work (including extra study) for, respectively, 30, 40 and 50 years.

Table 1. Linking the rate of return to an extra year of schooling (r) to the internal rate of return (irr)

r	irr for 30	irr for 40	irr for 50	r–irr40
0.02	negative	negative	negative	
0.04	0.010	0.024	0.031	0.016
0.06	0.042	0.052	0.056	0.008
0.08	0.068	0.075	0.078	0.005
0.10	0.092	0.097	0.099	0.003
0.12	0.115	0.118	0.120	0.002

We see from the table (last column) that the difference between the actual increase in wages and the internal rate of return decreases with the magnitude of the wage increase from an extra year of schooling. Hence, for high values of *r*, breaking the assumption does not affect the results in any significant way.

However, if we break the assumption and simultaneously assume that people work for the *same* number of years[2], then the *irr* for any number of years worked will be equal to the actual increase in wages from one additional year in education (as is proved in the Appendix – Proof 1).

The natural logarithm of (1+r) is equal to r

If we look at the Taylor expansion of $ln(1+r)$, i.e. $ln(1+r) = r - r^2/2 + r^3/3 - \ldots$ we see that the only value for which $ln(1+r) = r$ is $r = 0$ given that $-1<r\leq 1$. The following table shows the value of *r* for different values of $ln(1+r)$

Table 2. The difference between r and ln(1+r)

ln(1+r)	r	r–ln(1+r)
0.02	0.020201	0.000201
0.04	0.040811	0.000811
0.06	0.061837	0.001837
0.08	0.083287	0.003287
0.10	0.105171	0.005171
0.12	0.127497	0.007497

We see from the third column of Table 2 that the difference between *r* and $ln(1+r)$ is increasing in *r* (Proof 2 in the Appendix).

The only cost people face during their studies is forgone earnings (or the extra cost of studying is paid by part-time work of the students)

This assumption may hold but, for sure, does not cover all the different realities of costs and subsidies that studying involves. In some

[2] People with one more year of education retire one year later.

countries students have to pay high tuition fees and there is little support, while in other countries the support might cover not only the extra expenses due to study but also part of the living costs.

As an example, assume that one extra year of schooling gives rise to a 10% increase in wages, that people retire after 40 years in working life, and that the extra cost of studying is a certain per cent of the forgone earnings (negative in case of subsidies). Then the following table may be constructed.

Table 3. The cost of studying in % of forgone earnings (% y_0) and the corresponding internal rate of education (irr)

% y_0	irr
100	4.51
80	5.18
60	5.99
40	6.99
20	8.27
0	10.00
-20	12.53
-40	16.69
-60	25.01
-80	50.00

From the above table we see that the internal rate of return depends a lot on the costs and subsidies people face during their studies. The same education-induced increase in wages may give rise to very different rewards to the student depending on the extent of public funding. Consequently, as the Mincerian wage equation does not account for this, comparing rates of return to education between different countries can be a meaningless task.

Let us perform a more sophisticated example by using the returns to education for males in 12 European countries[3] and an in-

[3] These returns were produced within the PURE project and are not yet published.

dicator for the support to the students as measured by the ratio of the average direct support in the form of grants/loans per student divided by the estimated cost per student in University (Daniel et al., 1999). The countries are ranked according to the estimated returns (rank 1) and to the size of the support indicator (rank 2). Finally, these two ranks are added (see Table 4).

Table 4. Comparison of country rankings according to the estimated rate of return to education for men and an support/costs indicator

	Return to education for men	Rank 1	*Indicator for support per costs*	Rank 2	Rank 1 + Rank 2
Italy (‘95)	*0.062*	2	*2*	1	3
Greece (‘94)	*0.063*	4	*2*	1	5
Spain (‘94)	*0.072*	7	*4*	3	10
Austria (‘95)	*0.069*	6	*10*	6	12
Netherlands (‘96)	*0.063*	3	*39*	10	13
Sweden (‘91)	*0.041*	1	*58*	12	13
Germany (W) (‘95)	*0.079*	9	*7*	5	14
Portugal (‘94)(‘95)	*0.097*	12	*4*	3	15
Ireland (‘94)	*0.077*	8	*18*	7	15
Denmark (‘95)	*0.064*	5	*49*	11	16
UK (’94 – ‘96)	*0.094*	11	*31*	8	19
Finland (‘93)	*0.086*	10	*37*	9	19
					Average 12.8
					Std. Dev. 4.9

Source: The estimated returns to education for men are from unpublished PURE results and the support-per-costs indicator from Daniel et al. (1999, Table V).

As expected, most high-support countries are associated with low returns to education. If the rankings were perfectly negatively correlated the sum would always be 13. From the table we see that the average is close to 13 (12.8) and most countries are in the range average plus or minus one standard deviation. Italy and Greece are exceptions at the lower end of the scale, as they stand for very low returns to education and also very low support. At the other end are Finland and the United Kingdom with very high returns and high support. (These "outliers" might be accounted for by the lack of distinction between grants and loans in our framework).

2 What do we know?

In brief, the overall picture mediated by the country-specific literature reviews is that there exist Mincer-type estimates of rates of return to an additional year of schooling for at least some years for all 15 countries. For some countries the available estimates cover a short period of time, while for others the time span stretches over several decades. In both cases, however, a common problem arises, viz. that of lacking comparability of the various estimates.

This lack of comparability is the outcome of the reviewed studies having used different data sets, model specifications and estimation techniques. The comparability of results is often further impaired by the fact that the estimated rate of return to education is merely a by-product in a research focusing on some other issue. Popular themes are overall wage determination, private vs. public sector wage differentials and gender discrimination. The consequent, often rather mixed picture of the magnitude of and the trend in the rate of return to education therefore mostly allow only cautious conclusions to be drawn when trying to summarise the empirical evidence reported in the reviewed studies.

In some countries the returns to education seem to be increasing. In other countries the trend seems to be decreasing, and in some countries no clear trend can be distinguished. For some countries the returns to education are reported to be higher in the private than in the public sector, while the reversed situation prevails in other countries. The same mixed picture across countries emerges when comparing male and female returns to education. Moreover, the estimated returns to education for a specific country may provide an equally mixed picture with contradicting results concerning the overall trend, the difference between sectors and genders, among others.

The following table reveals some of this mixture in the existing empirical evidence on returns to education. It may, nevertheless, be noted that in most countries the higher estimate is no more than twice the lowest estimate. Notable exceptions when looking at the whole-sample estimates are Greece, Italy, the Netherlands and the United Kingdom (due to the small value of the lower estimate) and Germany (due to the large difference between the lower and the upper estimate). The spread in estimates are clearly larger among females, with three additional countries having the upper estimate more than double the lower estimate, viz. Austria, France and Sweden. For the male sample the exceptions are Austria, Finland, Greece, Italy and Sweden.

Table 5. Summary of selected OLS estimates of returns to years of schooling reported in the country-specific chapters

Country	All	Females	Males
Austria	5–9	2.5–6.8	1–9.37
Denmark	2.6–4.5	1.9–3.9	3.45–6
Finland	7–9.1	7.4–10.5	4.9–11
France	4.2–8.7	8.5–19.3	8.2
Germany	5.0–14.0	6.5–13.8	11.5–12.8
Greece	3.3–7.8	2.8–9	2.3–9.2
Ireland		8.2–8.3	
Italy	2.0–5.5	1.4–3.9	2.9–6.0
Netherlands	2.4–7.0	3.9–8.6	4.4–6.5
Norway	4.0–7.0	3.2–6.3	3.9–6.3
Portugal	6.2–10	8–11.1	7–10.8
Spain	4.2–8.1	7.5–10.1	5.2–8.5
Sweden	3.9–7.8	4.3–8.9	4–8.7
Switzerland		7.4–9.1	5.5–8.3
United Kingdom		3–8.3	3–10.8

The attention paid to the return to education *per se* has varied a lot across the 15 European countries reviewed here. In some countries the only available estimates are those from a standard Mincer-type wage equation where the individuals' education is taken as exogenously given. At most the equation has been adjusted for sample selection bias or for selection into e.g. sectors when analysing sector-specific returns to education.

For other countries there are a few estimates available from attempts to treat education as an endogeous variable, that is, to account for the fact that an individual's observed education is most likely the outcome of his/her individual choice, possibly in combination with the admission rules that are typical for at least some educational fields. This endogeneity of education is usually modelled by means of ability measures and family background (instrumental variables techniques). Only exceptionally have panel data studies or twin studies been performed. On the other hand, a few of the surveyed countries display quite an impressive battery of studies on the endogeneity of educational choices.

The instrumental variables estimates of education are persistently higher (in the upper bound) than the corresponding OLS estimates. The discrepancy between the IV and the OLS estimates can, however, be the outcome of several factors that should be recognised when contrasting IV estimates against OLS estimates. These explanations are discussed in several of the chapters.

In a few countries strong interest on the topic in combination with suitable data has moved the research on educational returns one step further. Issues covered are, *inter alia*, over/undereducation, sheepskin effects and the role of screening.

3 The need for further research

The mixed evidence on returns to education both within and across countries clearly show the need for comparative analysis based on as similar as possible data sets and variable definitions, and identical model specifications and estimation techniques. In addition, the sensitivity of the estimated returns to education in various dimensions should be explored. The available evidence is rather inconclusive also when it comes to explaining the observed trends in educational returns.

Another important aspect is the degree to which country-specific differences in public funding are reflected in the observed cross-country differences in the absolute magnitude of the return to education. Equally relevant is the question of how much have eventual changes in the system of public funding affected the return to education.

The PURE project will hopefully provide an answer to these questions.

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Appendix

Statement I: If the individual works the same number of years after studying as an individual with no studies then the internal rate of return is the return to education.

Proof 1:

$y_t = y_0(1+r)^t$ wage after t periods of study

The present value (PV) of the investment in education is

$$PV = -y_0 - \ldots - \frac{y_0}{(1+i)^{t-1}} + \frac{y_t - y_0}{(1+i)^{t-1}} + \ldots + \frac{y_t - y_0}{(1+i)^{n-1}} + \frac{y_t}{(1+i)^n} + \ldots + \frac{y_t}{(1+i)^{n+t-1}} =$$
$$= PV1 + PV2 + PV3$$

where PV1 corresponds to the lost earnings during studies, PV2 to the wage differential while (s)he would be working had (s)he no education, and PV3 to the age where (s)he is still working but would not have been had (s)he not studied.

If we remember that

$$S_n = 1 + x + \ldots + x^{n-1} = \frac{1-x^n}{1-x} \text{ if } x \neq 1$$

then

$$PV1 = (-y_0)\frac{1+i}{i}\left(1 - \frac{1}{(1+i)^t}\right) = PV1a + PV1b$$

$$PV2 = \frac{y_t - y_0}{i(1+i)^{t-1}}\left(1 - \frac{1}{(1+i)^{n-t}}\right)$$
$$= \frac{y_t}{i(1+i)^{t-1}}\left(1 - \frac{1}{(1+i)^{n-t}}\right) + \frac{-y_0}{i(1+i)^{t-1}}\left(1 - \frac{1}{(1+i)^{n-t}}\right)$$
$$= PV2a + PV2b + PV2c + PV2d$$

$$PV3 = \frac{y_t}{i(1+i)^{n-1}}\left(1 - \frac{1}{(1+i)^t}\right) = PV3a + PV3b$$

Now we show that if $i=r$ then $PV=0$.

$$y_t = y_0(1+i)^t$$

and in $PV2a$ and $PV2b$

$$\frac{y_t}{i(1+i)^{t-1}} = \frac{y_0(1+i)}{i}$$

and in $PV3a$ and $PV3b$

$$\frac{y_t}{i(1+i)^{n-1}} = \frac{y_0}{i(1+i)^{n-t-1}}$$

and therefore

$$PV1a + PV2a = 0$$
$$PV1b + PV2c = 0$$
$$PV2b + PV3a = 0$$
$$PV2d + PV3b = 0$$

and adding them all we obtain the result.

Statement II: The difference between r and $ln(1+r)$ is increasing in r if $r > 0$.

Proof 2:

$a = r - ln(1+r)$

$da/dr = 1 - 1/(1+r) > 0$ if $r > 0$

CHAPTER 2

Human Capital and Earnings in Austria

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1 Introduction

In this paper we review the empirical literature on returns to human capital variables available in Austria. In Austria, only a couple of papers studying wage functions exist. Although the first paper on this topic was published in 1984, the topic disappeared from research for about 10 years.

The studies address several problems discussed in labour economics. So they differ in the population sample considered and the regression equations applied. Consequently, we are mainly interested in the robustness of the results according to various specifications. But we are also looking for differences in the regression estimates between the sub-samples examined.

The paper is organised as follows: Section 2 contains a brief description of the data sets used in various studies. We discuss estimation methods and variables entered in the regression equations in Section 3 and we compare the results in Section 4. Section 5 concludes.

2 Data sets

Most empirical studies concerning Austria's wage structure are based on micro-data from the *Mikrozensus* of the Central Statistical Office. This is a quarterly 1% household survey, which is representative for the Austrian economy. It contains detailed information on personal characteristics like sex, age, nationality, human capital, labour market status, working hours and industry affiliation. For most years no direct information on work experience and job tenure is available. The Mikrozensus has been established in 1981 and information about earnings of the dependent working population is available only every second year.

Apart from this survey information, information from administrative social security records is available *(Hauptverband der Sozialversicherungsträger)*. Here, earnings data and complete working careers for all workers in Austria are recorded – starting from 1972. As these data are kept for purposes of the social security administration only – primarily for the calculation of old age retirement pensions – many important socio-economic characteristics of workers are missing. Earnings are only recorded up to the social security contribution ceiling (censored data), education can only be constructed by the year of entry in the labour force and no family affiliation is recorded; but there is good information on vocational training (apprenticeship) which is important in Austria for blue-collar workers. So far, a 2% sample of these data has been used for the years 1972 – 1991.

3 Methods and variables

Christl (1984), Hofer and Pichelmann (1997), and Boss et al. (1997) estimate Mincerian wage equations using ordinary least squares methods. Whereas Christl (1984) investigates differences in returns to schooling across occupational groups in 1981[1], Hofer and Pichelmann (1997) are interested in whether the wage differentials between low and high skilled workers have gradually disappeared between 1981 and 1993. Returns to education for different occupational groups, especially public and private sector workers, are presented by Boss et al. (1997). Because information about female work interruptions is hardly available, Christl (1984) and Hofer and Pichelmann (1997) concentrate on male workers only. Moreover, since the proportion of men who do not participate in the labour force is negligible, they do not control for selection bias.

The dependent variable is the logarithm of (real) monthly net wages. Because monthly wages are heavily determined by hours worked, working-time adjusted earnings based on a 40 hours week were constructed in the studies mentioned above. Christl (1984) has a very parsimonious specification using only years of education, experience and experience squared as exogenous variables (see Appendix Table A1). Experience means potential experience, i.e. age – years of schooling – 6 (school starting age).

In order to get a more flexible specification, Hofer and Pichelmann (1997) as well as Boss et al. (1997) differentiate between 6

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1 Christl (1984) runs regressions for all male workers, blue-collar workers, white-collar workers, and civil servants separately.

educational categories, namely compulsory school without any higher education or vocational degree, apprenticeship, intermediate vocational school (BMS), upper vocational school (BHS), academic secondary school (AHS – upper cycle), and university (UNI). But Hofer and Pichelmann (1997) also run regressions with years of schooling instead of dummy variables to facilitate international comparisons.

Besides the human capital proxies used by Christl (1984), Hofer and Pichelmann (1997) include a dummy variable and interaction terms between this dummy variable and experience and its square to differentiate between blue-collar and white-collar workers. A vector of 8 industry dummies and a foreigner dummy complete the list of independent variables used. Information about family background, region, nationality and hours worked are used by Boss et al. (1997).

Civil servants are subject to strict salary scales, not directly related to market wages. Therefore Hofer and Pichelmann (1997), Winter-Ebmer (1995) as well as Zweimüller and Winter-Ebmer (1994) exclude civil servants from the population analysed; otherwise the estimates of returns to schooling and experience are possibly downward biased (see Table 1).

Zweimüller and Winter-Ebmer (1994) investigate gender wage differentials in private and public sector jobs in Austria in 1983,

Table 1. Data sets, observation periods and population groups considered

	Data set used	Year(s) covered	Sample
Christl (1984)	Mikrozensus	1981	all males
Zweimüller and Winter-Ebmer (1994)	Mikrozensus	1983	males and female white-collar workers
Winter-Ebmer (1995)	Mikrozensus	1983	males and females, civil servants excluded
Winter-Ebmer and Zweimüller (1996)	Social Security Records	1991	male native blue-collar workers below age 31
Boss et al. (1997)	Mikrozensus	1985-1993 pooled	males and females
Hofer and Pichelmann (1997)	Mikrozensus	1981-1993	males (15 – 54 yrs), civil servants excluded

applying Heckman's two-stage method to control both for participation decisions and sectoral choice. Their regression equation is more comprehensive compared to that of Hofer and Pichelmann (1997). Additionally, they include years of work interruption, city size, marital status, number of children, weekly working hours, regional and occupational dummies, and 6 professional position dummies in their regression equation. As professional positions are highly determined by education, on the one hand, and work experience, on the other, results with and without these dummies are presented. Work interruption is proxied by age – minimal years of schooling for a certain degree – 6 – actual experience. Regressions are run separately for four sub-populations: males in the private sector, females in the private sector, males in the public sector, and females in the public sector. Net hourly wages in logarithmic terms are used as the dependent variable constructed as: monthly net earnings divided by usual hours worked per week. Because of potentially biased estimates due to selective participation in the labour market and sectoral choice, they include two Heckman selectivity terms, which do not seem to influence the results very much, though. Boss et al. (1997) use a selectivity correction term to control for selective response rates for the income question, which does not seem to matter in the empirical results.

In estimating gender discrimination, Winter-Ebmer (1995) employs more or less the same specification as Zweimüller and Winter-Ebmer (1994). He includes concentration ratios in the labour and the product market but drops professional position dummies. Again, least squares estimates are presented using log net hourly wages as the dependent variable. As he is interested in job-lock and mobility of women, separate results for single and married persons are available.

Ichino and Winter-Ebmer (1998) focus on endogeneity of the schooling decision within an Instrumental Variables framework. As cohorts in Central Europe, who were at school age during World War II, had significantly lower educational attainment than cohorts who went to school either before or after the war, cohort information can be used as an instrument for educational attainment. As age 10 is the crucial age for high-school enrolment and further university enrolment, which depends on high-school graduation, this cohort information – being 10 to 14 years of age during the war – is used as an instrument for education. Moreover, it can be assumed that not all individuals react similarly to this instrument: only those with high liquidity constraints reduce their schooling attainment because of the war.

In accordance with the Local Average Treatment Effects (LATE) interpretation of Instrumental Variables estimates (see e.g. Angrist and Imbens, 1995), they refrain from interpreting their IV results as *average* returns to education in the population. If the instrument "being 10 to 14 during World War II" shifts the educational attainment of specific individuals only, i.e. those with liquidity constraints, the resulting returns to education should be interpreted as the average returns to education for those individuals who changed educational attainment just because of the liquidity constraints caused by the war. Because mainly individuals with potentially high returns and high liquidity constraints are likely to react, this can be considered to be an upper bound for average returns to education.[2] The authors use a very parsimonious specification: besides education, only age terms, because all other variables might be considered as endogenous themselves.

An example of the use of data from social security records is Winter-Ebmer and Zweimüller (1996). The authors regress monthly gross earnings on (constructed) years of education, apprenticeship training and detailed work experience and job tenure. As years of education are only approximated, measurement error will lead to downward biased estimates for returns to education. Moreover, due to top-coding in monthly earnings, they use a Tobit framework.

4 Results

The empirical specification of the earnings equation differs considerably across various studies, obviously depending on the specific aim of the paper. Therefore we concentrate ourselves to report only estimates for human capital proxies.

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2 See Ichino and Winter-Ebmer (1999) for an argument on how upper and lower bounds for returns to education can be approximated by using different Instrumental Variables estimators.

4.1 Returns to education

In all studies, the estimates of the educational wage premium give the expected results and are rather similar. The results are summarised in Tables 2 to 5.

Christl (1984) reports returns to education of about 9% for all males, white-collar workers, and civil servants but only 6% for blue-collar workers. The chosen human capital function explains the variance in earnings very well (adj. R^2 of about 25% for all males and white-collar workers and of 44% for civil servants). However, for blue collar workers the human capital earnings function explains only 5% of the variance around the mean. This indicates that for blue-collar workers schooling and work experi-ence are of minor importance for their earned income. Zweimüller

Table 2. Returns to education (%) – years of schooling

	Year	Years of education	
		Female	Male
Christl (1984)			
all males	1981		9.37
blue-collar	1981		6.83
white-collar	1981		8.90
civil servants	1981		9.12
Zweimüller and Winter-Ebmer (1994)			
professional position excluded			
private white-collar	1983	6.10	4.80
public white-collar	1983	5.30	5.10
professional position included			
private white-collar	1983	2.50	1.00
public white-collar	1983	3.00	2.10
Winter-Ebmer (1995)			
unmarried	1983	5.60	6.10
married	1983	6.80	6.40
Hofer and Pichelmann (1997)	1981		8.69
	1983		7.87
	1985		7.63
	1987		7.44
	1989		7.60
	1991		7.37
	1993		7.22

and Winter-Ebmer (1994) estimate returns to schooling (between 4.8% and 6.1% for male and female white-collar worker in the private sector, respectively) which are somewhat smaller. These results relate to their specification, where professional position dummies are not included in the regression equation. If included, then the estimated returns to education are dramatically lower (between 1% and 3%) indicating a high correlation between years of schooling and professional position.[3]

Hofer and Pichelmann (1997) have comparable data for both the 1980s and early 1990s. They found no increase in the education premium in this period. On the contrary, they report a decline in the returns to one additional year of education from 8.7% in 1981 to 7.2% in 1993. This is also true if schooling levels are entered as dummy variables. In particular, individuals with higher education levels lost ground as compared to persons with compulsory schooling. For example, the wage premium for a university degree has fallen from 96% in 1981 to 84% in 1993 (see Table 3a). The figures for an upper vocational school degree (BHS) are 54% in 1981 and 41% in 1993, respectively.

Table 3b reports returns to different types of schools for occupational groups (Boss et al., 1997). It has to be noted that – owing to very low enrolment rates – calculating returns to higher education for the case of blue-collar workers does not make big sense. Comparing returns for white-collars and public servants, we see that for males, returns are always higher in the private sector, whereas for females, returns are higher in the public sector for the lower schooling types, but higher in the private sector for university educated workers.

Estimated returns to education of about 5 – 6% for male as well as female private and public white-collar workers are reported by Zweimüller and Winter-Ebmer (1994).[4] Winter-Ebmer (1995) presents estimates of returns to education for married and unmarried private employees. As expected, the estimates do not differ with marital status.

3 The professional positions are: unskilled, low skilled, medium skilled, high skilled, leading, leading manager.

4 Differences in returns to education between males and females and across sectors are not statistically significant except for the difference between male and female private white-collar workers (significant at 10%).

Table 3a. Returns to education for males for different school types (%)[a]

	1981	**1983**	**1985**	**1987**	**1989**	**1991**	**1993**
Hofer and Pichelmann (1997)							
Compulsory (base)	-	-	-	-	-	-	-
Apprenticeship	10.20	09.25	11.20	11.20	11.22	11.69	11.28
BMS [b]	20.67	17.32	20.33	21.26	23.86	18.71	21.81
AHS [c]	39.08	33.94	35.70	37.89	39.21	33.71	29.74
BHS [d]	54.20	44.40	47.65	45.30	48.16	48.25	41.03
UNI [e]	95.93	88.97	83.40	84.02	83.53	82.18	84.34

Notes: [a] all estimates are transformed by (exp(β)-1) x 100
[b] intermediate vocational school (2 to 4 year courses)
[c] academic secondary school (upper cycle – 4 year courses)
[d] upper vocational school (5 year courses)
[e] university

Table 3b. Returns to education for different school types (%)[a]

	Male			**Female**		
	Blue-collar	White-collar	Civil servants	Blue-collar	White-collar	Civil servants
Boss et al. (1997)						
Compulsory (base)	-	-	-	-	-	-
Apprenticeship	13.66	13.43	6.40	5.65	6.61	14.11
BMS [b]	17.59	28.53	20.80	5.55	23.86	31.26
AHS [c]	10.63	45.35	41.76	12.19	34.04	44.20
BHS [d]	28.40	56.67	45.50	10.96	40.21	52.81
UNI [e]	7.14*	86.64	82.40	-4.02*	80.04	67.20

Notes: Observations pooled over the years 1985, 1987, 1989, 1991 and 1993, annual dummies included.
[a] all estimates are transformed by (exp(β)-1) x 100
[b] intermediate vocational school (2 to 4 year courses)
[c] academic secondary school (upper cycle – 4 year courses)
[d] upper vocational school (5 year courses)
[e] university
* not significant

The results by Ichino and Winter-Ebmer (1998) use a very crude measure for educational attainment: having completed high school or not. Using this measure, they find that those with lower education command 40% lower wages according to the OLS regression. In the IV-LATE framework wages are 61.2% lower for workers who did not finish high school because of the war. As this is the only IV result for Austria, which is relatively difficult to compare with the other estimates, it can be assumed that returns to education estimated by Instrumental Variables are approximately 50% higher than those measured by OLS.

4.2 Returns to apprenticeship training

Table 4 summarises the estimates of returns to apprenticeship training. The estimates of the various studies are quite different and they range between 1.6% (female white-collar workers in the private sector) and 13.7% (male blue-collar workers).

Table 4. Returns to apprenticeship training (%)[a]

	Year	Female	Male
Zweimüller and Winter-Ebmer (1994)			
professional dummies excluded			
private white-collar	1983	1.61*	2.12*
public white-collar	1983	-1.58*	2.94*
Winter-Ebmer (1995)			
unmarried	1983	3.25*	12.18
married	1983	4.92*	7.47
Winter-Ebmer and Zweimüller (1996)			
blue-collar below age 31	1991		13.31
Hofer and Pichelmann (1997): see Table 3a			
Boss et al. (1997): see 3b			

Notes: [a] all estimates are transformed by (exp(β)-1) x 100
* insignificant estimate

According to Hofer and Pichelmann (1997), who investigate returns to education for private sector male workers, apprenticeship training leads to a 9.3 – 11.1% wage premium relative to individuals who hold only compulsory education (see Table 3a). This figure is in accordance with estimates presented by Winter-Ebmer (1995) for married and unmarried male workers (private sector), Winter-Ebmer and Zweimüller (1996) for blue-collar workers below age 31, and Boss et al. (1997) for blue- and white-collar male workers employed in the private sector (see Table 3b). However, estimates of returns to apprenticeship training for females working in private enterprises are quite low compared to their male counterparts (6% vs. 13% in Boss et al., 1997). This may be a consequence of segregation in apprentice recruitment. Whereas men enter an apprentice position with good chances of a craftsman career, more women enter dead-end education, where they have to change occupation after the completion of the apprenticeship.

Boss et al. (1997) also publish estimates of returns to apprenticeship training for male and female civil servants. In the public sector, females holding an apprenticeship degree can command 14.1% higher wages compared to those who hold only compulsory education. The corresponding figure for males is only 6.4%, which is unusually low. Moreover, Zweimüller and Winter-Ebmer (1994) report estimates for white-collar workers (males and females) which are dramatically lower (about 2%). Indeed, these estimates are not significant. These large differences in estimates of returns to apprenticeship training are quite unsatisfactory, since no explanations could be proposed. Therefore more research effort should be devoted to this area.

4.3 Returns to experience

In all studies, the estimated earnings-experience profiles are concave as human capital theory predicts. Table 5 reports estimates for returns to experience and experience squared. Note that the results for Christl (1984), Hofer and Pichelmann (1997), and Boss et al. (1997) relate to potential experience, whereas the studies by Zweimüller and Winter-Ebmer (1994), Winter-Ebmer (1995), and Winter-Ebmer and Zweimüller (1996) relate to actual years of work experience.

Christl (1984) and Hofer and Pichelmann (1997) estimate returns to experience for male blue-collar and male white-collar workers in 1981. As expected, both studies report an earnings-experience profile which is flatter for blue-collar workers than for white-collars. According to their results, blue-collar workers (white-collar workers) can expect the highest returns to experience after 26 – 31 (27 – 30) years.

Various studies report quite a different shape of earnings-experience profiles. The profiles estimated by Christl (1984) and Zweimüller and Winter-Ebmer (1994) are flatter and less concave than those presented by Hofer and Pichelmann (1997). Whether these differences are attributable to the more flexible specification applied by Hofer and Pichelmann (1997) requires further research (see Card (1998) for a discussion for using credentials vs. schooling years).

Considering the development of returns to experience between 1981 and 1993, Hofer and Pichelmann (1997) observe a small tendency to a flatter profile for both groups.

Gender differences in rewards for experience can be seen from Zweimüller and Winter-Ebmer (1994) and Winter-Ebmer (1995). In the private sector, years of experience are more honoured for males (3.2%) than for females (2.1%) in the early stages of their working lives. In the public sector, no differences in the returns for experience are detected. Again, estimates for returns to experience are generally lower if professional position dummies are included, but the same picture concerning discrimination by gender appears.

4.4 Returns to tenure

Information about job tenure is hardly available in Austria. Only Winter-Ebmer and Zweimüller (1996), who use information from administrative social security records, investigate tenure induced wage effects by including years of tenure and its square in their regressions. They report returns to tenure only for male blue-collar workers below age 31. For this group a convex earnings-tenure profile is found, with falling returns to tenure at the beginning of the career with a firm. This result seems to be at odds with human capital theory, but can be explained by the prevalent job-hopping and job-matching behaviour of this group of very young workers.

Table 5. Returns to experience (%)

	Year	Experience		Experience Sq.	
		Female	Male	Female	Male
Christl (1984)					
all males	1981		3.02		-0.05
blue-collar	1981		1.89		-0.03
white-collar	1981		4.26		-0.07
civil servants	1981		2.26		-0.02
Zweimüller and Winter-Ebmer (1994)					
professional position excluded					
private white-collar	1983	2.10	3.20	-0.02	-0.05
public white-collar	1983	1.90	2.10	-0.02	-0.02
professional position included					
private white-collar	1983	1.80	2.80	-0.02	-0.04
public white-collar	1983	1.90	2.10	-0.02	-0.02
Winter-Ebmer (1995)					
unmarried	1983	3.10	2.80	-0.07	-0.05
married	1983	0.20	1.60	-0.00	-0.03
Winter-Ebmer and Zweimüller (1996)					
blue collar below age 31	1991		7.60		-0.50
Boss et al (1997)					
all workers		2.30	2.40	-0.04	-0.04
blue-collar workers	1985-	0.90	1.90	-0.02	-0.03
white-collar workers	1993	3.20	3.70	-0.06	-0.05
civil servants	pooled	2.30	2.00	-0.03	-0.02
Hofer and Pichelmann (1997)					
blue-collar	1981		4.68		-0.09
	1983		4.69		-0.09
	1985		5.07		-0.10
	1987		4.48		-0.08
	1989		4.26		-0.08
	1991		3.90		-0.07
	1993		4.02		-0.07
white-collar	1981		6.53		-0.12
	1983		6.35		-0.11
	1985		6.57		-0.12
	1987		6.76		-0.10
	1989		6.83		-0.10
	1991		6.30		-0.09
	1993		5.40		-0.09

In an earnings change equation (over a period of 3 years), positive returns to tenure between 0.6 and 1% are found, if the change of employer and the change of industry in this 3-year period is controlled for.

5 Conclusion

In this paper we reviewed various Austrian studies with regard to their estimates of standard human capital proxies. All estimates (except the estimate for tenure) are in accordance with theory and show the expected sign. Returns to schooling lie in a range from 5% to 9%. They are higher for instrumental variables estimates. However, if occupational dummies are included the estimates are dramatically lower.

With respect to returns to experience, all studies found concave earnings-experience profiles. The estimates are difficult to compare, since different data sets might observe workers at a different point in their work career, and thus the concave wage pattern might be differently approximated by a quadratic profile. But at a first glance, earnings-experience profiles of employees in the public sector as well as those of married people are flatter and less concave.

Estimates of returns to apprenticeship training are more diverse. Whereas non-governmental male workers holding an apprenticeship degree can command a wage increase of up to 13%, the premium for female workers is only 6%. However, this picture is reversed for civil servants, honouring apprentice training with a 14% wage premium for females but only with a 6% wage increase for males. Tenure induced wage effects have hardly been investigated in Austria.

Generally, in Austria no comprehensive study concerning human capital variables and private returns exists. The various studies described above differ substantially in the questions addressed and the samples used to estimate the parameters of different wage equations, so that the results are sometimes hard to compare. Moreover, most studies use data for only one year. So there is a need for a lot of further research in this field, which comprises all aspects concerning human capital and earnings.

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Appendix

Table A1. Applied research on returns to education in Austria: variables included

	Christl (1984)	Hofer/ Pichelmann (1997)	Boss et al. (1997)	Zweimüller/ Winter-Ebmer (1994)	Winter-Ebmer (1995)	Winter-Ebmer/ Zweimüller (1996)
Years of Education	x			x	x	x
Levels of Education		x	x			
Experience	potential	potential	potential	actual	actual	actual
Experience Squared	x	x	x	x	x	x
Blue collar/ White collar	x	x	x			
Professional Status			x	x/-*		
Working Hours			x	x	x	
Sector Public/ Private				x		
Region			x	x	x	x
City Size				x	x	x
Sector of Industry		x		x		x
Marital Status/ Children			x	x	x	
Work Interruption				x		
Apprentice Training				x	x	x
Seasonal Occupation				x	x	
Foreigner		x		x	x	x
Tenure/ Tenure Squared						x
Unemployment rate						x
Select. Bias Correction			x	x	x	x

Note: * Regressions are run with and without professional status.

CHAPTER 3

Wages and Human Capital: The Danish Evidence

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&

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1 Introduction to the research

The purpose of this introduction is partly to provide an introductory and formal presentation of the studies reviewed in this paper, and partly to outline the objective of each study. The studies reviewed are: Asplund et al. (1996a), Asplund et al. (1996b), Pedersen et al. (1990), Smith and Westergård-Nielsen (1988), and Bingley and Westergård-Nielsen (1997). The first two studies are part of a cross-country comparison of the Nordic countries[1], whereas the last three solely analyze the Danish labour market. The unit of observation for all studies is the individual, and the theoretical approaches are, in a broad sense, all based on various and augmented specifications of the standard human capital earnings function as proposed by Mincer (1974).[2] However, the objectives of the studies differ to some extent. Thus, where Asplund et al. (1996a) focus on the wage distribution (due to experience, education, occupation, etc.) across individuals in general, the target of Asplund et al. (1996b) along with Smith and Westergård-Nielsen (1988) is the wage differentials due to gender alone. Likewise, Pedersen et al. (1990) specifically focus on wage differentials between individuals employed in the private and public sectors. Finally, the objective of Bingley and Westergård-Nielsen (1997) is to estimate the size of demand induced firm wage determinants, while accounting for individual worker supply wage determinants. Primarily due to the fact that the results obtained in Asplund et al. (1996a), Asplund et al. (1996b), and Bingley and Westergård-Nielsen (1997) are based on the most recent data, there is reason to put emphasis on the empirical findings of these three studies.

2 Data

Table 1 provides a survey of the data sets used in the five studies. Common to the studies is partly that the estimations are based on data drawn from administrative registers (which ensures a high de-

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1 *The Nordic Labour Markets in the 1990´s*, edited by E. Wadensjö (1996).

2 $\ln W = \beta_0 + \beta_1 \cdot S + \beta_2 \cdot EXP + \beta_3 \cdot EXP^2 + \varepsilon$. The specific definitions of the wage variable (W), the schooling variable (S), and the experience variable (EXP) emerge from Section 3.

gree of accuracy and reliability), and partly that the samples are relatively large. Four out of the five studies are based on DLDB (*Danish Longitudinal DataBase*), which is a representative 1% sample of the population; i.e. of individuals aged 16 – 75.[3] The study by Bingley and Westergård-Nielsen (1997) is, however, based on a sample of IDA (*Integrated DataBase for Labour Market Research*), which contains information on *all* private sector establishments (app. 230,000) *and* the entire population of individuals in Denmark (app. 5,2 million).

Table 1. Data sets used

STUDY	DATA
Asplund et al. (1996a)	DLDB (*Danish Longitudinal DataBase*). Representative 1% sample of the population in the age group 16-75 covering the years 1976 to 1990 (around 30,000 – 40,000 observations each year). All information is drawn from administrative registers and is provided by Statistics Denmark. In this specific study, estimations are based on the 1990 observations of individuals in the age group 16-64 (around 22,000 observations).
Asplund et al. (1996b)	As in Asplund et al. (1996a).
Smith and Westergård-Nielsen (1988)	Sub-sample of DLDB (see above). Consists of 6,536 individuals observed, on average, over 6,16 years.
Pedersen, Schmidt-Sørensen, Smith, and Westergård-Nielsen (1990)	Sub-sample of DLDB (se above). Consists of 5,557 individuals observed, on average, over 7,95 years.
Bingley and Westergård-Nielsen (1997)	IDA (*Integrated DataBase for Labour Market Research*). Created by Statistics Denmark. IDA contains information on labour market conditions for the total population of individuals and establishments in Denmark over the years 1980-1991. The information originates from various administrative registers and is merged by Statistics Denmark. A representative sub-sample containing information on 1,400 private sector firms and all of their employees over 11 years is used in this specific study.

3 Today, DLDB is officially called LLMR (*Longitudinal Labour Market Register*).

3 Variables

According to Table 2, which summarizes the variables included, both human capital variables as well as several other variables (in order to control for geographical factors, firm specific factors, worker specific factors, etc.) are used in the estimations of the five studies reviewed. As opposed to most human capital studies conducted in other countries, the variables *Age* and *Log working hours* are not included in any estimations of the wage function. *Age* is not included due to the access of rather accurate work experience data provided in the registers of the supplementary pension system (ATP), and *Log working hours* is not a relevant explanatory variable, since *Wage* (hourly) is calculated directly from the annual wage and the amount of hours worked in a year (also provided in the registers of ATP). In addition, it should be stressed that the dependent variable in all studies is *Log (gross) hourly wage*, i.e. the hourly wage rate *before* taxes. Due to the relatively small size of the Danish labour market, a dummy for *Province,* which takes the value of 1 when the wage earner lives outside the Greater Copenhagen area, is replacing the variable *Region*. The *Occupation* variable distinguishes between *Salaried employees* (upper, intermediate, and assistant), *Skilled workers*, *Unskilled workers*, and *Other workers*. The schooling variable is generally measured by the length (in years) of the highest attained vocational training and formal education beyond basic school (9 years), but Asplund et al. (1996a) also estimate the wage function using *levels* of education.[4]

As indicated above, the access to relatively accurate register data has allowed the use of *Actual experience* at the expense of *Potential experience / Mincer experience* (Age – S – school starting age). Consequently, *all* estimations are based on *Actual experience.* Finally, three out of five studies include variables to correct for selection bias (see notes in Table 2). The method used is Heckman's correction (Heckman, 1979).

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4 This approach can be used to evaluate whether the relationship between years of schooling and log wage is in fact linear (as in the Mincer approach).

Table 2. Applied research on return to education in Denmark: Variables included[a]

	Asplund et al. (1996a)[b]	Asplund et al. (1996b)[b]	Smith and Westergård-Nielsen (1988)	Pedersen et al. (1990)	Bingley and Westergård-Nielsen (1997)
Education (years)	x	x	x	x	x
Education (level)	x	-	-	-	-
Experience[h]	x	x	x	x	x
Experience squared	x	x	x	x	x
Tenure/seniority	x	-	-	-	x[g]
Occupation[c]	x	x	x	x	-
Sector (public/ private)	x	x	x	x	-
Firm size	-	-	-	-	x
Region	-	x	x	x	x
Sector (industry)	-	x	x	-	x
Other	-	x	x	x	x
Select. bias correc.	-	x[d]	x[e]	x[f]	-

Notes: [a] Not necessarily in the same estimation at the same time. All estimations use gross hourly wage.

[b] Part of a Nordic cross-country comparison (The Nordic Labour Markets in the 1990´s. Edited by E. Wadensjö, 1996).

[c] Occupation (Upper level sal. emp., Intermediate sal. emp., Assistant sal. emp., Skilled workers, Unskilled workers, and Other).

[d] Correction due to the exclusion of non-participants in the labour market.

[e] Correction for censoring due to confidentiality regarding wages higher than DKK 200,000 (1976-1980), DKK 220,000 (1981-1984).

[f] Correction due to individuals who work less than full time *and* correction for censoring due to confidentiality regarding wages higher than DKK 200,000 (only 1976-1980).

[g] Newcomers (Tenure proxy).

[h] Measured/actual experience.

4 Estimation techniques and central results

Even though all studies are, more or less, based on standard OLS estimations, there are a few exceptions depending on the specific aim of each study.[5] The intention of this subsection is to briefly describe the estimation techniques used in the studies, and to report the central results (summarized in Tables 3, 4, 5, 6, and 7) along with comments on the most striking similarities and dissimilarities. First and foremost, we focus on the "core variables" of the Standard Mincer specification, i.e. *Schooling* (years), *Experience*, and *Experience squared*. In addition to these core variables, some comments will be attached to the empirical findings in terms of returns to *Levels of education* and addition of variables to control for firm and worker specific factors (4.2).

4.1 Returns to education (years) and experience

The overall (restricted) 1990 cross-section OLS estimates of returns to education and experience in Asplund et al. (1996a) are 0.045 and 0.017, respectively (Tables 3 and 4), and the return to experience is clearly bell-shaped (Table 5), i.e. the coefficient of experience squared is negative (-0.00023). However, for ease of exposition we have chosen only to report the linear experience term, i.e. the return to an individual at the time of entry into the labour market. The squared experience term of each estimation appears from Table 5.[6] An OLS estimation run separately for men and women (unrestricted) leads to rather different estimates, both in terms of returns to education and returns to experience. Thus, the returns to education and experience for men are 0.051 and 0.025, respectively, whereas the same coefficients for women are 0.034

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5 In order to avoid any likely correlation between schooling and the unobserved effects from ability and motivation, Pedersen et al. (1990) only report returns to schooling based on instrumental variable estimation. Note that when using OLS, it is implicitly assumed that the error term (ε) of the regression equation (see footnote 2) is independent and normally distributed with fixed variance σ^2.

6 Due to the log specification, the coefficients (when multiplied by 100) approximately equal the percentage returns. Thus, $100(e^{(coefficient)} - 1)$ = percentage return. Furthermore, the correct calculation of returns to experience is taking the squared term into account. Thus, the marginal return to experience for a person with 10 years of experience (EXP=10) in Asplund et al. (1996a) is 0.017 – 2*0.00023*EXP = 0.012, corresponding to a percentage return of $100(e^{0.012}-1)$ = 1.21%. Consequently, Table 4 gives the estimated return to experience for a person with no experience (EXP=0), i.e. the squared term has not been taken into account.

Table 3. Wage equations: Returns to education (years)

STUDY	YEAR	SECTOR	Coefficient[b] Female	Male	All
Asplund, Barth, Le Grand, Mastekaasa, Westergård-Nielsen (1996)	1990	*Public* & *private* *Public* *Private*	0.0342 0.0356 0.0387	0.0508 0.0503 0.0591	0.0449 - -
Asplund, Barth, Smith, Wadensjö (1996)[c]	1990	*Public* & *private*	0.0240	0.0360	-
Smith and Westergård-Nielsen (1988)	1976-1984	*Public* & *private*	-	-	0.0260
Pedersen, Schmidt-Sørensen, Smith, Westergård-Nielsen (1990)[a]	1976-1985	*Public* *Private*	0.0190 [-0.0030]	0.0595 0.0422	- -
Bingley and Westergård-Nielsen (1997)[c]	1981-1991	*Private*	0.0238	0.0345	-

Notes: The numbers in brackets are not significant at any reasonable level. [a] Instrumental variable (IV) estimates. [b] See footnote 6. [c] Estimated returns from a model which includes several control variables.

Table 4. Wage equations: Experience (years)

STUDY	YEAR	SECTOR/ OCCUPATION	Coefficient[a] Female	Male	All
Asplund, Barth, Le Grand, Mastekaasa, Westergård-Nielsen (1996)	1990	*Public* & *private* *Public* *Private*	0.0089 0.0003 0.0173	0.0247 0.0129 0.0281	0.0167 - -
Asplund, Barth, Smith, Wadensjö (1996)	1990	*Public* & *private*	0.0110	0.0180	-
Smith and Westergård-Nielsen (1988)	1976-1984	*Salaried employee* *Skilled* *Unskilled*	0.0030 [-0.001] -0.0100	0.0200 0.0100 [-0.001]	- - -
Pedersen, Schmidt-Sørensen, Smith, Westergård-Nielsen (1990)	1976-1985	*Public* *Private*	0.0029 [0.0009]	0.0084 0.0083	- -
Bingley and Westergård-Nielsen (1997)	1981-1991	*Private*	0.0169	0.0205	-

Notes: The numbers in brackets are not significant at any reasonable level. [a] Instrumental variable (IV) estimates.

and 0.009, respectively. This apparent discrimination regarding returns to human capital is, as mentioned in the introduction, the main concern of Asplund et al. (1996b), where the conclusion is the same: The estimated returns to education and experience for men are 0.036 and 0.018 respectively, and for women 0.024 and 0.011, respectively (OLS estimations for 1990).

The gender specific returns to human capital variables have been analyzed in Smith and Westergård-Nielsen (1988) as well. Smith and Westergård-Nielsen (1988) do not estimate overall returns for males and females on average, but choose to estimate occupation specific returns (pooled cross-section OLS and fixed effects models), and the results are rather striking as concerns returns to experience (Table 4). Thus, the return to experience is generally (and significantly) lower than the equivalent estimates of the other studies. This is clearly illustrated by the extreme case of unskilled female workers whose return to experience is significantly negative.

In order to specifically investigate the wage differential between individuals in the public and private sectors, Pedersen et al. (1990) estimate gender and sector specific wage functions (pooled cross-section OLS and IV). The return to education (IV estimates) in the public sector is around 0.06 for men and 0.019 for women, which is more or less in accordance with the results obtained in other studies. However, according to Table 3, the estimate (IV) of the female return to education in the private sector is 0 (0.042 for men), which is quite remarkable. Likewise, the return to experience in Pedersen et al. (1990) is remarkably low, ranging from 0.001 to 0.008 (Table 4).

The estimated returns to both education and experience (pooled cross-section OLS & GLS, error-component model) in Bingley and Westergård-Nielsen (1997) also indicate some degree of discrimination, but not equivalently striking. The estimated male returns to education and experience are 0.035 and 0.021, respectively and for females 0.024 and 0.017, respectively (OLS estimates). Controlling for workplace and worker non-observables (GLS, error-component estimates) does not significantly alter the OLS estimated human capital coefficients, indicating that the specific choice of estimation technique is not critical to the basic findings concerning returns to education and experience.

Table 5. Wage equations: Experience² (years)

STUDY	YEAR	SECTOR/ OCCUPATION	Coefficient		
			Female	Male	All
Asplund, Barth, Le Grand, Mastekaasa, Westergård-Nielsen (1996)	1990	*Public & private*	-0.0001	-0.00045	-0.00023
		Public	0.00014	-0.00018	-
		Private	-0.00031	-0.0005	-
Asplund, Barth, Smith, Wadensjö (1996)	1990	*Public & private*	-0.0002	-0.00032	-
Smith and Westergård-Nielsen (1988)	1976-1984	*Salaried employee*	-0.00004	-0.00043	-
		Skilled	[0.00005]	-0.00028	-
		Unskilled	0.00020	[-0.00027]	-
Pedersen, Schmidt-Sørensen, Smith, Westergård-Nielsen (1990)	1976-1985	*Public*	0.0000049	-0.000049	-
		Private	0.000	-0.000091	-
Bingley and Westergård-Nielsen (1997)	1981-1991	*Private*	-0.00034	-0.00038	-

Note: The numbers in brackets are not significant at any reasonable level.

4.2 Returns to levels of education and addition of other variables

As outlined in Table 2, a variety of variables have been used in the estimation of the human capital wage function, but it is beyond the scope of this paper to comment on all of them. Instead, four topics have been picked for a brief elaboration; namely estimation based on *Levels of education* (4.2.1), controls for *Province* (4.2.2), returns to *Tenure* (4.2.3), and controls for *Occupation and Public sector employment* (4.2.4).

4.2.1 Levels of education[7]

According to Table 2 and Table 6, Asplund et al. (1996a) is the only study that reports returns to *Levels of education.* The four cate-

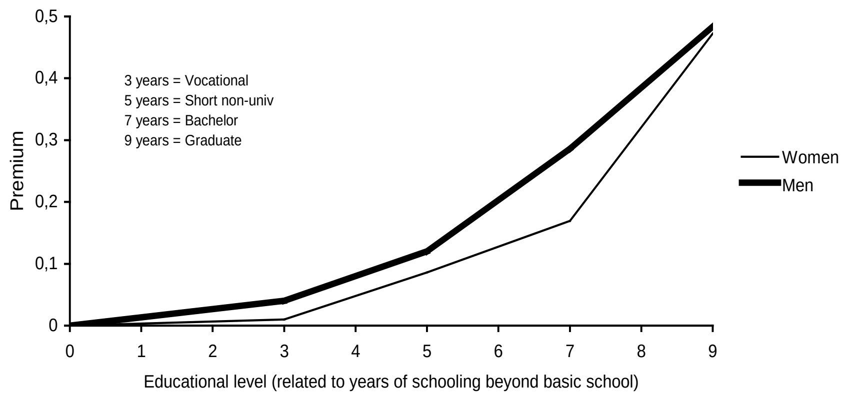
[7] The schooling variable in the regression equation (see footnote 2) is replaced by a dummy for each educational level (k in total) minus 1. Thus, $\ln W = \beta_0 + \beta_j \cdot Dummy_j + \varepsilon$, where j = 1,...,k-1. The omitted dummy (which can be chosen arbitrarily) is represented by the general intercept term of the regression equation (equivalent to including dummies for all educational levels and then run the regression without a general intercept term).

Table 6. Wage equations: Dummy variables for educational level (basic school omitted)

STUDY	YEAR	LEVEL	Coefficient[a] Female	Male	All
Asplund, Barth,	1990	*Vocational*	0.0099	0.0402	0.0189
Le Grand, Mastekaasa,		*Short non uni*	0.0860	0.1200	0.1048
Westergård-Nielsen		*Bachelor*	0.1695	0.2863	0.2204
(1996)		*Graduate*	0.4725	0.4834	0.4758

Note: [a] Due to the log specification, the dummy coefficients (multiplied by 100) are approximately equal to the hourly wage rate %-premiums (referred to as returns) of each educational level compared to a basic school education (the omitted dummy). Proof: $\ln(w) = \beta_0 + \beta_j \cdot$dummy $\Rightarrow \beta_j = \Delta(\ln w) = \ln(1+\Delta w/w) = \ln(1+g) \cong g$, where g = rate of change. Regarding female bachelors for example, the real %-premium is thus $e^{(0.086)}-1 = 8.98$ %.

Figure 1. Returns to levels of education (premium compared to basic school = 9 years)



Note: Exact numbers are outlined in Table 6 above. The percentage premium equals $100(e^{(\text{premium})} - 1)$.

gories/dummies (basic school omitted) are, however, closely related to *years* of education (beyond basic school, 9 years). Thus, *Vocational* = 3 years, *Short non. uni.* = 5 years, *Bachelor* = 7 years, and *Graduate* = 9 years. When looking at Table 6 and Figure 1 (a graphical presentation of the returns in Table 6), it is obvious that returns are a positive *and* convex function of education (years & level). The convexity implies that the incentive to move from one educational level to a higher one is present at all levels, and that the linear relationship of the human capital model might be inappropriate. Furthermore, it emerges from Figure 1 that male returns exceed female returns for each educational level – most significantly at the level *Bachelors* (7 years).

4.2.2 Province

Except for Asplund et al. (1996a), all the reviewed studies include a dummy for *Province* (1 if the individual lives outside the area of Greater Copenhagen), and the findings are rather similar; i.e., in all estimations (across time and study) the average disadvantage (discount) of living in the province in terms of wages is between 5% and 10% depending on gender.

4.2.3 Tenure

Though Bingley and Westergård-Nielsen (1997) use the variable *Newcomers* as a proxy, Asplund et al. (1996a) is the only study in which the wage effect of *Tenure* has been analyzed thoroughly. The returns are outlined in Table 7.[8] One main conclusion has been drawn by Asplund et al. (1996a): The return to *Tenure* is generally larger in the public sector than in the private sector – especially for men. This is partly explained by the fact that wages among public sector employees are regulated by relatively rigid pay scales and seniority based promotion patterns.

Table 7. Wage equations: Tenure

			Coefficient[a]		
STUDY	**YEAR**	**SECTOR**	Female	Male	All
Asplund, Barth, Le Grand, Mastekaasa, Westergård-Nielsen (1996)	1990	*All*	-	-	0.0034
		Private	0.0030	0.0041	-
		Public	0.0027	0.0052	-

Note: [a] See footnote 6.

[8] Since the reported returns to *Experience* (Table 4) and the reported returns to *Tenure* (Table 7) have been estimated separately, one should be careful to draw any conclusion regarding the relative effect of tenure and total experience on wages.

4.2.4 Controls for occupation and sector

According to the estimations carried out in Asplund et al. (1996a), there are two major effects of controlling for occupational status and public sector employment; the wage equation is significantly better explained, and the returns to schooling are, roughly speaking, halved (compare Table 8 with Table 3). On the other hand, returns to experience are apparently not sensitive to the addition of variables to control for occupation and sector. Furthermore, Table 8 reveals that public sector wages (on average) are lower than private sector wages, especially for men (around 11% on average).

Table 8. Wage equations: Returns to schooling, controls for occupation and public sector

STUDY	YEAR	VARIABLES	Coefficient[b]	
			Female	Male
Asplund, Barth, Le Grand, Mastekaasa, Westergård-Nielsen (1996)	1990	*Schooling*	0.0227	0.0294
		Experience	0.0106	0.0225
		Experience²	–0.00016	–0.00043
		DUMMIES:[a]		
		High Salaried emp	0.2855	0.3262
		Medium Salaried emp	0.0544	0.1247
		Skilled worker	–0.0440	0.0136
		Unskilled worker	0.0084	0.0219
		Other	0.0360	0.0093
		Public	-0.0340	-0.1075

Notes: [a] Omitted occupational dummy is *Assistant salaried employees*.
[b] See note (a) of Table 6.

5 Conclusion

In accordance with the objective we have given a formal description of the Danish evidence in terms of returns to human capital variables (five studies in total). The five papers presented have been chosen for a review because of their comprehensive nature, and are thus not the only research which has been carried out within the field of schooling and earnings. Furthermore the five papers share a common (and very attractive) feature: they are all based on large representative register based samples (DLDB (LLMR) & IDA).

Although the estimations use the same kind of data, the estimated returns differ quite significantly (due to different model specifications, addition of control variables, differences in terms of years covered, inclusion of variables to correct for selectivity bias, etc.). Nevertheless, reported female returns to schooling are found to be around 2 – 4%, and the male equivalent is around 5% (OLS). Based on the most recent findings, returns to schooling are higher in the private sector than in the public sector. As concerns returns to years of (actual) experience, the picture is more or less the same; male returns (around 2%) are higher than female returns (around 1%) and private sector returns exceed public sector returns. Throughout all estimations (roughly speaking) the earnings profile related to experience is found to be bell-shaped. Controlling for occupation and (less importantly) public sector employment significantly reduces returns to one additional year of schooling.

Basing the estimation on *levels of education* reveals a positive relationship between log wages and the level of education; i.e., moving from one educational level to a higher one is (on average) associated with higher hourly wage rates. In other words, there is a clear incentive to acquire formal skills in terms of the Danish labour market. The relationship between log wages and years of schooling is, however, not distinctively linear, but rather convex, implying that the linear specification might be inappropriate.

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CHAPTER 4

Earnings and Human Capital: Evidence for Finland

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1 Introduction

This chapter reviews existing empirical evidence on the rewarding of individual human capital in general and formal education in particular in the Finnish labour market. As will become evident, the literature of this research field is still rather sparse in Finland. Most of the available evidence has, in effect, been produced during the past decade. Apart from a fairly limited number of studies, any generalisations of results will also suffer from the fact that the comparability of reported results is impaired by the use of different data sets, differing definitions of variables as well as crucial differences in the estimated model specifications. Differences in the employed estimation techniques seem to play a much smaller role, mainly because of the minor impact of sample selection bias on the estimated coefficients.

The overall impression mediated by the reviewed research is that the average return to education has declined substantially during the past decades. The decline was particularly strong in the 1970s, and continued at a slower pace up to the mid-80s. The average return to education has remained roughly unchanged since the latter half of the 80s with the general trend still pointing downward rather than upward. Moreover, the rewarding of human capital accumulated in working life turns out to be very modest in Finland. This holds for general work experience and, especially, for tenure as measured by the length of the current employment relationship.

2 Purpose and data sets used

The influence of individual differences in human capital endowments on earnings determination in the Finnish labour market has been examined using mainly three extensive individual-level databases: Population Census Data constructed by Statistics Finland, Labour Force Surveys conducted by Statistics Finland and Wage Data Files gathered by the Confederation of Finnish Industry and Employers (TT). The coverage and richness of these databases differ considerably. Moreover, they have been utilised to a highly varying extent depending on the primary purpose of the study.

This diversification weakens profoundly the possibilities to draw general conclusions concerning magnitudes and trends of private returns to human capital in the Finnish labour market.[1]

2.1 Population Census Data

The Population Censuses cover the whole population and are available for every fifth year starting in 1970.[2] The most recent census is for 1995. Based on these quinquennial censuses Statistics Finland has compiled the *Finnish Longitudinal Census Data File*, which contains all individuals (some 6,4 million people) who lived in Finland during at least one of the census years. The censuses before 1990 are based partly on statutory questionnaires and partly on administrative registers. The 1990 and 1995 censuses, in contrast, are entirely register-based. This change has inevitably introduced some measurement error as well as artificial changes in some individuals' status over time. As a consequence the censuses are not fully comparable between different years. The earnings data come from the records of the tax authorities and refer to all taxable wage and salary incomes including most types of compensation such as fringe benefits, overtime and vacation pay, etc.

Some crucial disadvantages of the database are also worth mentioning: information on working hours is not available for any of the census years, and the number of months worked is missing for 1970; the income data for the 1970 census is actually from 1971 while all the other information refers to 1970; part-timers cannot be distinguished from full-timers for 1970, 1990 or 1995; high income earners (the top percentile) have persistently been top-coded and instead of their actual income, these individuals have been given the average earnings above the top-code cut-offs.

Brunila (1990) uses two representative cross-sections from the 1975 and 1985 Population Censuses to investigate earnings differentials across genders. The one per cent sample drawn from the employed

1 Lilja and Vartia (1980) and Nygård (1989) have used Household Survey data to estimate the impact of the education of the head of the household on observed differences in household incomes.

2 Recently Statistics Finland has made available a restricted sample covering the year 1950 (see Statistics Finland, 1998). So far no estimations of the return to human capital have been reported based on that data set.

population in respective year is for data-related reasons restricted to full-year, full-time employees, exclusive of those engaged in agriculture, forestry and mining. When further excluding employees classified into agricultural or entrepreneurial occupations as well as those with annual earnings below FIM 25 000, Brunila arrives at an estimating sample including some 11,000 full-year full-timers for both years investigated. The wage concept used is gross annual earnings.

Helo and Uusitalo (1995) address the question whether it is worthwhile for Finnish youths to invest in a university education. Apart from estimating Mincer-type earnings equations, they also calculate and compare internal rates of return for university degrees taken within different educational fields. Their analyses depart from a 10 per cent sample drawn from the Longitudinal Census Data File covering the years 1975, 1980, 1985 and 1990. They further restrict the estimating data to individuals aged 19–64 having either completed a university degree at the MA- or post-graduate level or merely taken the matriculation examination (i.e. completed the Gymnasium). This procedure results in four cross-sections containing between 8,700 (in 1975) and 23,200 (in 1990) individuals. The wage concept is annual taxable income including wage and salary income as well as entrepreneurial and capital income.

Eriksson (1994) and Eriksson and Jäntti (1996,1997) analyse the distribution and determination of earnings using a random sample containing some 10 per cent of the population included in the Longitudinal Census Data File covering the years 1970, 1975, 1980, 1985 and 1990. Eriksson (1994) restricts the estimating data to wage and salary earners between 16 and 65 years of age, giving a sample size that grows from about 111,000 individuals for 1970 to over 202,000 for 1990. In Eriksson and Jäntti (1996,1997) the sample is further restricted to those over 25 years old earning more than 100 FIM in 1990 prices, which reduces the sample size to some 71,000 individuals for 1970 and about 180,000 for 1990. Two different wage concepts are used: before-tax monthly and annual earnings.[3] The analysis is restricted to all employees in Eriksson (1994) and Eriksson and Jäntti (1996) but is separated also by gender in Eriksson and Jäntti (1997).

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3 The reported results are affected only marginally when excluding those who are younger than 25 and when using annual instead of monthly earnings (Eriksson and Jäntti, 1996).

Uusitalo (1999) explores the influence of ability bias and schooling choice on estimated returns to education using two random samples of young men who performed their military service in, respectively, 1970 and 1982. The first sample departs from 2,000 recruits having performed the Finnish Defence Forces Basic Ability Test in 1970. The Longitudinal Census Data File for 1970–90 is used to add information on the sample individuals as well as on their parents. Due to missing data some 1,500 men were retained in the final sample. Further reductions in sample size were caused by restrictions to full-time employees and missing information on family background. The wage concept used is gross annual earnings.

The second sample used by Uusitalo (1999) covers 37,000 young men who performed their military service in 1982. Again labour market information on the sample men and their parents was obtained from the Longitudinal Census Data File for 1970–90. In addition, administrative labour market records were used to add information for 1994 on earnings and completed formal education. When further restricting the sample to men in full-time employment earning FIM 2 000 or more per month (in 1994) and with information on family background available, the effective sample dropped to 22,572 male employees. The wage concept used is gross monthly earnings calculated from annual taxable income and an estimated number of months worked.

2.2 The Labour Force Survey

The *Labour Force Survey* (LFS) is a biannual survey conducted by Statistics Finland. It covers a random sample of some 9,000 individuals, representing the entire population aged 15–64 years as stratified according to sex, age and region. Apart from these three characteristics, only a few additional variables, such as the acquired formal schooling, are taken from registers; most of the information provided in the LFS is self-reported. The LFS has been conducted for several years, but only a limited number of the surveys have been supplemented with income data from the tax registers. So far Statistics Finland has made income-extended surveys available for 1987, 1989, 1991 and 1993, and recently also for 1995. Compared to the Population Census Data the LFS has the advantage of comprising a rich set of background characteristics concerning the individual and his/her job. A less satisfactory feature of the data is that it lacks the panel property, i.e. the survey sample varies from year to year.

Ingberg (1987) was the first to report empirical evidence on the effects of schooling and experience on earnings in Finland. He used an *ad hoc* data set created by Statistics Finland through merging the 1980 Labour Force Survey and income and labour force status variables from the registers of the 1980 Housing and Population Census. The data comprise some 10,000 individuals of which close to 6,200 are recorded to be labour force participants. The wage concept refers to annual taxable earnings, comprising wages and salaries, income from farming, and entrepreneurial income (with capital income, pensions and other unearned income excluded).

Asplund (1993a) utilises the 1987 Labour Force Survey, i.e. the first LFS that was supplemented with income data from the tax records, to explore the relationship between individual earnings and human capital in the Finnish labour market.[4] When the sample was restricted to employed wage and salary earners aged 16–64 and sorted out with respect to missing or incomplete information on crucial variables, the actual estimating sample dropped to close to 4,000 individuals. The wage concept used is the average (before-tax) hourly wage calculated as annual taxable earnings divided by annual working hours estimated from the self-reported number of months worked and normal weekly working hours. The same data set is used in several comprehensive comparisons of wages and human capital in the Nordic countries (Albæk et al., 1996a; Asplund et al., 1996a,b).

Asplund (1998a) extends the analysis of gender-specific wage formation in the private and public sectors to the years 1989, 1991 and 1993. All four survey years were also utilised in a recent study exploring the potential impact of computer skills on the average return to schooling (Asplund, 1998b). The estimating data comprise more than 4,000 individuals in 1989 and 1991, but only some 2,500 employees for 1993, which reflects the dramatically worsened employment situation in Finland since 1991.

4 Apart from extensively specified wage equations estimated for all employees and separately by gender, Asplund (1993a) also analyses occupational choice and earnings, sectoral choice and earnings, and inter-industry wage differentials with the emphasis on the human capital aspect.

2.3 The TT Wage Data

The Confederation of Finnish Industry and Employers (TT) collects detailed individual-level information from member firms once a year for non-manual workers and four times a year for manual workers. The wage as well as all other information provided is taken directly from the employers' registers and should, accordingly, be highly reliable. The member firms cover approximately 75 per cent of Finnish manufacturing but only a minor share of the services sectors.

Asplund (1996, 1998c) and Asplund and Vuori (1996) utilise a representative sample of full-time non-manual workers drawn from this broad TT database in such a way that the estimating data has both cross-section and panel properties. The sample covers the years 1980 to 1994 and comprises some 135,000 individual time observations. Of these, part concerns non-manual workers observed during just one year, whereas the rest concerns non-manual workers observed during at least two consecutive years and at most during all 15 years investigated. Asplund (1996) analyses all non-manual workers and three non-manual subcategories, i.e. upper-level, technical and clerical non-manual workers. Asplund (1998c) extends the analysis to a comparison of male and female non-manual workers. Asplund and Vuori (1996), finally, divide the non-manual workers into two groups – those engaged in high-tech and other growth industries and those in slowly growing industries – and compare the labour market and wage performance of the two groups, with a further distinction made between different-sized establishments. The wage concept used in all three studies is the average (before-tax) hourly wage calculated as gross monthly earnings divided by monthly working hours estimated from normal weekly working hours.

Similar analyses have not been undertaken for manual workers because the TT database does not comprise information on the manual workers' formal schooling nor on their working experience. The only human capital-related information concerns the manual worker's qualification category[5] and age.

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5 The qualification categories, which rank workers according to their skills and tenure, differ across industry branches and are settled in branch-level wage negotiations.

3 Estimation methods

Most cross-section studies of the effect of human capital on wage determination in the Finnish labour market have used ordinary least squares (OLS) techniques.[6] In other words, individual wages have been regressed on a varying number of personal and job-related characteristics that are assumed to contribute to explaining the observed variation in wage outcomes. This method overlooks at least two main issues: the potential presence of a non-negligible sample selection bias and the fact that one or more of the explanatory variables might be endogenously determined.

A sample selectivity bias problem may arise if the sample individuals recorded as being employed are not randomly selected from the entire population. Asplund (1993a) and Asplund et al. (1996b) adjust for this by estimating the earnings equation in combination with a selection function of the probit type explaining the probability of the i^{th} sample individual being employed. The two equations are estimated first using an ordinary Heckman two-stage procedure and are then re-estimated jointly using the full-information maximum likelihood estimator (FIML), whereby the final values from the Heckman two-stage procedure are used as starting values. Neither for men nor for women did the estimation results (for 1987) point to a significant sample selection bias affecting the estimation results for Finland. This finding indicates that estimation of the earnings equation using OLS techniques produces consistent parameter estimates. The finding of no serious sample selection bias may, however, also be due – at least in part – to the usually high correlation between the exogenous variables in the selection equation and the earnings equation making even the FIML estimator very unrobust (see e.g. Puhani, 1997; Asplund, 1998b).

Several of the individual background variables commonly included in earnings equations can be expected to be the outcome of a selection process rather than a random drawing. Crucial

6 OLS techniques have been used by Ingberg (1987), Brunila (1990), Eriksson (1994), Eriksson and Jäntti (1996,1997), Asplund (1996, 1998b, 1998c), Asplund and Vuori (1996) and Asplund et al. (1996a). Helo and Uusitalo (1995) use a Tobit procedure in order to account for that fact that their income variable is censored in both ends.

among these variables are education, occupational status and sectoral affiliation (employment in the private or the public sector). Few attempts have, however, been made in Finland to approach the obvious endogeneity of these variables.

Uusitalo (1996,1999) addresses the question of endogeneity of education, i.e. the possibility of non-negligible self-selectivity into different levels of education. This is done by specifying and estimating various models of individual schooling choice and by using more or less standard instruments, such as family background indicators (see further Section 4.1.3 below).

Asplund (1993a) makes an attempt to explore whether the omission of any factors influencing the individual's choice or access to a given occupation might give rise to problems of selectivity bias in the estimations. In order to correct for the potential presence of selectivity bias arising from occupational choice, occupation-specific earnings equations are estimated in combination with occupational attainment equations using the multinomial logit-OLS two-stage estimator. More exactly, the multinomial probability function capturing occupational choice is estimated by maximum likelihood and the obtained information is used to compute occupation-specific lambdas, i.e. the terms controlling for the potential effects of selectivity bias. The occupation-specific earnings equations are then estimated using OLS techniques. The results obtained from 1987 Labour Force Survey data provide evidence on some degree of non-randomness in the allocation of employees across occupational categories. Among female employees there seems to be a strong (negative) selectivity into manual works outside manufacturing, which may be the outcome of relatively low starting wages in typical female jobs in the distribution and services sectors. This, in turn, points to some kind of crowding-in effect, implying that the category comprises proportionally more jobs to which access is relatively easy especially for less-skilled women. For male employees, in contrast, the results reveal a strong (positive) selectivity into manufacturing jobs, which seems reasonable in view of the fact that manufacturing comprises many export-led, male-dominated, relatively high-paid sectors.

In analysing earnings determination in the private and public sectors in Finland, attempts have been made to account for the fact that the individuals may exercise some choice over their sectoral status (Asplund, 1993a, 1998a). In other words, the observed allocation is thought to be the outcome of a non-random distribution of individuals on sectors, reflecting different preferences over, *inter alia*, working conditions. In addition to treating the individual's sectoral status as endogenously determined, account is also taken for the potential presence of a sample selectivity bias. This is done by estimating sector-specific earnings equations in combination with a sequential selection model of the bivariate probit type explaining the probability of the i^{th} sample individual being employed and, moreover, in the given sector. In other words, there are two criterion functions: the selection of being employed, and the selection of private versus public status. More formally, the applied estimation method allows the two decisions underlying employment in a given sector to be correlated, and accounts for sample selection both in the bivariate probit model and in the earnings model. The statistical significance of the estimated correlation and correction terms varies strongly with the employee category (men/women in private/public-sector employment) and the year investigated (1987, 1989, 1991, 1993). Although the variation in results seems to largely reflect the different way in which the four employee categories were affected by the dramatic changes in the activity level of the Finnish economy in these years, the sample selectivity and endogeneity problems do not stand out as serious.

Because of the different occupational structure of the private and public sectors there is, however, reason to expect some degree of selectivity also when it comes to the occupational status of the employee. In a second step, therefore, Asplund (1993a) treats both the private/public-sector status and the occupational social status of the employee as endogenously determined through a selection process. This multiple choice approach allows the employees to select across four labour markets: private- and public-sector non-manual/manual jobs. The selection model is identical to the one described above for the estimation of occupational earnings equations. The results, which refer to 1987, point to no serious selectivity bias arising from labour market choice influencing the estimation results. There is one notable exception, though: a strong (negative) selection of women into private-sector manual jobs, a result well in line with the strong (negative) selection of women into non-manufacturing jobs obtained from estimating selectivity-corrected occupational earnings equations (see above).

4 Estimation results

Common to all the studies reviewed in the previous sections is that they estimate a conventional Mincerian earnings equation with the natural logarithm of the sample individuals' wages regressed on their educational attainment (measured by years or degrees), years of experience (actual, potential or proxied by age), gender and a varying set of other key explanatory variables, including tenure. Apart from estimations for all employees, some studies also run separate earnings regressions for men and women and/or for the private and the public sector. Some analyses are restricted to full-year, full-time employees while other comprise all employed. A few studies, finally, focus on more restricted but nevertheless representative samples, such as non-manual workers in manufacturing or particular male cohorts. Table A1 of the Appendix provides a summary of the data, model specifications and estimation methods used in the studies reviewed.

4.1 Returns to education

The regular education system in Finland is composed of the comprehensive school, the senior secondary school, vocational and professional education institutions, and universities. The comprehensive school provides basic education and is compulsory for the whole age group 7 to 16. The post-comprehensive general education provided by senior secondary schools is classified as an upper level of upper secondary education. Vocational and professional education institutions provide education both at the upper secondary level (vocational schools) and at the tertiary level (vocational colleges, technical institutes). Based on the length of the vocational education provided by vocational schools, upper secondary education is divided into lower-level and upper-level education, whereby the former refers to less than three years of vocational and professional training and the latter to about three years of training.

Tertiary-level or higher education comprises three (previously four) levels of education.[7] Vocational and professional schooling at the lowest level of tertiary education is provided by vocational colleges and technical institutes and takes 4–6 years. The certificates issued at this level are not equivalent to university degrees.

A declining number of persons have completed an undergraduate, i.e. Bachelor-level, university degree. This is partly the result of a degree system reform, whereby several BA-level degrees were raised to Master's level. Today, all first university degrees are equivalent to a Master's degree and take, on average, 6–8 years to complete. BA-level degrees are completed mainly in vocational and professional education institutions. Post-graduate schooling, finally, includes degrees at the licentiate and doctorate levels.

4.1.1 Returns to years of schooling

Both the Labour Force Survey and the Population Census Data include register data, compiled by Statistics Finland, on the formal schooling attained by each individual. The registered degree, however, only shows the single highest level of education completed by the individual. A total of eight levels of education are distinguished. The educational classification available in the TT data up to 1994 is very similar, albeit not identical, to that of Statistics Finland. From 1995 onwards also the TT data is supplemented with official educational classification codes.

The registered levels of education can be turned into years of full-time schooling using the Finnish Standard Classification of Education as follows: basic education = 9 years, lower level of upper secondary education = 10–11 years, upper level of upper secondary education = 12 years, lowest level of higher education = 13–14 years, BA-level = 15 years, MA-level = 16 years and postgraduate or equivalent education = 18+ years. Unless indicated otherwise, this is the stereotype key used when turning educational degree levels into the years of schooling variable for which estimates are reported in Table 1.

Table 1. Average returns to years of schooling, log-%

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[7] Degree reforms in higher education that have come into force in recent years, i.e. in years not covered by the reviewed studies, are overlooked in this context.

	Year	All	Men	Women
Ingberg (1987) [a]	1980	9.1	9.3	-
Asplund et al. (1996a) [b]	1987	7.0	7.4	6.4
Asplund (1993a) [c]	1987	8.6	8.8	8.0
Asplund (1999) [d]	1987	8.3	8.4	8.0
	1989	8.2	8.4	7.8
	1991	8.8	8.8	8.7
	1993	8.2	7.8	8.3
Uusitalo (1999; recruits in 1970)	1975-90 [e]		8.9	
Ability-corrected return			7.4	
Uusitalo (1999; recruits in 1982)	1994		9.1	
Ability-corrected return			7.9	

		Private sector		Public sector	
		Men	Women	Men	Women
Asplund et al. (1996a) [f]	1987	7.4	4.9	7.9	7.3
Asplund (unpublished) [g]	1987	8.8	6.6	9.9	8.9
	1989	10.5	5.7	8.7	10.0
	1991	9.3	6.8	8.9	11.0
	1993	7.6	7.4	8.2	9.3

Notes: All estimates are statistically significant at the 1% level.

[a] Only a year of schooling variable is included.

[b] Explanatory variables are: experience and experience squared, and a gender dummy in the wage equation for all employees. A less detailed key than the stereotype one was used when transforming educational degrees into years of schooling.

[c] In addition to human capital variables, the wage equation is supplemented with a broad set of other personal and job-related characteristics.

[d] Explanatory variables are: experience, experience squared, dummy for tenure less than one year, tenure and tenure squared, dummy for participation in employer-financed training, and a gender dummy in the wage equation for all employees.

[e] The estimations are based on average values for the period 1975–90.

[f] Controls are added for experience, experience squared and tenure.

[g] Account is made for differences in various personal and job-related characteristics, not occupational or industrial status, though. See Table A1 of the Appendix for more detailed information.

The existing evidence on average returns to schooling is rather limited. Obviously, this is mainly due to the lack of information on actual years spent in schooling. Instead information on years in school has to be imputed from the available register data on completed educational degrees. Moreover, the use of years of schooling has been noted to give a less satisfactory fit compared to adding educational degree variables to the estimated wage model.

The results obtained by Ingberg (1987) from the estimation of a simple schooling model merely including a variable for the number of completed school years, point to an average return on schooling of some 9.5 per cent[8] when restricting the analysis to individuals having been employed the whole year.[9] The corresponding estimate for all participants in the labour market amounts to some 12 per cent.

Table 1 further suggests that the average return to an additional year in schooling has changed only marginally from 1987 to 1993, despite the turbulence in the Finnish economy in these years.[10] The gap between men and women in the average rewarding of formal schooling stands out as small or negligible, but widens in favour of men when more personal and job-related characteristics are added to the estimated wage model (which, in the table, is illustrated for 1987). The difference in the reported estimates for 1987 also reveals how sensitive the estimates are to even small changes in the number of years attached to each educational degree when turning educational degrees into a continuous years of schooling variable.

The returns to additional years of schooling are approximately halved when including controls for the individual's occupational status (e.g. Asplund, 1993a; Asplund et al., 1996a,b). Moreover, this effect has been found to reflect the positive influence that education has on the individual's occupational chances rather than occupational attainment having a tendency of weakening the earnings effects of the

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8 The returns reported in the tables are the estimated coefficients for the variable in question, multiplied by 100. In the text, these log-returns are throughout turned into normal per cent by using the antilog formula $[(e^a - 1)*100]$, where a is the parameter estimate.

9 Inclusion of the natural logarithm of the number of reported weeks worked during the year changes the size of the estimated returns only marginally.

10 It may also be noted in this context that the expansion of computer use has had no effect whatsoever on the estimated returns to schooling in Finland. This result contrasts sharply with evidence reported for the US, where some 35–40 per cent of the increase in returns to schooling experienced over the past decades can be attributed to rapidly expanding use of computers at the job. (See Asplund, 1998b).

acquired formal education (Asplund, 1993a). This is also to be expected for countries like Finland where formal education contains a large amount of occupation-specific skills and the possession of a given educational degree is even a prerequisite for certain occupations. Simultaneously highly varying returns to human capital endowments among occupational categories indicate that occupation has a marked influence on the sensitivity of the individual's earnings to changes in crucial personal characteristics.[11]

Table 1 also shows that the public sector has persistently rewarded formal education at least as well as the private sector. The estimates for 1993, however, point to a clear narrowing in the average returns to additional years in schooling between both sectors and genders.

A longer-term trend in the average returns to years of schooling is obtained from the TT wage data but for non-manual workers in manufacturing only. Figure 1 displays estimated returns for all non-manual workers and separately by gender and non-manual worker category. Figure 2 compares non-manual workers in high-tech and other fast growing industries with those in slowly growing industries. For the former category a further distinction is made between different-sized establishments such that the estimates for the two extremes – micro plants and big plants – are depicted. Too few observations in some of the establishment-size categories prevented reasonable estimates to be obtained for the slowly growing industry category and are, therefore, not shown here.

The average effect of an additional year in schooling has remained approximately unchanged over the investigated 15-year period when looking at all non-manual workers. Separate analyses for men and women also point to roughly unchanged average returns – around 6 per cent for men and about one percentage point less for women, but only in the 1980s.[12] In the early 1990s the average re-

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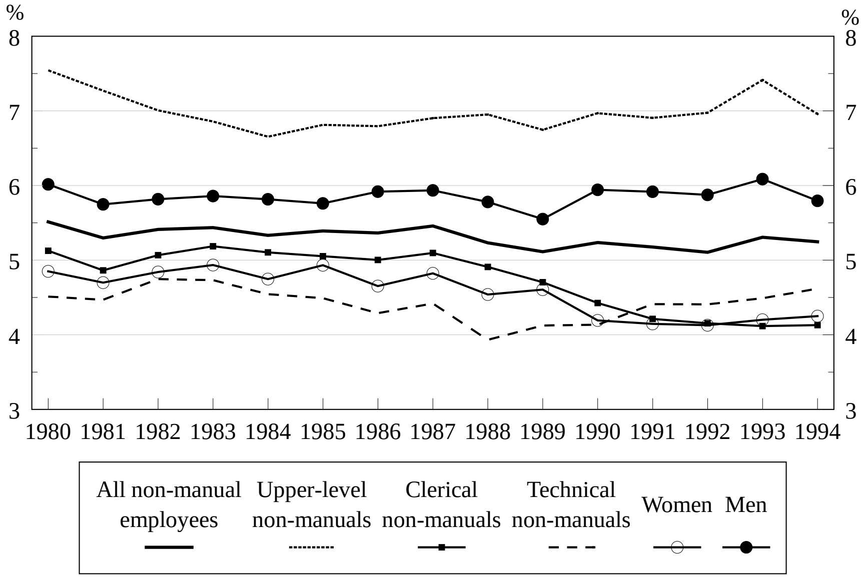
[11] Asplund (1993a) estimates the average return to years of schooling to be significantly higher for non-manual workers than for manual workers in 1987: for men(women) in upper-level non-manual jobs the average return is estimated at 7.4(6.6) per cent, for those in lower-level non-manual jobs at 6.5(4.6) per cent and for male manufacturing workers at 4.0 per cent. The corresponding estimate for women is insignificantly different from zero, as are the estimates for both men and women in non-manufacturing manual jobs.

[12] Asplund (1993a) also reports a significantly lower average return to additional years in schooling for women in private-sector non-manual jobs. In the public

turn to an additional year in schooling dropped permanently to around 4 per cent per annum among female non-manual workers, while it remained some 6 per cent for their male counterparts, thus widening the gender gap in this respect to nearly two percentage points. Similar trends are discernible for the male-dominated categories of upper-level and technical non-manual workers and the female-dominated category of clerical non-manual workers.

Figure 2, in turn, reveals that the average returns to educational endowments have not differed significantly between fast and slowly growing industries over the period 1980–94, not even in the

Figure 1. Average returns to years of schooling estimated for non-manual workers in manufacturing, 1980-94, log-%



Source: Asplund (1996, 1998c)

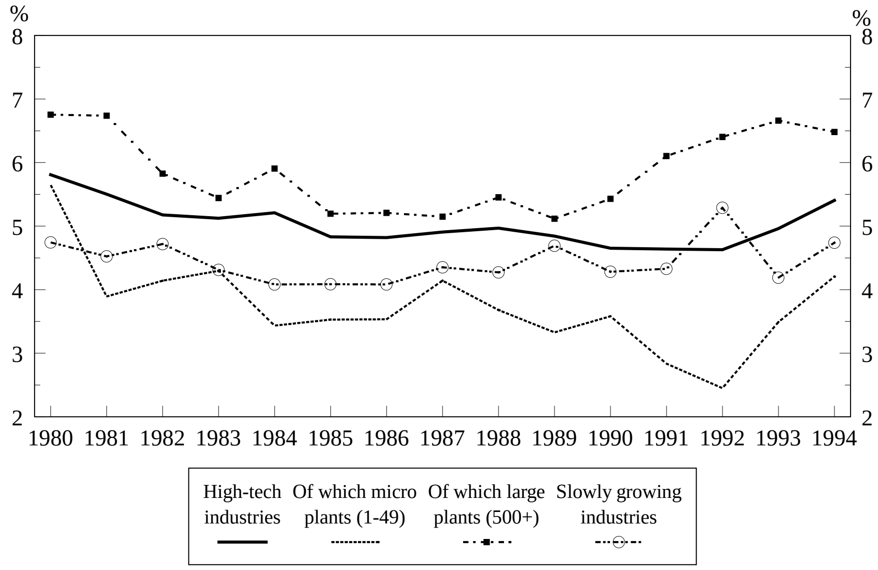
deep recession years in the early 1990s. Substantial variation in educational returns is found *within* industrial categories, not least between different-sized establishments, but only in the early 1990s;

sector, in contrast, the difference in educational returns is insignificant between men and women in non-manual jobs.

the differences in returns to education across different-sized establishments estimated for the 1980s are statistically insignificant, implying that prior to the 1990s non-manual workers have, on average, been equally rewarded for their educational endowments irrespective of the size of the establishment in which they are working.[13]

The average returns to extra years in schooling reported by Uusitalo (1999) for two male cohorts having performed their military service in, respectively, 1970 and 1982, are slightly higher

Figure 2. Average returns to years of schooling estimated for non-manual workers in high-tech and other fast growing industries (also differentiated according to establishment size) and for non-manual workers in slowly growing industries, 1980-94, log-%



Source: Asplund and Vuori (1996)

than those obtained in other studies for the whole male population. Most likely the (fairly minor) difference in estimated returns is a combination of differences in the underlying population, the de-

[13] This is in line with the finding of no significant differences in educational returns across different-sized plants reported in Albæk et al. (1996b).

finition of variables and the model specification used.[14] More interestingly, when adding ability measures[15] to the wage equation, Uusitalo obtains significantly lower returns to education, the drop being 1.5 percentage points for the 1970 sample and slightly less (1.2 percentage points) for the 1982 sample. Hence, part of the estimated educational returns seems, indeed, to capture individual differences in innate ability. This ability bias, however, turns out to be relatively small, leaving the average return to additional year in school at a comparatively generous level.

4.1.2 Returns to educational degrees

The existing evidence on returns to educational degrees is fairly rich compared to that on returns to years of schooling. The set of schooling indicators that can be distinguished based on the available register data, are: basic (compulsory) education, lower level of upper secondary education, upper level of upper secondary education, short non-university education, BA-level, MA-level and post-graduate degrees. The number of schooling indicators actually accounted for in the estimations vary slightly across studies but, nevertheless, allow cautious comparisons to be made. Comparison of results across studies is, in fact, more impaired by differences in the set of other personal and job-related characteristics added to the estimated wage model. Again the inclusion of controls for the individuals' occupational status affects most strongly the estimated educational returns and thus the comparability of returns (see e.g. Asplund, 1993a).

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14 For instance, the rate of return estimate for the 1982 sample reported by Uusitalo (1999, Table 2, p. 49) drops from 0.091 to between 0.083 and 0.087 when using calculated work experience (time elapsed since last degree) instead of potential experience, and depending on whether regional variables (describing the residential environment of the sample men in 1980) and the father's and mother's schooling and earnings (in 1980) are included.

15 The ability measures are constructed from the Finnish Defence Force Basic Ability Test, which is taken by all new recruits at the beginning of their military service (for selection of the rookies that are given officer training). The test consists of three sub-tests measuring verbal ability, analytical reasoning and mathematical reasoning (for more details, see Uusitalo, 1996). The estimations for the 1970 sample are based on "raw" ability measures while the estimations for the 1982 sample are based on pre-test schooling adjusted ability measures.

Table A2 in the Appendix gives average returns to different educational degrees estimated for all employees and separately by gender. The available evidence indicates that the average return to educational investment declined at all degree levels up to the mid-80s, albeit at a slower pace in the 1980–85 period than in the 1975–80 period.[16] During the latter half of the 1980s, the decline stopped at the lower end of the educational scale, and was even slightly reversed at the very top of the educational scale.[17] The deep recession in the early 1990s seems, however, to have put an end to this stable or even increasing trend – the average returns estimated for 1993 point to a slight weakening in the rewarding of educational investment at practically all educational levels. Moreover, much the same pattern is discernible among both men and women. All in all, the average return to education was at all degree levels significantly lower in the early 1990s than in the early 1970s.

Separate analysis of the private and public sectors, however, points to certain noteworthy sectoral differences in the development of returns to education between 1987 and 1993 (see Table A3 of the Appendix). In particular, while the educational-induced wage differentials among men in private-sector employment declined remarkably during the deep recession in the early 1990s, their female counterparts experienced increasing returns, especially to university degrees. In the public sector, in contrast, both men and women have seen a continuous, albeit moderate, decline in educational returns since the late 1980s. By 1993, these different time trends had resulted in a situation with small, if any, differences in educational returns across sectors and genders (Asplund, 1998a).

Evidence pointing to narrowing wage differentials between differently educated employees since the early 1980s, has also been ob-

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16 A declining trend between 1975 and 1985 is also reported by Brunila (1990), although the decline is smaller in absolute size since she also accounts for differences in occupational status.

17 Roughly the same trend is reported for the private sector by Vainiomäki and Laaksonen (1995). A similar trend is also displayed by Helo and Uusitalo (1995) when relating the earnings of those with a university degree to the earnings of those having merely taken the matriculation examination. They also show that the size of this university-degree wage premium varies considerably across educational fields. This is evident also from their calculated *internal* rates of return to different university-level educational fields.

tained from TT wage data for non-manual workers engaged in manufacturing. A declining trend is discernible among both men and women, and also within fast growing industries (Table A4 of the Appendix).

In sum, the average return to education has declined substantially in Finland over the past decades. The decline was particularly strong in the 1970s, and continued at a slower pace up to the mid-80s. This declining trend came to an end during the latter half of the 1980s. Weak signs of increasing returns to university degrees have been reported for the early 1990s, especially among women in private-sector employment.

4.1.3 Special issue: Endogeneity of schooling choice

There is, so far, only one study – that of Uusitalo (1999) – that attempts to adjust the estimated return to education for the possibility of the observed distribution of individuals across educational levels being the outcome of individual choice rather than random selection into schooling of varying length. Uusitalo departs from a random coefficient model of earnings determination which allows schooling choices to vary across individuals because of differences in their returns to education and because of their differing rates of substitution between schooling and future earnings. While the first phenomenon may be due to differences in ability, the latter is related to variation in access to funds and/or tastes for schooling. Broadly speaking, the specified model is estimated using a control function approach, i.e. a two-step selection correction combining the OLS regression of earnings on schooling with a participation decision model. If the participation-in-schooling decision is assumed to be linear (which turns out to be an acceptable approximation in the Finnish case), the two-step selection correction is shown to be equivalent to the Instrumental Variable (IV) estimator and the control function merely a less restrictive form of IV.

The instruments used by Uusitalo (1999) are standard. For the 1970 sample Uusitalo experiments with father's schooling and income as instruments. The 1982 sample offers a slightly broader set of possible instruments: father's and mother's schooling and earnings as well as residence in a university city, all information for 1980. These instruments are grouped in four different ways, and returns to schooling are reported for each of them with the earnings equation given four different specifications, each of which is estimated using both the IV(2SLS) and the control function estimator. This framework results in no less than 28 ability-adjusted[18] return-to-schooling estimates ranging from 0.052 to 0.112 (Uusitalo, 1999, Table 4, p. 54). The corresponding ability-adjusted OLS estimates vary between 0.077 and 0.083 depending on whether work experience refers to potential or calculated years in working life and whether or not the parents' schooling is added to the earnings equation. Thus, some of the IV estimates[19] are clearly higher, some are clearly lower than the OLS estimates.

There seem to be mainly two explanations for this outcome. First, the highest and lowest IV estimates relate to specifications with parents' schooling being used as an instrument (alone or interacted with some other instrument) and/or included as an exogenous variable in the earnings equation. Since the parents' schooling turns out to affect both the son's schooling decision and his future earnings, it is not a valid instrument.[20] This is also the conclusion reached by Uusitalo (1999, p. 53). Second, the university city stands out as a more credible instrument. Here, however, significantly higher IV than OLS estimates are only to be expected as, in this case, the IV estimate obviously reflects to a larger extent the average return to a university year than to a school year in general.

Faced with this mixed evidence on the variation of educational returns across individuals, Uusitalo (1999) attempts to capture the potential effects of individual selection into schooling of different

18 The estimates are adjusted for ability bias by the inclusion of ability measures both in the earnings equation and in the schooling decision equation.

19 The conclusions concerning IV estimates hold also for the control function estimates, since the two techniques produce highly similar estimates.

20 Uusitalo (1999, Table 5, p. 25) faces similar problems with his 1970 sample, where the father's income turns out to affect both the son's schooling decision and his future earnings. The very high rates of return to schooling reported based on this sample (estimates ranging from 0.124 to 0.157 compared to an OLS estimate of 0.081) are therefore to be interpreted not as an average return to schooling for the underlying population but as the *marginal* return that a son from a low income family would have obtained from an additional year in school, had he decided to continue in school.

length by interacting years of schooling with ability and family background measures. In brief, the results suggest that educational returns do, on average, increase with ability (especially with math ability). The strong effect of ability on the variation in returns to schooling and thus on schooling choice, is noted to be the outcome of the combined effect of lower costs and higher returns for individuals with higher ability (mainly to convert human capital absorbed in school into marketable skills valued at the workplace). The substantial effect of family background, on the other hand, is found to origin solely in its effect on the discount rate. On the whole, though, observable heterogeneity turns out to leave a significant part of the individual variation in returns to schooling unexplained.

Uusitalo (1999) goes deeper into the question of schooling choices and the impact on these of various personal characteristics and family background by estimating a discrete choice schooling model, which is given the specification of an ordered generalised extreme value model. Earnings equations *for different educational levels* are thereafter estimated using a simple selectivity correction model. In particular, Uusitalo (1999) focuses on the selection point by which students are faced after completed general upper secondary education (Gymnasium) giving them the matriculation diploma.[21]

The returns to education are estimated in a setting where individuals have the possibility to choose between several alternative educational levels. The schooling investment decision is assumed to be driven by the different rewarding of skills depending on the job performed. Consequently rational individuals can be expected to choose the educational level that leads to the occupation where their skills are best rewarded. Attempts are made to capture the effects on earnings of both cognitive and non-cognitive skills measured from ability and personality tests administered by the Finnish Army. The data used is the 1982 male sample, now restricted to those close to 6,900 recruits with a recent high school diploma and no further education at the time of entering military service.

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[21] Of these about one-third are admitted to universities (the same year), while the rest continue their studies in vocational institutions or enter the labour market (for more details, see OECD, 1998).

In brief the results indicate that cognitive and non-cognitive test scores explain relatively little of the *within* educational level variation in earnings. The effects of test scores are found to differ only marginally also between different educational levels, which points to minor differences in skill prices across educational levels. The main conclusion to be drawn concerning schooling choice is that neither the (non-)cognitive skills nor family background provide a clear-cut pattern; only a few characteristics stand out as statistically significant and most clearly for the choice of a university education. Put differently, individual skills and family background do not seem to cause clear self-selection into different educational levels.

4.2 Returns to work experience

4.2.1 Earnings effects of age

There is very limited evidence on the impact on earnings of the individual's age. The existing estimates are based on Population Census Data, which in contrast to the Labour Force Survey and the TT wage data do not include information on actual years spent in working life.

Brunila (1990) uses a single age variable and obtains a very modest average effect of increasing age on annual earnings among full-year, full-time employees: 0.6 per cent per annum for 1975 and 0.8 per cent per annum for 1985 among both men and women. Uusitalo (1999) obtains insignificant wage effects for age from his sample of males that performed their military service in 1970.

Eriksson and Jäntti (1997) distinguish between eight age groups in their estimations of earnings equations for all employees and separately for male and female employees for the years 1971, 1975, 1980, 1985 and 1990. Their estimates are reproduced in Table 2 in the form of age premiums calculated as (unweighted) percentage deviations from the overall mean earnings in the labour market.

Table 2. Age premiums of different age groups for all employees and separately by gender, 1971-90, log-%

All employees					
Age group	1971	1975	1980	1985	1990
25-29	2.3	-8.6	-13.6	-17.0	-15.9
30-34	7.2	2.0	-2.7	-7.4	-5.5
35-39	10.0	4.9	5.1	1.0	2.2
40-44	8.2	6.6	6.7	6.8	7.9
45-49	5.6	3.6	6.3	6.5	10.8
50-54	0.5	2.0	2.5	5.8	7.4
55-59	-9.2	-2.5	1.3	5.8	3.3
60-64	-24.4	-8.1	-5.5	-1.4	-10.0
Male employees					
25-29	3.3	-7.5	-11.6	-14.1	-10.8
30-34	8.1	3.6	-2.0	-6.0	-1.4
35-39	10.7	4.8	4.6	1.6	2.3
40-44	7.8	5.9	6.2	5.8	6.6
45-49	5.6	3.0	4.6	4.7	8.4
50-54	0.5	1.7	1.8	4.4	4.0
55-59	-8.3	-2.0	1.0	4.7	0.8
60-64	-27.5	-9.5	-4.5	-1.0	-9.9
Female employees					
25-29	1.3	-9.8	-16.0	-20.0	-21.0
30-34	5.8	0.1	-3.8	-8.8	-9.8
35-39	9.1	5.0	5.8	0.5	2.3
40-44	8.7	7.5	7.2	8.1	9.7
45-49	5.6	4.1	8.1	8.4	13.5
50-54	0.5	2.5	3.4	7.2	10.6
55-59	-10.1	-3.1	1.7	6.9	5.1
60-64	-20.7	-6.2	-6.6	-2.0	-10.1

Source: Eriksson and Jäntti (1997, Table 5) transformed into unweighted age premiums by the author.

Two main changes deserve attention. First, the increasing parts of the age-earnings profiles have become steeper while the declining parts have become flatter, except in the last year (1990) studied. Second, the age differentials have widened substantially since the early 1970s. These results change only marginally when including employees younger than 25 years (Eriksson, 1994) or when using monthly earnings instead of annual earnings as in Table 2 (cf. Eriksson and Jäntti, 1996).

4.2.2 Earnings effects of work experience

The existing evidence on the influence of increasing work experience on individual earnings is so far quite limited, as is evident from Table 3. The reported estimates refer to the individuals' *total* years *actually* (i.e. self-reportedly) spent in working life.[22]

The experience acquired in working life turns out to be rather weakly reflected in the wages of Finnish employees. Both the initial wage influence of work experience and the experience-earnings profile are particularly modest for women. The only exception is women employed in the private sector, who seem to be experiencing a boom in the rewarding of their work experience. Among men, the wage advantage arising from increasing work experience has persistently been approximately equally strong irrespective of the sector of employment. Moreover, the experience-induced effect on male wages seems to have strengthened slightly in the early 1990s.

The table also shows that the estimates of work experience are to some extent sensitive to the definition of the schooling variable as well as to the inclusion of other personal and job-related characteristics. As in the case for returns to schooling, the decline in the estimated wage effect of work experience is non-negligible only when supplementing the wage model with controls for the individuals' occupational status (see e.g. Asplund, 1993a; Asplund et al., 1996a).[23]

Table 3. Average wage effects of total (actual) work experience, log-%

	Experience	Experience squared

[22] Asplund (1993a) shows that the use of potential instead of actual years in working life produces a strongly upward-biased estimate especially for female employees.

[23] It may also be noted in this context that Uusitalo (1999) attempts to treat (potential) work experience as an endogenous variable by using age and age squared as instruments. This leads not only to a decline in the estimated coefficient for the experience variable; it turns insignificant altogether.

	Year	All	Men	Women	All	Men	Women
Asplund et al. (1996a) [a]	1987	1.8	2.6	0.9	-0.024	-0.039	-0.010[i]
Asplund et al. (1996a) [a]	1987	1.6	2.5	0.8	-0.024	-0.039	-0.009[i]
Asplund (1993a) [b]	1987	1.5	1.9	1.3	-0.020	-0.029	-0.017
Uusitalo (1999; recruits in 1982)	1994	-	1.4 [d]	-	-	-	-

PRIVATE SECTOR

	Year	Men	Women	Men	Women
Asplund (1998a) [c]	1987	2.1	1.4	-0.034	-0.021[i]
	1989	2.4	1.2	-0.037	-0.016[i]
	1991	2.5	1.2	-0.038	-0.012[i]
	1993	2.5	2.9	-0.034	-0.053

PUBLIC SECTOR

	Year	Men	Women	Men	Women
Asplund (1998a) [c]	1987	2.2	1.1	-0.033	-0.006[i]
	1989	1.3	1.6	-0.018[i]	-0.021
	1991	2.8	1.0	-0.048	-0.008[i]
	1993	2.8	1.7	-0.045	-0.020[i]

Notes: [i] indicates insignificance at the 5% level.

[a] Explanatory variables are: first row, schooling years, second row, four indicators for educational degree levels, and a gender dummy in the wage equation for all employees.

[b] In addition to five indicators for educational degree levels, the wage equation is supplemented with a broad set of other personal and job-related characteristics.

[c] Account is made for differences in educational degree levels (five indicators) as well as for various other personal and job-related characteristics, not occupational or industrial status, though.

[d] Calculated as number of years after graduation. None of the wage equations controls for tenure.

Experiments with work experience given the form of a linear spline (thereby following Stewart, 1983) instead of the conventionally used concave shape display quite an unexpected, but fairly similar overall pattern across genders and sectors. Instead of rising steeply, the experience profiles tend to decline or remain approximately unchanged for the first five years in working life. The rising trend starts only during the next five years representing 5–9 years of work experience. These years seem to be the most important ones especially for women in private-sector employment and men in public-sector employment. The next ten years give a further push up the wage scale, most strongly for men in private-sector employment. After 20 years of work experience the experience-earnings profile stays flat towards the end of working life. This lack of a declining trend with increasing work experience is repeated across genders and sectors and emerges irrespective of the activity level of the economy.[24]

From the estimated coefficients of (actual) work experience obtained for non-manual workers in manufacturing using TT wage data, it may be concluded that the rewarding of work experience has weakened substantially over the 15-year period 1980–94 (Asplund, 1996). In other words, the wage position of the inexperienced workers entering a manufacturing job has strengthened relative to their more experienced colleagues. The overall trend has been much the same among upper-level, technical and clerical non-manual workers (Asplund, 1993b). Comparison of male and female non-manual workers, in turn, displays a huge gender gap in the wage impact of work experience, a gap that has expanded further in the early 1990s (Asplund, 1998c). The experience-earnings profiles look completely different also when comparing non-manual workers employed in fast growing and slowly growing industries. In particular, the former category has persistently faced a significantly higher and also more steeply rising wage effect from increasing work experience (Asplund and Vuori, 1996). Common to both categories, however, is that they have seen a steady decline in the estimated wage effect, albeit of a highly different magnitude. The experience-earnings gap between the two industry categories was, as a consequence, notably larger in the early 1990s than in the early 1980s. This trend was further strengthened by a weak recovering in experience-induced wage effects in the fast growing industries in the mid-90s.[25]

Accounting for the individuals' tenure not only adds to the drop in the estimated wage effects of work experience but also changes the interpretation of the estimate of the experience variable. Now the estimated wage effect of work experience reflects the influence of the work experience acquired before entering the current job. The differ-

24 For more details, see Asplund (1998a).
25 Asplund and Vuori (1996) also report corresponding results for different-sized establishments.

ence between this experience-induced wage effect and the total wage effect reported in Table 3 above thus illustrates the influence on wages

Table 4. Average wage effects of (actual) work experience when also controlling for tenure, log-%

		Experience			Experience squared		
	Year	All	Men	Women	All	Men	Women
Asplund et al. (1996a) [a]	1987	1.4	2.3	0.5[i]	-0.022	-0.038	-0.007[i]
Asplund (1999) [b]	1987	1.5	2.1	1.0	-0.026	-0.034	-0.020
	1989	1.1	1.8	0.3[i]	-0.018	-0.030	-0.004[i]
	1991	1.8	2.3	1.5	-0.032	-0.040	-0.028
	1993	1.7	2.3	1.1	-0.027	-0.036	-0.017[i]
PRIVATE SECTOR							
	Year		Men	Women		Men	Women
Asplund (1998a) [c]	1987		1.8	0.9[i]		-0.032	-0.016[i]
	1989		2.0	0.6[i]		-0.033	-0.008[i]
	1991		1.9	0.8[i]		-0.031	-0.012[i]
	1993		1.8	3.0		-0.022	-0.062
PUBLIC SECTOR							
	Year		Men	Women		Men	Women
Asplund (1998a) [c]	1987		1.8	0.6[i]		-0.028[i]	-0.006[i]
	1989		0.5[i]	0.9[i]		-0.005[i]	-0.015[i]
	1991		2.7	0.7[i]		-0.047	-0.010[i]
	1993		1.9	1.6		-0.030[i]	-0.025[i]

Notes: [i] indicates insignificance at the 5% level.

[a] Explanatory variables are: schooling years, tenure and a gender dummy in the wage equation for all employees.

[b] Explanatory variables are: five indicators for completed educational level, dummy for tenure less than one year, tenure and tenure squared, dummy for participation in employer-financed training and a gender dummy in the wage equation for all employees.

[c] Account is made for differences in educational degree levels (five indicators) and tenure (dummy for tenure less than one year, tenure and tenure squared as well as for various other personal and job-related characteristics, not occupational or industrial status, though.

of tenure, often interpreted as capturing the firm-specific training acquired in working life. Table 4 reproduces some of the estimates from Table 3, now adjusted for the wage impact of tenure. The general impression is that the change in the experience-earnings profiles is minor, which is also to be expected from the small overall wage effect of work experience and the minor overall role of tenure (see next subsection).

4.2.3 Earnings effects of tenure

The wage effects reported for work experience give a good hint of the size of the wage growth induced by increasing tenure. The available evidence for the Finnish labour market is reviewed in Table 5, with tenure referring to the length of the individual's employment relationship at the current employer. The overall impression mediated by the table is, indeed, a minor wage influence of tenure. The very small size of the tenure effect is also evident from the fact that the tenure-earnings profile is throughout estimated to be flat or almost flat.

The results obtained for the boom years in the late 1980s indicate that the role of longer tenure for wage growth was much more important among public-sector employees, although the effect was quite strong also among women employed in the private sector. The deep recession in the early 1990s seems, however, to have fundamentally reversed this pattern. More precisely, by 1993 the tenure-induced growth in female wages had disappeared in both sectors at the same time as the rewarding of their general work experience boosted (cf. Table 4 above). Men in private-sector employment, in contrast, faced the opposite change with the length of the current employment relationship exerting an increasing influence on their wage growth.

The tenure-induced wage effects estimated for non-manual workers in manufacturing from TT wage data are equally moderate. Moreover, the wage advantage of a longer employment relationship shows no time trend whatsoever and has varied quite randomly – mostly between negligible and negative values. This overall pattern is repeated for all non-manual categories as well as for all the subgroups investigated.[26]

Table 5. Wage effects of tenure for all employees and separately by gender and sector, log-%

	Tenure	Tenure squared

[26] See Asplund (1996) for results for all non-manual workers and separately for upper-level, clerical and technical non-manual workers, Asplund (1998c) for male and female non-manual workers, and Asplund and Vuori (1996) for non-manual workers employed in, respectively, fast and slowly growing industries.

	Year	All	Men	Women	All	Men	Women
Asplund et al. (1996a) [a]	1987	0.6	0.5	0.7	-	-	-
Asplund (1993) [b]	1987	0.6	0.4[i]	0.7	-0.001[i]	-0.001[i]	0.000 [i]

		Tenure < 1 year		Tenure		Tenure squared	
WHOLE ECONOMY		Men	Women	Men	Women	Men	Women
Asplund (1999) [c]	1987	1.2[i]	14.6	0.4[i]	1.3	-0.002[i]	-0.021
	1989	6.3	13.7	1.0	1.7	-0.012[i]	-0.031
	1991	4.6[i]	11.4	1.1	0.8	-0.017	-0.005[i]
	1993	5.8[i]	14.2	1.1	0.1[i]	-0.018[i]	0.014[i]
PRIVATE SECTOR							
Asplund et al. (1996a) [a]	1987	-	-	0.5	0.4	-	-
Asplund (1998a) [d]	1987	2.2[i]	9.0	0.3[i]	1.0	-0.003[i]	-0.016[i]
	1989	3.0[i]	10.8	0.7	1.6	-0.006[i]	-0.030
	1991	5.9[i]	17.2	1.2	1.0	-0.019	-0.009[i]
	1993	6.8[i]	8.3[i]	1.7	0.3[i]	-0.038	0.011[i]
PUBLIC SECTOR							
Asplund et al. (1996a) [a]	1987	-	-	0.7	0.9	-	-
Asplund (1998a) [d]	1987	12.6	20.0	1.2	1.9	-0.019[i]	-0.026[i]
	1989	31.1	19.3	1.8	2.0	-0.029[i]	-0.032
	1991	7.3[i]	10.6	0.6[i]	1.1	-0.010[i]	-0.009[I]
	1993	20.0	19.4	1.6	0.5[i]	-0.026[i]	0.009[i]

Notes: [i] indicates insignificance at the 5% level.

[a] Explanatory variables are: schooling years, experience, experience squared and a gender dummy in the wage equation for all employees.

[b] Account is made for differences in educational degree levels (five indicators) and work experience as well as for various other personal and job-related characteristics, not for occupational status, though.

[c] Explanatory variables are: five indicators for completed educational level, experience, experience squared, dummy for participation in employer-financed training and a gender dummy in the wage equation for all employees.

[d] Account is made for differences in educational degree levels (five indicators) and work experience as well as for various other personal and job-related characteristics, not for occupational status or industry affiliation, though.

4.2.4 Earnings effects of job training

The only individual-level database containing information about the individuals' participation in employer-financed job training is the Labour Force Survey. The sample individuals are asked whether they have participated in employer-financed training courses outside the workplace and for how many days in total during the past 12 months. The available empirical evidence based on this information is displayed in Table 6.

The estimates point to a substantially lower rewarding of participation in employer-financed job training among women, which is primarily attributable to the negligible wage advantage of women employed in the public sector of participating in this type of training. It is also of interest to note that the deep recession seems to have strengthened the importance not only of tenure but also of training in

Table 6. Wage effects of participation in employer-financed job training outside the workplace, log-%

		Male employees			Female employees		
		All	Private sector	Public sector	All	Private sector	Public sector
Asplund (1993a) [a]	1987	10.1	13.0	8.2	3.1	8.9	-1.0[i]
Asplund (1998a,1999) [b]	1987	10.8	11.7	7.2	3.0	9.5	-1.5[i]
	1989	8.6	8.7	8.5	4.1	11.7	-2.8[i]
	1991	8.5	9.6	4.1[i]	5.8	9.6	4.9
	1993	9.9	12.4	6.7	3.8	8.3	1.8[i]

Notes: [i] indicates insignificance at the 5% level.

[a] Account is made for differences in educational degree levels (five indicators), experience (and its square), tenure (and its square) as well as for various other personal and job-related characteristics, not for occupational status or industry affiliation.

[b] Account is made for differences in educational degree levels (five indicators), experience (and its square), tenure (tenure < 1 year – dummy, tenure and its square) in the "All" equations (Asplund, 1999), while the sectoral equations are, in addition, supplemented with a limited number of other personal and job-related characteristics, not occupational status or industry affiliation, though (Asplund, 1998a).

explaining observed wage differentials among men employed in the private sector. Again an opposite trend is observable for their female counterparts, i.e., a decline in the wage influence of training as well as tenure.

The estimated differences in wage effects may, of course, be the result of crucial differences both in the length and the content of the training received. Evidence for 1987 indicates, however, that the overall pattern is maintained when accounting for differences in the total number of training days (Asplund, 1993a).

5 Conclusions

Most existing evidence for Finland on the earnings effects of human capital endowments refer to a rather short time period, viz. 1987 to 1993. Only occasionally have results been reported for a longer sequence of years and then mostly for a very limited set of human capital proxies or for a specific category of workers.

Moreover, the analysis of the interplay between the individuals' earnings and their human capital endowments has drawn heavily on the conventional Mincer-type earnings model. Few attempts have been made to account for the fact that the human capital acquired by the individual is not necessarily the outcome of a random process but rather the result of individual choice. More research is needed on the impact of innate ability and family background on returns to schooling and schooling choice. Also totally unexplored areas should be penetrated. For instance, we are lacking empirical evidence on the effects of screening/signalling and sheepskin effects as well as on the link between educational returns and unemployment. In fact, compared to many other European countries (see the other country-specific literature reviews in this volume) Finland is without doubt lagging far behind when it comes to empirical evidence on the rewarding in the labour market of investment in education and other types of human capital.

Needless to say, the richness of the empirical evidence produced in a country largely reflects the availability of proper data. This is certainly true when it comes to returns to schooling. Enlarging our knowledge on returns to human capital in general and to schooling in particular is thus a challenge not only for the research community but also for the bodies creating and producing statistical databases.

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Table A1. Summary of the studies reviewed

Study	Ingberg (1987)	Brunila (1990)	Asplund (1993)	Eriksson (1994)	Helo & Uusitalo (1995)	Asplund (1996)	Asplund & Vuori (1996)
Data used	LFS 1980 HPC 1980	PCD 1975, 1985	LFS 1987	PCD 1970, 75, 80, 85, 90	PCD 1975, 80, 85, 90	TT wage data 1980-94	TT wage data 1980-94
Type of data	Cross-section	Cross-sections	Cross-section	Cross-sections	Cross-sections	Cross-sections	Cross-sections
Population covered	All, men	Full-time, full-year All, men, women	All, men, women, private vs. public sector, occupational categories	All	All with either a university degree or merely a matriculation examination	All non-manual workers, mainly manufacturing & 3 sub-groups (technical, clerical, upper-level)	Non-manual workers in high-tech & other fast growing vs. slowly growing industries, further division by plant size
Wage concept	Annual taxable income*	Gross annual earnings	Gross hourly wage	Gross monthly and annual earnings	Annual taxable income**	Gross hourly wage	Gross hourly wage
Estimation method(s)	OLS	OLS	OLS, correction for sample, occup. & sectoral selectivity bias	OLS	Tobit	OLS	OLS
Years of schooling	X		X			X	X
Educational levels		X	X	X	X	X	X
Experience		Age	Actual (self-reported)	Age	Calculated as time elapsed since graduation	Actual (from employer registers)	Actual (from employer registers)
Tenure/ OJT			X/X			X/-	X/-

Other variables		X	X	X	X	X	X
No of obs.	4,041/ 2,176	A total of some 11,000 per year	A total of 3,895	Some 100,000 to 200,000	Some 9,000 to 23,000	Some 10,000 to 15,000 per year	Some 10,000 to 15,000 per year

Notes: All variables indicated are not necessarily included at the same time.
LFS = Labour Force Survey; HPC = Household and Population Census; PCD = Population Census Data
* Inclusive of farming and entrepreneurial income; ** inclusive of entrepreneurial and capital income.

Table A1. (cont.)

Study	Asplund et al. (1996a)	Asplund et al. (1996b)	Eriksson & Jäntti (1996)	Eriksson & Jäntti (1997)	Asplund (1998a)	Asplund (1998b)	Uusitalo (1999)
Data used	LFS 1987	LFS 1987	PCD 1970, 75, 80, 85, 90	PCD 1970, 75, 80, 85, 90	LFS 1987, 89, 91, 93	LFS 1987, 89, 91, 93	Merging of several data sources
Type of data	Cross-section	Cross-section	Cross-sections	Cross-sections	Cross-sections	Cross-sections	Cross-sections
Population covered	All, men, women, private vs. public sector	Men, women	All	All, males, females	Men, women by sector (private vs. public)	All	Recruits in 1970; recruits in 1982
Wage concept	Gross hourly wage	Gross hourly wage	Gross monthly and annual earnings	Gross monthly earnings	Gross hourly wage	Gross hourly wage	1970 sample: average annual taxable earnings for 1975-90; 1982 sample: gross monthly earnings for 1994

Estimation method(s)	OLS	Sample selection correction	OLS	OLS	Correction for sample and sector selection bias	OLS	OLS, different schooling choice models
Years of schooling	X	X			X	X	X
Educational levels	X		X	X	X	X	X
Experience	Actual (self-reported)	Actual (self-reported)	Age	Age	Actual (self-reported)	Actual (self-reported)	Age, potential & calculated experience
Tenure/ OJT	X/-	X/-			X/X	X/X	
Other variables	X	X	X	X	X	X	X, ability
No of obs.	A total of 3,895	1,873/ 1,974	Some 70,000 to 180,000	Some 70,000 to 180,000	A total of some 2,500 to 4,000	A total of some 2,500 to 4,000	~ 1,500 (1970 sample); ~ 22,500 (1982 sample)

Table A2. Average returns to educational degrees, all employees and by gender, log -%

	Year	Educational degree: Basic (9 years)	Lower secondary (11-12 years)	Upper secondary (12 years)	Short non-university (13-14 years)	BA-level (15 years)	MA-level (16 years)	Post-graduate (18-20 years)
All employees								
Asplund (1999) [a]	1987	ref.	4.8	22.8	38.0	50.0	62.1 [c]	
	1989	ref.	4.0	20.4	36.5	49.3	62.0 [c]	
	1991	ref.	3.1	20.2	40.2	49.3	63.4 [c]	
	1993	ref.	3.3	19.1	33.3	43.4	60.5 [c]	
Eriksson & Jäntti (1996a) [b]	1971	ref.		43.4	67.3	96.6		103.8
	1975	ref.		27.1	44.9	66.1		79.0
	1980	ref.		21.8	40.9	60.8		76.3
	1985	ref.		18.8	37.2	56.3		64.9
	1990	ref.		18.4	36.1	56.7		73.9
Male employees								
Asplund (1999) [a]	1987	ref.	8.0	25.9	41.0	45.0	61.0	
	1989	ref.	5.4	21.9	42.1	45.8	62.4	
	1991	ref.	3.8	22.7	43.3	52.7	61.7	
	1993	ref.	1.9 [i]	21.4	32.6	36.0	58.4	
Eriksson & Jäntti (1996a) [b]	1971	ref.		48.0	71.5	99.8		112.2
	1975	ref.		28.4	46.6	69.2		83.4
	1980	ref.		22.4	40.5	62.8		79.0
	1985	ref.		20.7	39.4	57.6		69.1
	1990	ref.		22.0	40.6	60.4		78.3

Female employees								
Asplund (1999) [a]	1987	ref.	0.018 [i]	19.0	35.3	50.7	62.5	
	1989	ref.	0.021 [i]	17.9	30.4	51.0	60.6	
	1991	ref.	0.026 [i]	18.0	36.9	47.7	65.3	
	1993	ref.	0.042 [i]	15.5	33.5	48.0	59.6	
Eriksson & Jäntti (1996a) [b]	1971	ref.		34.0	62.4	94.6		124.5
	1975	ref.		24.4	42.8	63.8		102.3
	1980	ref.		21.4	42.1	60.6		91.1
	1985	ref.		17.1	35.8	57.3		69.8
	1990	ref.		15.9	32.1	55.1		85.8

Notes: An [i] indicates that the estimate is not significantly different from zero, i.e. from the reference category, at the 5% level.

[a] Also see Asplund (1993a) and Asplund et al. (1996a).

[b] The results are approximately the same when using annual and monthly earnings as the dependent variable (see Eriksson and Jäntti, 1996b). Including those aged 16-24 also leaves the results approximately unchanged (cf. Eriksson, 1994).

[c] The very small number of post-graduates do not allow a distinction to be made between graduated and post-graduated.

Table A3. Average returns to educational degrees by sector and gender, log -%

	Year	Educational degree					
		Basic (9 years)	Lower secondary (11-12 years)	Upper secondary (12 years)	Short non-university (13-14 years)	BA-level (15 years)	MA-level (16 years)
Private sector							
Male employees	1987	ref.	11.3	30.4	56.2	60.3	69.0
	1989	ref.	8.5	29.9	58.1	77.2	82.4
	1991	ref.	7.7	28.6	53.5	73.0	70.0
	1993	ref.	1.0 [i]	19.5	36.1	45.0	59.0
Female empoyees	1987	ref.	-3.0 [i]	16.1	32.5	44.9	58.4
	1989	ref.	1.5 [i]	18.1	32.9	40.1	53.5
	1991	ref.	-0.4 [i]	17.1	33.2	37.5	45.7
	1993	ref.	5.7 [i]	18.5	43.2	48.2	71.2
Public sector							
Male employees	1987	ref.	12.0	28.8	51.2	52.6	70.0
	1989	ref.	3.7 [i]	22.2	42.9	41.8	65.3
	1991	ref.	6.4 [i]	25.6	45.7	51.5	66.2
	1993	ref.	4.7 [i]	22.8	32.8	41.5	65.8
Female employees	1987	ref.	3.8 [i]	20.3	37.0	52.5	65.2
	1989	ref.	9.5	25.5	42.2	64.5	75.1
	1991	ref.	9.5	24.7	47.2	59.6	78.8
	1993	ref.	11.2	17.1	41.5	52.8	65.0

Note: An [i] indicates that the estimate is not significantly different from zero, i.e. from the reference category, at the 5% level.
Source: Asplund (1998a)

Table A4. **Average returns to educational degrees for all non-manual workers in manufacturing and separately for selected subgroups, log-%**

	All non-manual workers			Male non-manual workers			Female non-manual workers			Non-manual workers in fast growing industries			Non-manual workers in slowly growing industries		
	Upper sec. education	Short non-univ. education	Graduate or higher	Upper sec. education	Short non-univ. education	Graduate or higher	Upper sec education	Short non-univ. education	Graduate or higher	Upper sec. education	Short non-univ. education	Graduate or higher	Upper sec. education	Short non-univ. education	Graduate or higher
1980	13.4	25.9	49.9	14.5	25.9	53.6	12.6	32.0	36.2	13.7	28.5	55.2	5.2	17.3	40.1
1981	12.1	23.7	47.3	13.4	23.6	50.6	10.7	29.7	35.4	12.2	25.7	52.7	3.4	17.6	35.8
1982	12.6	23.9	45.8	15.2	25.1	50.5	10.8	29.9	34.3	10.9	21.7	42.3	3.4	17.2	41.5
1983	12.8	23.6	46.3	14.1	23.5	50.2	11.4	30.6	34.5	13.2	23.5	43.9	6.2	16.7	34.3
1984	12.5	22.2	43.0	15.1	23.9	51.5	10.0	27.2	33.8	12.5	19.6	38.9	8.6	16.4	37.0
1985	12.4	22.9	46.2	16.0	26.0	52.9	9.4	25.6	36.1	11.2	20.3	41.2	1.6	15.8	39.5
1986	11.4	21.4	44.5	16.2	26.5	53.3	8.1	22.0	32.9	8.6	17.0	37.7	-0.7	17.4	32.5
1987	11.9	21.9	45.3	17.6	28.5	54.6	8.0	20.2	36.0	11.1	19.3	39.8	-3.0	16.5	26.7
1988	9.0	17.9	41.4	11.1	20.3	46.7	7.0	18.7	31.6	9.2	15.7	34.0	2.9	21.2	35.0
1989	8.6	15.7	38.8	10.7	17.3	42.9	6.9	19.1	32.8	7.1	14.0	36.4	4.4	21.5	36.9
1990	10.1	18.4	42.1	12.3	21.7	48.6	7.8	17.0	28.9	7.8	14.9	34.4	0.9	11.7	34.4
1991	9.9	17.8	39.7	13.6	22.6	47.7	6.5	15.7	29.0	8.5	15.2	34.4	0.5	9.2	37.0
1992	11.1	18.5	40.5	14.5	23.0	48.4	8.0	18.3	29.9	8.4	13.9	33.8	9.7	24.6	54.3
1993	11.0	18.4	41.8	16.2	25.0	51.8	6.8	16.5	28.3	9.6	14.5	36.7	1.0	9.3	23.2
1994	11.8	18.8	42.8	13.7	21.7	47.8	9.4	18.8	34.7	11.3	19.2	43.3	7.8	15.1	46.9

Note: The reference category is non-manual workers with a basic education only. Estimation results for non-manual workers having completed the lower level of upper secondary education are not reported since most estimates are either insignificant or even negatively signed.

Source: Asplund (1996, 1998c) and Asplund and Vuori (1996)

CHAPTER 5

Returns to Human Capital: A Review of the French Empirical Literature

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1 Introduction[1]

Since Becker (1964), economists agree upon the idea that the more individuals invest in human capital, the more they acquire skills and the higher their earnings are. Yet, this quantitative aspect is not sufficient to understand the relationship between human capital and earnings. Human capital has components that differ in nature. Not only should one distinguish the skills that are of value for any employer from those that are of value for a single employer, but also those acquired before entering the labour market from those that are naturally enhanced through experience.

Individuals who decide to attend extra years in school beyond compulsory schooling must find it preferable to delay their entry into the labour market and to acquire general human capital by raising their education level. Theoretically, an individual who seeks to maximise lifetime net income, will undertake the investment if it leads to a positive net present value and/or if the internal rate of return is greater than the market real interest rate (see Filer, Hammermesh and Rees, 1996).

From an empirical point of view, it is also reasonable to argue that for the criteria of net present value or internal rate of return to be satisfied, the age-earnings profiles must be higher for workers with more education throughout their working lives.

A very popular way to compare age-earnings profiles for individuals with different education levels consists in estimating Mincer-type equations (Mincer, 1974). The popularity of such an approach resides in its simplicity and in the existence of compatible data. Moreover, it is very flexible as it enables one to directly estimate the average wage differentials between individuals with different education levels or simply the returns to an extra year of schooling.

To estimate the returns to human capital, economists very often use cross-section data, that is, a synthetic cohort composed of workers of different ages observed in the same year. It might, however, be misleading to compare the earnings of people with possibly very different attitudes in the labour market. Of course, it is always possible to restrict the analysis to samples where individuals can be

1 We are grateful to John G. Treble for helpful comments.

considered as reasonably homogeneous.[2] This, however, is not sufficient since comparing the earnings of people born before World War II to those of people who entered the labour market in the nineties might also be misleading. This makes the use of panel data preferable as it allows a longitudinal approach to the relationship between human capital and earnings.

There remain nonetheless a number of reasons why the returns to human capital estimated via the use of a Mincer-type equation might be biased. Indeed, very often this approach neglects non-wage returns, such as the better working conditions under which highly educated workers generally do their jobs (Lucas, 1977). It also neglects the loss in workers' welfare, due to the higher price of leisure induced by the positive relationship between investment in human capital and wages (Lindsay, 1971).

A possibly more serious source of bias emerges from the lack of a precise measure of individuals' ability. Ability biases have given rise to a number of studies addressing the question of whether the factors that make individuals more likely to reach high education levels would yield higher earnings even if they had stopped their education at earlier stages. If such a hypothesis holds, then the estimates of the returns to education would be biased upward as long as they ignore the reason why some individuals reach high education levels while others do not (Card, 1998).

Yet, intrinsic individual ability is not the only determinant of individuals' education level. For instance, social status and family background are also possible and perhaps more easily measurable candidates. This means that education can no longer be treated as a simple exogenous variable if endogeneity biases are to be avoided.

It is worth noticing that most of the recent empirical literature reports attempts to overcome these various sources of bias in estimating the returns to human capital. One of the reasons why it is important to precisely measure the private returns to education is that they can be compared to the social returns that include both private and public costs and benefits of education. Indeed, the more the higher earnings of more educated people result from education increasing their productivity, the more the society or the government represen-

[2] This is the reason why so many analyses focus only on year-round, full-time male workers.

ting it will be induced to devote more resources to education, *ceteris paribus*. If on the contrary the estimated private returns do not reflect an increase in productivity, then it is likely that the social returns are less than the private ones (Polachek and Siebert, 1993). Thus, once the private returns are estimated, there remains the problem of the accuracy of their interpretation in terms of productivity.

Indeed, alternative explanations exist. The old-school-tie hypothesis argues that successful applicants are selected by previous graduates of similar schools on the basis of loyalty and friendship rather than on performance. A perhaps more relevant explanation is that underlying the so-called screening hypothesis. The idea here is that diplomas may be a way of demonstrating to employers that the graduates have attractive characteristics and ability to perform well on the job. In a variant of the screening hypothesis, it is argued that if the decision of investing in education is affected by employers' willingness to offer higher wages to highly educated individuals, then education functions as a signal to employers of the applicants' ability (see Spence, 1974).

If the returns to education reflect productivity, then there must be no significant bonus returns for being successful in obtaining a diploma as it is difficult to argue that such a bonus reflects higher accumulation of human capital. However, evidence reports that such bonuses do exist. Called sheepskin effects, they probably reflect personal attributes valued by employers, such as the determination needed to finish tasks, rather than the greater human capital of the graduates compared with the one of the drop-outs (Kane and Rouse, 1995). To analyze sheepskin effects, individuals must be distinguished not only according to the number of years of schooling, but also with respect to the diplomas they hold. Another reason why the distinction between diplomas is important is that the number of years of schooling is a rather crude measure of human capital in countries with multiple education streams, leading to different returns to education.

To sum up, returns to human capital are neither easy to estimate nor clearly interpretable. This explains the effort made by researchers in order to shed light on the various topics discussed above. Our purpose here is to report the answers that are suggested by analyses of the French labour market.

The chapter is organized as follows: Section 2 gives a brief description of the data sets on which the empirical analyses are based. Section 3 reports the attempts that have been made to evaluate the importance of the various sources of bias and/or to interpret the estimated returns. Section 4 summarizes analyses comparing the earnings of individuals with different endowments or characteristics. Section 5 discusses research focusing on either international comparisons or the evolution over time of the returns to human capital. Finally, some concluding remarks are made in Section 6.

2 Data

As emphasized by Mincer (1958), theoretical concepts such as learning and earnings imply a longitudinal approach to individuals' income. Nevertheless, analyses of French earnings equations are often driven on the basis of cross-section data, a fact mainly explainable by the scarcity of panel data sets. However, such an approach assumes strong stationarity hypotheses. For this reason, although different cross-sectional data sets are available, most authors interested in the effect of education on earnings have chosen the surveys called *Formation et Qualifications Professionnelles* (FQP)[3] conducted by INSEE, the French National Statistics Institute, among a sample of households drawn from each population census.[4]

Indeed, these surveys present very interesting characteristics. First, not only are they the richer ones in terms of initial as well as post-initial[5] education and professional outcomes, but they also contain very detailed information about individuals[6] and their household characteristics and cover the public as well as the private sector. Secondly, they contain very interesting biographical variables such as the individual's characteristics as well as his job description five years earlier. Finally, though not concerned withthe same individuals, the 5 FQP data sets that are available (1963, 1970, 1977, 1985, 1993) imply that the same information about the French labour market can be ob-

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3 Training and Professional Qualifications.
4 The periodicity of the population census in France is eight years.
5 Continuing education, formal vocational training programmes, etc.
6 Whether they participate or not in the labour force, are employees or self-employed.

served for many points in time. Though it is not possible to track individuals, some authors use successive waves of the FQP survey in order to highlight the evolution of the observed patterns. Other build pseudo-panel data sets in order to capture cohort effects.

In contrast to others FQP, the other cross-section data sets used in the literature are not directly concerned with education. The *Enquête sur le Coût de la Main-d'Oeuvre et la Structure des Salaires* (ECMOSS)[7] has been conducted by INSEE for the years 1972, 1978, 1986 and 1992. Questionnaires were sent to a sample of establishments in the private non-agricultural sector. Within these establishments random samples of individuals were drawn and their wages and characteristics were described by the employer.[8] Thus, each of the resulting surveys contains two sets of variables. The first is concerned with the production unit (industry and activity, size, region, etc.) while the second describes individual characteristics (nationality, gender, age, occupation and tenure) as well as some labour contract features.[9]

While the 1986 survey covers about 16,200 establishments and some 680,000 employees, that of 1992 concerns around 14,700 production units and 150,000 individuals. The reason why there are fewer individuals is that the 1992 survey focused with fine detail on employer characteristics (manning, turnover, unions activity, labour organisation, product market, etc.). Note, however, that for 1986 there is no information about education while for 1992 detailed description of diplomas is available.

Another interesting data set is that from the fairly recent *Enquête Européenne sur la Structure des Salaires* (EESS)[10] conducted in France by INSEE in 1994 and in Germany by the *Statistiches Bundesamt* in 1995. The EESS data cover 9,669,400 West-German workers and 6,648,500 French workers in establishments with more than nine employees from the sectors of industry, commerce, construction and financial services.

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[7] Labour Costs and Wages Structure Survey.

[8] The sector of services has been included only after 1972.

[9] Only the 1986 and 1992 ECMOSS surveys are used in the papers discussed in this review.

[10] European Wages Structure Survey.

The *Enquête Carrière et Mobilité* (ECM)[11], conducted by INSEE for the years 1974, 1981 and 1989, is another data source used in the literature. In the 1989 survey, individuals born between 1930 and 1959 had to fill in a questionnaire about the characteristics of their first job and of their jobs in March 1960, 1967, 1974, 1981 and 1989.[12]

Compared to the numerous cross-section data sets available in France, panels are rather scarce. In fact, the only panel data sets conducted by INSEE and used in the literature are the so-called *Enquête Emploi* (Emploi)[13], where only a third of the sample is renewed each year, and the *Déclarations Annuelles des Salaires* (DAS)[14], which has been conducted annually since 1967 and covers workers born in October each even year. These workers enter the sample as soon as they get their first job in firms from the private or semi-public sectors so that the sampling rate is about 1/25. It should be noted, however, that while the DAS survey contains a rather rich information on remunerations, it provides no direct measure of human capital.

3 Estimates of returns to education

The results from French labour market data are consistent with the predictions of human capital theory. However, as shown in Table A1 of the Appendix, there are significant discrepancies in the estimated coefficients associated with human capital components, especially with respect to the number of years of schooling, the returns to which vary from 4.2 to 19.2% with an approximate average of 8%.[15] Potential explanations of the observed differences reside in the period under consideration, the data the analyses are based on, the adopted methodologies and the individual and/or employer characteristics controlled for. Another explanation is that the various

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11 Careers and Mobility Survey.
12 Only the 1989 ECM survey is used in the literature discussed below.
13 Employment Survey.
14 Annual Declarations of Wages.
15 Except where the schooling variable is standardized as is the case in Goux and Maurin's (1994) study which we will discuss later.

potential sources of bias are not always taken into account. It is therefore important to start our presentation by identifying the studies where effort has been expended to evaluate the importance of such biases.

The first extensive analysis of Mincerian equations in France is provided by Riboud (1978). The author is interested in the interpretation of earnings equations and the empirical problems their estimation leads to. She analyzes the role of experience, initial as well as post-initial education and household characteristics as wage determinants. However, the perhaps most remarkable feature of Riboud's work is her intuition about the endogeneity of education. She uses the 1963 FQP survey and focuses on French men aged between 13 and 65. Mincer-type earnings equations are first fit by OLS (quadratic function of education and experience), the results of which lead to a discussion of possible explanations of the residuals. Alternative specifications are then estimated including a distinction between secondary education and university and introducing post-initial education. When considering family background effects, the author argues that education is endogenous and regresses the number of years of schooling on the education of the individual's father. Although the results highlight a positive correlation between these two variables, the author merely includes the father's education as a supplementary regressor and obtains lower returns to education in the augmented earnings function.

A satisfactory approach to the endogeneity problem using French data was given only fifteen years later by Boumahdi and Plassard (1992). Their analysis is based on the 1985 FQP survey from which a sample of male employees aged between 16 and 65 was drawn. A Hausman test is performed to examine the relevance of the exogeneity hypothesis. In fact, the test consists in comparing the results from an earnings equation fit by OLS to those obtained when running the same equation using two-stage least squares techniques, the instruments being the parents' education. Compared to the 8.7% OLS estimate, instrumental variables result in a return to education of 11.3%.

Guillotin and Sevestre (1994) also use Instrumental Variables methods (IV), but contrary to Boumahdi and Plassard (1992), their analysis is based on panel data. However, the DAS survey they use provides no direct information on human capital. To remedy this lack of information, they focus only on individuals entering the survey.

They define the entrant year *t* according to whether the individual was absent from the data before *t*, but present in years *t*, *t*+1, *t*+2 and was aged less than 30 in year *t*. As individuals enter the survey as soon as they get their first job, the authors calculate education as the difference between the age of entry into the sample and 14 years.[16] Besides, experience is calculated as the difference between the current date and the date of entry into the sample. The result is an unbalanced panel data set covering the period 1968–1987.

An interesting feature of Guillotin and Sevestre's (1994) approach is their willingness to report estimates of returns to education, which would have been impossible had they chosen Within estimates.[17] Thus, the authors compare results from OLS, Feasible Generalised Least Squares (FGLS) as well as IV methods to overcome the problem of education endogeneity.[18] The authors also claim that the use of a balanced data set might lead to a loss of sample representativity and thus compare estimates based on balanced and unbalanced data sets.[19] Note also that the authors attempt to correct for selectivity bias due to possible non-representativity of the whole sample.[20]

The results obtained by Guillotin and Sevestre (1994) show that the returns to education are underestimated when using OLS or FGLS; between 3.8 and 4.2% with a balanced data set and around 5% with an unbalanced one. Correcting for education endogeneity results in estimates between 7.5 and 14%. The returns are even higher when controlling for selectivity bias (between 7.3 and 16.3%).

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16 The age of compulsory schooling until 1959. Astonishingly, the authors consider this value though their sample includes individuals for whom the age of compulsory schooling was 16.

17 Within estimates eliminate variables that are constant over time (e.g. education).

18 The IV methods proposed by Hausman and Taylor (1981) or Breusch, Mizon and Schmidt (1989) are then more appropriate.

19 Tests for the presence of a balance bias is performed using the Nijman and Verbeek (1992) method, which is an extension of the Hausman test.

20 Arguing that the two-step Heckman procedure (inverse of Mills' ratio) is too heavy to implement when using panel data, the authors use instead the Nijman and Verbeek (1992) method which consists in adding dummy variables describing the status of individuals in the sample. These variables take the value of 1 if the individual is present during the whole period covered by the sample and/or 1 at time *t* if the individual was present at time *t-1*. An alternative method consists in using the number of times the individual is present in the sample as an additional variable.

It is worth noting that there is no agreement in the studies discussed so far about a unique measure of returns to education. However, they all come to the conclusion that assuming education as exogenous results in returns to education that are biased downward.

Though not directly interested in earnings, other French studies analyze the effect of family characteristics on individuals' professional career. As an example, Goux and Maurin (1997a,b) investigate the propensity of individuals to reproduce their parents' social status. Such an effect is then compared to that of education as a determinant of the individuals' own social status. On the basis of a sample of males aged between 25 and 64 from the 1977, 1985 and 1993 FQP surveys, Goux and Maurin (1997a) show that for a given education level, individuals have a tendency to reproduce their parents' social status. Moreover, along their professional career the effect of education levels on their own social status decreases while the effect of their family social status becomes more and more dominant. In another study, Goux and Maurin (1997b) exhibit that though diplomas become more necessary for individuals to get employed, they are less sufficient to access the same social status as for older generations, while the link between individuals' diplomas and those of their parents' becomes stronger than in the past.

Another interesting feature of Guillotin and Sevestre's (1994) study is that they conclude to the existence of individual fixed effects and to the rejection of the independence hypothesis between these and observables. Obviously, their approach is interesting as it underlines the importance of individual heterogeneity even though its potential sources cannot be identified since unobservables may include intrinsic ability as well as social origin or any unmeasured characteristic.

The same conclusion is shared by Goux and Maurin (1994). In order to analyze the experience-wage relationship they use a subsample of male full-time workers drawn from the Emploi surveys for the years 1990 to 1994. Like Guillotin and Sevestre (1994), they show that not only individual fixed effects have an impact on wages, but they condition the influence of observables on wages. However, as Goux and Maurin (1994) report Within estimates, fixed effects include the role of education. Hence, part of the correlation between fixed effects and observables might be due to a correlation between education and observables such as experience.

To our knowledge, no further efforts have been made in the French empirical literature to overcome the problem of individual heterogeneity and the various biases it might lead to. Instead, some of the researchers address the question of how to interpret the resulting estimates of the return to education.

Jarousse and Mingat (1986) address the question of whether the returns to education reflect performance or only a filter useful to employers. In order to compare the explanatory power of these two hypotheses, the authors estimate an earnings equation where the education variable is standardized in such a way that it reflects the number of years which would have been necessary to an individual from a given generation to obtain his degree. Their idea is that the latter measure eliminates the number of repeats as well as the number of years spent at school without leading to a higher degree. Indeed, the number of repeats may be considered, at least on average, as an ability measure and thus might lead to a negative effect on wages. Non-graduating years, on the other hand, enhance the individual's knowledge but might be less remunerated if sheepskin effects do exist.

Jarousse and Mingat's (1986) analysis is based on samples of French men, drawn from the 1970 and 1977 FQP surveys. Their empirical analysis starts with an OLS estimation of a quadratic function of the number of years of schooling and experience separately for the years 1970 and 1977. Jarousse and Mingat (1986) suggest that simply considering the number of years of schooling results in an overestimation of the returns to education of 2 percentage points.

With more or less the same idea in mind, Goux and Maurin (1994) use a sample of male full-time employees aged between 20 and 64 from the 1993 FQP survey. They consider the average number of years necessary to obtain a diploma, but the OLS coefficient associated with this variable seems to be higher than that associated with the number of years of schooling. Note, however, that the "normal" schooling variable they consider is different from the standardized version of Jarousse and Mingat (1986). Moreover, the two studies do not consider the same period nor do they estimate the same specification. Furthermore, in a different specification, the authors also include the number of repeats as well as the number of non-graduating years as explanatory variables. This allows them to show that non-graduating years result in a rate of return of 3.2% per year while graduating years are about three times more remunerated, thus suggesting the existence of sheepskin effects.

4 Differences across worker groups

All discussion so far has concerned analyses of more or less homogeneous groups of individuals. We should now address the question of how the returns to human capital vary if we consider different groups of workers. This section focuses on three important dimensions: occupational levels, gender and employer characteristics.

Age-earnings profiles of individuals with the same occupational level (labourers, clerks, foremen, white collars) are examined by Lhéritier (1992) on the basis of a cross-section and by Lollivier and Payen (1990) who use panel data. Note, however, that no education variable is available in these two studies.

The first attempt to estimate earnings equations using longitudinal data for France was actually made by Lollivier and Payen (1990) who used a sub-sample of males aged between 20 and 65 drawn from the DAS surveys for 1967–1982. However, insofar as no human capital variable is available, the data did not enable the authors to measure the effects of initial education or even experience and tenure on wages. This is why the only explanatory variables considered are age and occupations. Hence, the analysis focuses on comparing estimated age-earnings profiles for different occupations and for different generations of workers. The results are obtained from the estimation and identification of two equations. In the first one, variables are means, by generation. In the second one, individual variables are expressed in terms of their deviation from their generation average values.

The analysis by Lhéritier (1992) is based on the 1986 ECMOSS survey. The author uses OLS to estimate a series of earnings equations including various sets of individual and employer characteristics and compares the results from different sub-samples.

Both studies confirm the prediction of human capital theory; that is, an increasing and concave age-earnings profile. They also both confirm the stylised fact of a differently shaped age-earnings profile from one professional category to another: it is steeper for white-collar than for blue-collar workers or even intermediate categories.

Another result reported by Lhéritier (1992) is a measure of the gender wage gap per industry and occupation levels. Indeed, he shows that in 1986, there existed a wage differential between men and women[21] comparable from the point of view of their age, tenure, citizenship and employer size. This differential ranged from 4.4% for employees with low qualifications, working in the sector of services, to 39.9% for top managers in the same sector. These figures confirm those obtained in other studies such as Guillotin and Sevestre (1994) (between 6 and 18%) and Plassard and Tahar (1990) (25% for the year 1977).

Another gender gap analysis is provided by Sofer (1990) who examines the extent to which the male-female differential is related to the depreciation of women's human capital, due to their longer interruptions of activity. For this purpose, she uses the 1977 FQP survey. However, she includes only men and women whose first job started between 1972 and 1977 and those who remained employed in the same firm before 1972. Such a restriction enables the author to reconstitute the entire wage career of all sample individuals or, more precisely, to establish the total length and characteristics of the periods of inactivity and unemployment.

The analysis by Sofer (1990) of gender wage differentials is initially based on the Oaxaca–Blinder decomposition and thus on the comparison of two gender-specific wage equations estimated using OLS. In a second step, she estimates other equations in order to precisely examine the role of experience and time spent unemployed as possible explanations of the observed gender gap. Moreover, different sub-samples are considered, in particular according to the femininisation rate of the individual's occupation. The Oaxaca–Blinder decomposition gives a discrimination effect varying between 0.7 and 9.3% according to whether the rate of femininisation is taken into account or not. These results induce the author to conclude that the observed gender gap is not due to

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[21] Full-time workers aged between 18 and 59 and having worked the whole year.

a depreciation of women's human capital, but rather to discrimination. Furthermore, a comparison of the earnings equation estimates highlights the existence of a small but systematic difference in the returns to education.

Another gender based comparison is the one provided by Simonnet (1996) who analyzes the impact of intra- and inter-firm mobility of men and women on their wage profiles. In particular, she examines the link between the gender gap in wages and in the returns to education. Simonnet (1996) uses the 1989 ECM survey, but focuses on a sub-sample of 30 to 35 year old full-time workers and considers only those whose first job was prior to March 1981 and whose first job or occupation change occurred after March 1974. The OLS estimation results she obtains suggest very appealing conclusions. In particular, she shows that the wage differential between men and women with comparable education levels and experience cannot be explained by gender differentials in the returns to education, by industry or geographical effects. It is, instead, the result of different professional careers and discrimination.

Indeed, it seems that intra-firm mobility of male workers is assimilated to an accumulation of specific human capital and thus results in higher wages than for women. In contrast, inter-firm mobility seems to be favourable to women, not to men. The net effect is, however, favourable to men.

In order to compare the explanatory power of mobility to that of different returns to education as possible determinants of the gender wage differential, Simonnet (1996) considers as additional regressors the number of years of schooling per type of diploma. Her approach is obviously interesting because it also highlights differences in the returns to a supplementary year of schooling depending on the chosen type of education. Moreover, it enables the author to show that the returns to education are not systematically in favour of men; they are higher for women who are technical *Bacheliers* or undergraduates.

Another result obtained by Simonnet (1996) shows that the tenure-wage profiles remain unchanged in nature when including training and/or continuing education indicators. However, these seem to have a positive effect on wages that is stronger for men than for women except when workers' mobility between the private and the public sector is taken into account.[22]

Simonnet's results may be linked to those obtained by Goux and Maurin (1997c) who try to identify the determinants of continuing education effort and to measure its effect on workers' wages and mobility. The data set used is a sub-sample of the 1993 FQP survey, covering workers aged between 20 and 64 who worked for the same employer between 1988 and 1993. Comparison of OLS and FGLS estimates suggests that continuing education has a positive but small effect on wages.[23]

Moreover, estimation of a probit model allows them to show that continuing education has a negative effect on the probability of workers employed both in 1988 and 1993 to quit their current employer. This effect is even more important for men than for women and for high education levels than for low ones.

The conclusion the authors draw from their work is that continuing education has a stronger effect on job stability than on wages. However, workers do not have equal access to continuing education. It even seems that workers with fragile stability in the labour market are those who have less access to continuing education.

Another result highlighted by Goux and Maurin (1997c) is that continuing education effort increases with employer size. This finding is also to be connected to that obtained by Araï, Ballot and Skalli (1996b), who analyze the effect of employer size on seniority-wage profiles. Using the 1992 ECMOSS survey, they show that for blue-collar workers, the larger the establishment size is, the higher are the returns to seniority in the beginning of the workers' careers and the more rapid is the decrease of these returns to seniority. For the other categories of employees, they observe the opposite. They then examine the relevance of several hypotheses as explanations of the observed differences in wage profiles. In particular, they consider the hypothesis of specific human capital by evaluating the effect of the firm's expenses in formal vocational

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22 A positive effect of post-initial education emerges also from the results by Riboud (1978) and Plassard and Tahar (1990). However, these authors make no gender-related comparisons of such an effect.

23 FGLS estimates are obtained from regressions with employer fixed effects and correction for selection in training programmes.

training programmes on the size-specific returns to seniority. However, the data seem to suggest that size-related differences in these expenses do not explain the differences observed in seniority-wage profiles.

These considerations suggest that employer characteristics may have non-negligible effects on wages and possibly on the returns to human capital. For instance, Araï, Ballot and Skalli (1996a) and Plassard and Tahar (1990) report evidence on the existence of inter-industry wage differentials.

The analysis by Araï, Ballot and Skalli (1996a) involves the estimation of several earnings functions using OLS including various sets of employer characteristics. As a further step, the authors try to measure the explanatory power of different employer characteristics as possible sources of the observed inter-industry wage differentials.

Plassard and Tahar (1990) are also interested in inter-industry wage differentials and their possible explanation in terms of efficiency wages. However, it is to be noted that their analysis is based on the 1977 FQP survey which contains detailed information on schooling and experience, while in Araï, Ballot and Skalli's (1996a) study, only education levels and age are available. Nevertheless, both studies provide evidence pointing to a non-negligible sensitivity of the returns to human capital according to whether industries, occupations and employer characteristics are controlled for or not. For example, the returns to education seem to be very sensitive to the presence of industry dummies as they drop from 9 to 6% in Plassard and Tahar (1990).

5 International comparisons and trends over time

So far we have neglected, for the sake of simplicity, two important dimensions: national specificities and trends over time. The literature provides some evidence regarding these two aspects.

Kaukewitsch and Rouault (1998) propose a comparison of wage hierarchies in France and Germany while Bell, Elliott and Skalli

(1996) compare the returns to age and education in France and the UK. Finally, Araï and Skalli (1996) provide a French-Swedish comparison of the distributions across industries of the returns to several characteristics, including gender, education, age and employer size.

The analysis by Kaukewitsch and Rouault (1998) is based on the *EESS survey*. Though the number of years of schooling is not available, interestingly, these data enabled the authors to construct for each country five dummy variables describing qualification bands, hence overcoming the problem of non-comparability of the French and German education systems.[24]

Another interesting feature in Kaukewitsch and Rouault's (1998) study is the use of the so-called Oaxaca–Blinder decomposition as a means of comparing the country-specific wage distributions, the ingredients of such a decomposition being earnings equations including individual and employer characteristics estimated using OLS.

Kaukewitsch and Rouault (1998) report that gross average hourly wages are 1.25 times higher in West-Germany than in France. However, the variance of wages is larger in France. In particular, while French young workers earn less than young West-German workers, the opposite is observed for older workers.[25] Such a difference in age-earnings profiles is also confirmed by higher returns to age in France.

Regarding occupation levels, it seems that, compared to their French colleagues, German labourers enjoy higher wages while white-collar workers earn less. Moreover, though the gender gap is higher in West-Germany, partly because the proportion of part-time female workers is larger, West-German women have more access to intermediate occupation levels.

An appealing feature of Kaukewitsch and Rouault's (1998) analysis is the reported difference in the role of education as a wage determinant. Indeed, they show that the number of workers with

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[24] Note that education levels were available only for a small sub-sample of workers. Thus the analysis is mainly based on earnings equations including occupation levels rather than education dummies.

[25] This specific pattern of age-earnings profiles in France is also highlighted by Baudelot and Gollac (1997) and Bell, Elliott and Skalli (1996).

extremely low and extremely high education levels is higher in France than in West-Germany. Moreover, it seems that compared to the French *Baccalauréat,* the German *Arbitur* is less necessary for accessing intermediate occupation levels. However, at the same time, returns to education levels are on average higher in France.

One characteristic of the Oaxaca-Blinder decomposition is that it completely neglects the role of the residuals from the estimated earnings functions. Thus, individual and/or country-specific unobservable characteristics are not taken into account. This is the idea underlying the UK–France comparison by Bell, Elliott and Skalli (1996) where the Juhn, Murphy and Pierce decomposition is preferred. Assuming that part of the residuals reflects institutional aspects of the labour market, the question addressed is how the distribution of wages would have looked like if French workers had the individual endowments of the British and if the French labour market institutions were similar to those of Great Britain. To perform such an analysis, the authors use the 1986 and 1992 New Earnings Survey for the UK and the French ECMOSS survey for the same years. Moreover, the estimated earnings equations are fit by OLS and include only age and five qualification bands, constructed in such a way that education levels are comparable in terms of the number of years of schooling.[26]

The age-earnings profiles are strikingly different between France and Britain. In France, the earnings of men and women rise steadily with age, until retirement, while in Britain, the profile assumes a distinct hump shape: they peak in the early thirties for women and in the early forties for men.[27] Moreover, the returns to age seem to be lower in France, perhaps because of the higher age of entry to the labour market. Another possible explanation is the existence of the minimum wage (SMIC) since the omitted groups are at the lower range of the age spectrum. Of course, this means that while employers in France may hire fewer younger workers

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26 Other variables included are comparable industry dummies and a capital city dummy.

27 These results suggest that quite different models are appropriate to describe the labour markets in Britain and France. While in the former, age-earnings profiles are compatible with human capital theory, in the latter, it might be the case that long-term contractual arrangements, perhaps as proposed in the theory of agency, are at work.

than in Britain they will be of higher average quality in France. After this adjustment to the SMIC has been achieved, one would expect to observe smaller wage differentials between younger and older workers in France.

Regarding education, it seems that in both countries, returns to jobs with different levels of required qualifications raise steadily for both males and females in 1986 as well as in 1992. However, the rise in the premia, in the earnings of those in qualified jobs relative to the earnings of those in unskilled jobs, is less steep in Britain than in France. More generally, returns to education are higher, particularly for well-educated women.

Synthetic earnings distributions for British male workers are also constructed by applying both observed returns and unobserved characteristics of the French labour market. The results indicate that the application of both influences tends to reduce earnings dispersion in Britain.

The wage structure in France is compared to the Swedish one in Araï and Skalli (1996). Here, however, differences in earnings are not decomposed in terms of differences in returns or in endowments. Rather, owing to a unique industry classification, inter-industry differentials in the returns to different characteristics are evaluated and then compared across the two countries. Indeed, the results are obtained from earnings equations fit by OLS and where gender, seniority, schooling and employer size are alternatively crossed with industry dummies. However, it should be noted that while the 1991 LNU survey[28] used for Sweden provides information about the number of years of schooling, the 1992 ECMOSS survey on which the French estimates are based does not. Instead, for the sake of comparability, education grades have been used to evaluate the theoretical number of years of schooling necessary to reach those grades.

The results obtained by Araï and Skalli (1996) indicate that high wage sectors pay higher returns to schooling and seniority and that

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[28] The Swedish Level of Living Survey (LNU) is conducted by the Swedish Institute for Social Research (SOFI). It covers a random sample of the Swedish population aged between 18 and 64 and contains around 6,000 individuals. For comparison considerations, only a sub-sample of 1,496 individuals working in the private non-agricultural sector is used in the analysis.

the employer-size wage effect is correlated to industry affiliation both in France and Sweden. Regarding the returns to schooling, it appears that they are higher in France than in Sweden (6% and 4.5%, respectively) and that the rankings of the estimated industry-specific rates are highly correlated between the two countries. This induces the authors to conclude that, though there are a number of institutional dissimilarities between Sweden and France with respect to private costs of education, and the education in Sweden can be assumed to be less heterogeneous than in France, the variation in returns to schooling has a striking similarity. Not only is the coefficient of correlation between the inter-industry differentials in the returns to education in the two countries 0.50, but the extreme returns to schooling are found in the same industries in both countries.

The authors also report results suggesting that the gender gap varies highly across industries. However, it turns out that these differentials are not systematically correlated across the two countries. Obviously, in order to understand the nature of the gender wage gap, it is necessary to examine the importance of cross-industry occupational distributions, an analysis the authors do not make.

Finally, it seems that the returns to seniority are 9 times higher in France than in Sweden. Moreover, despite differences in levels, not only are the industry-seniority effects positively correlated across countries, but they are also highly positively correlated with the schooling effects. Thus, high wage industries pay higher returns to both schooling and seniority and the pattern of this variation is similar in France and Sweden.

A common feature of the three international comparisons discussed above is that each one focuses exclusively on the results from a single pair of cross-sections. Thus, nothing can be said about the way the observed similarities or differences evolve through time. Therefore, we should at least examine the stability of the observed patterns in France.

Analyses of the evolution of the returns to human capital necessitate either availability of comparable sets of information observed at different points in time or, perhaps preferably, panel data sets. For this reason, studies reporting trends over time use either pseudo-panel data on the basis of the FQP surveys or panel data such as those drawn from the Emploi or the DAS surveys.

To our knowledge, the first extensive analysis of the evolution of age-earnings profiles through time is that by Baudelot and Glaude (1989) who perform a pseudo-panel analysis based on samples of male full-time employees from the 1970, 1977 and 1985 FQP surveys. Generations of workers are distinguished according to the year of their entry into the labour market, their wages being corrected to reflect constant Francs. Different specifications are then estimated using OLS in order to capture conjuncture and cohort effects. Note also that one version of the estimated model includes a standardized schooling variable while in another one, education is expressed in terms of diplomas.

Baudelot and Glaude (1989) show that during the period 1970–85, the role of schooling became more and more determinant in earnings setting. Because of the increasing number of individuals with longer schooling durations, the relative position of low-level diplomas is more and more depreciated. Even university degrees begin to be depreciated, at least among high-wage earners. Marginal returns to education have also decreased regularly. This decreasing trend is more clearly observable for general than for vocational education. However, those decreasing returns seem to be partly due to economic circumstances. The increase of low wages, particularly the minimum wage (SMIC), has led to less wage dispersion and thus has contributed to the depreciation of the returns to the high level diplomas. Actually, when these economic circumstances are taken into account, marginal returns to education decrease slowly; they even seem stable when reasoning in terms of cohorts of workers.

In a sense, the pseudo-panel analysis performed by Goux and Maurin (1994) could be seen as an update of Baudelot and Glaude's (1989) study since they include the 1993 FQP survey as well. Their results show that the rates of return to schooling tend to decrease by 1 percentage point each tenth generation. Moreover, they estimate earnings functions where the number of years of schooling is replaced by the relative position of individuals in their generation, which corresponds to a standardization of the schooling variable by generation. They then come to the result that the influence of the individual's rank in his generation diminishes faster for the younger generations than it did for those born around World War II.

The authors suggest different explanations of the observed decreasing patterns. It might be the case that firms, becoming more and more flexible, give more and more importance to individuals' ability in terms of autonomy and co-operation, than to standard criteria such as education. An alternative hypothesis is relative to unemployment. To be more specific, the increase in unemployment has led to a number of low-educated people being unemployed. The question is thus that of examining if the wages of the employed reflect their actual human capital or just the destiny of those who could avoid unemployment. Taking into account this selectivity process allows Goux and Maurin (1994) to confirm the hypothesis of decreasing returns to education.

Another interesting interpretation is that suggested by Jarousse (1988). This author shows that the shifts in new enrolments in various disciplines since the beginning of the decreasing trend of returns confirm the low influx of *Bacheliers* into the programmes with the highest values and the persistence of enrolments in declining fields, offering the lowest returns. His explanation focuses on the distinctiveness of the French academic system, which is extremely segmented. Thus, Jarousse (1988) proposes a model taking into account the endogeneity of educational costs. He then comes to the result that the increase in the number of options explains the seemingly paradoxical nature of Bacheliers' choices for degrees that have low job market value but also require a minimal effort to obtain. He shows that, in fact, the decrease in the returns to education is accompanied by a decrease in the amount of time devoted to study.

It is to be noted that evidence about differences in the job market value of different education streams is reported by Baudelot and Glaude (1989) and Goux and Maurin (1994). In both studies, a distinction is made between individuals according to the type of education they have chosen. The results highlight a stable hierarchy in the returns to education levels and significant differences in the returns to degrees necessitating the same number of years of schooling but different in type. For example, graduate students holding a *Grande Ecole* degree earn systematically more than graduate university students. Another example is the differential between those having chosen a general education stream and those who have pursued a specialised one.

Combined to each other, these results suggest that the returns to education are declining in absolute rather than in relative value since the hierarchy of education levels is stable. Further evidence about this stability is reported by Ponthieux (1997). The question she addresses is why the average young worker earns less in 1995 than in 1991, while he is more highly educated.

Ponthieux (1997) uses the 1991 and 1995 Emploi surveys from which she draws a sub-sample of workers aged between 16 and 29 who were in school the preceding year. She then estimates an earnings equation in which education level dummies are constructed according to whether individuals were employed in 1991 or 1995. These equations are estimated using OLS, but with a correction for selectivity bias as the sample contains only employed beginners.[29] Though the estimated coefficients are systematically lower for 1995 than for 1991, the author explains that a Fisher test resulted in the acceptance of the null hypothesis. Hence, she concludes that the reason why beginners earned less in 1995 than in 1991 does not reside in lower returns to education, but rather in worse insertion conditions in the labour market. In particular, she highlights the increasing role of short-term contracts and the decreasing trend of working time due to the development of part-time jobs.

One should not conclude that Ponthieux (1997) is in contradiction with Baudelot and Glaude (1989) or Goux and Maurin (1994). While she examines changes that have occurred during the four years she considers, they analyze differences between generations of workers by observing a time interval of more than 20 years.

Baudelot and Gollac (1997) are also interested in long-run transformations of the age-earnings profiles. Though they do not focus explicitly on education, their results suggest that the returns to human capital are significantly changing. Their analysis is mainly based on the 1970 and 1993 FQP surveys with no sample re-

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29 Age is not included in this regression as it is highly correlated with the education variables. Such a correlation is, of course, due to the sample including only beginners in the labour market.

striction.[30] Separate OLS estimates are presented for men and women for 1970 as well as for 1993. Interestingly, the results highlight decreasing returns to education for both sexes, but also huge increases in the returns to age. This result reflects radically changing age-earnings profiles. Indeed, the authors show that since 1975, age earnings differentials started to change significantly in such a way that the earnings of young workers were declining while those of the oldest were increasing. Moreover, though the age-earnings profiles are still concave, individuals reach their maximal earnings later and later. Such patterns are observed by the authors for men and women, white- and blue-collar workers in the private as well as in the public sector.

6 Concluding remarks

Most of the important questions addressed in the literature analyzing the causal effects of human capital on wages have been examined empirically using French data. In the studies we have summarized, topics like endogeneity bias, sheepskin effects and individuals' heterogeneity have been the subject of investigation. However, there remain some topics the evidence on which is not strongly convincing. Examples are the screening and ability bias hypotheses. Other topics have not been examined at all. For example, to what extent can measurement errors in human capital variables be considered as negligible? Does the legal length of compulsory schooling influence individuals' decisions to invest in education or the returns to education?

Unfortunately, researchers might find it difficult to explore new dimensions, simply because the available data are not necessarily appropriate. Among the surveyed studies, the two most sophisticated ones are Goux and Maurin (1994) and Guillotin and Sevestre (1994). Yet, the results they report suffer from the fragility of the data used. While Goux and Maurin (1994) have rather limited information on

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30 The 1962–1991 DAS surveys are also used by the authors in order to compare wages of those aged between 26 and 30 and those aged between 51 and 60.

education in their longitudinal analysis, Guillotin and Sevestre (1994) are obliged to approximate the number of years of schooling.

Thus, the question is how high would the returns to investment in detailed data sets and sophisticated methods be. Card (1998) concludes his survey of the literature, including recent studies of the earnings and schooling of twins and siblings, by arguing that the average return to education is not much different from the estimate that emerges from a standard human capital earnings function fit by OLS. This means that under the assumption that the various sources of bias have comparable effects from one country to another, international comparisons could reasonably be based on similar specifications of the earnings functions estimated using OLS.

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Appendix

Tables A1, A2 and A3 report the results from selected earnings functions estimated in the reviewed studies. The idea underlying our choice of the reported results is to enable the reader to examine the sensitivity of the estimated coefficients with respect to methods, samples and/or specifications. As an example, the reported results from Guillotin and Sevestre's (1994) study show differences in the returns to human capital according to whether endogeneity bias is taken into account or not, to the sample used (balanced versus unbalanced panel) and to the estimation method. Baudelot and Glaude's (1989) results, on the other hand, highlight the role of conjuncture as compared to that of generation effects.

At least because of their size, the reading of these tables remains unobvious. To make them more accessible, the following hints may be useful.

Firstly, employees in France receive (generally each month) gross wages excluding social security expenses and declare annually their total household revenue to the fiscal administration. The calculation of the taxes they have to pay is based on the household declaration. The calculated taxes are then paid during the year after the revenues have been received. As a result, analyses of earnings in France are always based on gross wages. Thus, net wages in the tables below refer to gross wages excluding social security expenses while gross wages refer to gross wages including social security expenses.

Secondly, empty cells either mean that the information is not provided in the study under consideration or that the coefficients have not been estimated. Returns to human capital have neither been reported when the measure used was non-continuous. Indeed, in such cases, the classifications (Education levels, Socio-economic categories, Age bands, etc.) differ from one study to another and sometimes also within the same study in such a way that reporting all the associated coefficients would have made the tables unreadable.

Thirdly, in none of the reviewed studies a distinction is made between private and public sector samples. However, analyses based on the ECMOSS survey cover the non-agricultural private sector only. In all other cases, the column “other exogenous variables” contains the code PP each time a private/public sector dummy has been included in the regression under consideration.

Finally, the following codes identify the rest of the variables controlled for and the coefficients of which have not been reported.

Codes	Variables
ABS	Number of days of absence
BD	Date of entry into the labour market
CC	Capital City dummy
CE	Continuing Education dummy
DCE	Duration of Continuing Education
DPS	Duration of Post-Schooling education
EBA	Existence of an industry (*Branche*) level collective Agreement
E88	Individual's Experience in the year 1988
FE	Father's Education
FLS	Firm's Law Status
FR	Femininisation Rate (proportion of women in the job)
FS	Firm Size
FS88	Firm Size in 1988
FVTP	Has been involved in Formal Vocational Training Program between 88 and 93
GD	Gender Dummy
HR	Working Hours Regime (3x8, night work, etc.)
IM	Intra-firm Mobility indicators
IND	INdustry Dummies
LC	Labor Contract dummies
MS	Marital Status dummies
NAT	Citizenship dummies
NUP	Number of Periods of Unemployment
NYS	Number of Years of Schooling
OCC	Occupation dummies
OLM	Duration of inactivity and unemployment periods
PIE	Post-Initial Education dummy
PR	Pay Regime (piece rate, time rate, etc.)
PP	Private/Public sector dummy
PS	Establishment Size
PT	Part-Time dummy
PTR	Part-Time Rate
REG	Regional dummies
SEC	Socio-Economic Category dummies
SM	Private/public Sector Mobility indicators
SNYS	Standardised Number of Years of Schooling
T88	Individual's job Tenure in the year 1988
UA	Size of the Urban Area
XM	Inter-firm mobility indicators
YE	Year of first job

Table A1. Returns to human capital from selected specifications

Authors	Data	Years	Method	Sample size	Wage	Education	Schooling	Schooling sq.
Riboud (1978)	FQP	1962	OLS	8809 men	Net yearly	NYS	0.108	
Riboud (1978)	FQP	1962	OLS	5883 men	Net yearly	NYS	0.098	
Riboud (1978)	FQP	1962	OLS	5883 men	Net yearly	NYS	0.108	
Jarousse & Mingat (1986)	FQP	1969	OLS	15903 men	Net yearly	NYS	0.193	-0.003
Jarousse & Mingat (1986)	FQP	1976	OLS	13849 men	Net yearly	NYS	0.099	
Jarousse & Mingat (1986)	FQP	1976	OLS	13849 men	Net yearly	NYS	0.156	-0.002
Jarousse & Mingat (1986)	FQP	1976	OLS	14546 men	Net yearly	NYS	0.154	-0.002
Jarousse & Mingat (1986)	FQP	1976	OLS	13849 men	Net yearly	NYS	0.142	-0.002
Jarousse & Mingat (1986)	FQP	1976	OLS	13849 men	Net yearly	SNYS	0.123	
Jarousse (1988)	FQP	1969, 1976	OLS		Net yearly	Levels		
Plassard & Tahar (1990)	FQP	1976	OLS	10078 ind.	Net yearly	NYS	0.0424	-0.0001
Plassard & Tahar (1990)	FQP	1976	OLS	10078 ind.	Net yearly	NYS	0.0543	-0.0005
Plassard & Tahar (1990)	FQP	1976	OLS	10078 ind.	Net yearly	NYS	0.0583	-0.0001
Plassard & Tahar (1990)	FQP	1976	OLS	10078 ind.	Net yearly	NYS	0.0912	-0.0003

Table A1. (continued)

Authors	Exp. Measure	Experience	Experience sq.	Tenure	Tenure sq.	Other exogenous variables
Riboud (1978)	Potential	0.071	-0.001			
Riboud (1978)	Potential	0.101	-0.002			FE
Riboud (1978)	Potential	0.071	-0.001			
Jarousse & Mingat (1986)	Potential	0.077	-0.001			
Jarousse & Mingat (1986)	Potential	0.063	-0.001			
Jarousse & Mingat (1986)	Potential	0.063	-0.001			
Jarousse & Mingat (1986)	Potential	0.091	-0.002			
Jarousse & Mingat (1986)	Potential	0.055	-0.001	0.0127	-0.0002	
Jarousse & Mingat (1986)	Potential	0.061	-0.001			
Jarousse (1988)	Potential					
Plassard & Tahar (1990)	Actual	0.0302	-0.0005	0.0155	-0.0002	GD, NAT, NUP, PT, CE, DCE, PS, DPS, IND, OCC
Plassard & Tahar (1990)	Actual	0.0299	-0.0005	0.0155	-0.0002	GD, NAT, NUP, PT, CE, DCE, PS, DPS, OCC
Plassard & Tahar (1990)	Actual	0.0387	-0.0006	0.0159	-0.0002	GD, NAT, NUP, PT, CE, DCE, PS, DPS, IND
Plassard & Tahar (1990)	Actual	0.0384	-0.0006	0.0147	-0.0002	GD, NAT, NUP, PT, CE, DCE, PS, DPS

Table A1. (continued)

Authors	Data	Years	Method	Sample size	Wage	Education	Schooling
Sofer (1990)	FQP	1976	OLS	2997 men	Net yearly	NYS	0.085
Sofer (1990)	FQP	1976	OLS	2595 men	Net yearly	NYS	0.088
Sofer (1990)	FQP	1976	OLS	2691 women	Net yearly	NYS	0.082
Sofer (1990)	FQP	1976	OLS	2571 women	Net yearly	NYS	0.082
Lollivier & Payen (1990)	DAS	1967-82	OLS	men	Net yearly	SEC	
Lhéritier (1992)	ECMOSS	1986	OLS	680000	Gross hourly	SEC	
Boumahdi & Plassard (1992)	FQP	1984	OLS		Net yearly	NYS	0.087
Boumahdi & Plassard (1992)	FQP	1984	IV (2SLS)		Net yearly	NYS	0.113
Guillotin & Sevestre (1994)	DAS	1970-87	OLS (Balanced)	9488 obs.	Net yearly	NYS	0.041
Guillotin & Sevestre (1994)	DAS	1970-87	QGLS (Balanced)	9488 obs.	Net yearly	NYS	0.042
Guillotin & Sevestre (1994)	DAS	1970-87	Hausman-Tylor (Balanced)	9488 obs.	Net yearly	NYS	0.237
Guillotin & Sevestre (1994)	DAS	1970-87	Breush-Mizon-Schmidt (Bal.)	9488 obs.	Net yearly	NYS	0.198
Guillotin & Sevestre (1994)	DAS	1970-87	OLS (Unbalanced)	98979 obs.	Net yearly	NYS	0.051
Guillotin & Sevestre (1994)	DAS	1970-87	Hausman-Taylor (Unbal.)	98979 obs.	Net yearly	NYS	0.153

Table A1. (continued)

Authors	Exp. Measure	Experience	Experience sq.	Tenure	Tenure sq.	Other exogenous variables
Sofer (1990)	Actual	0.031		-0.003		OLM
Sofer (1990)	Actual	0.030		-0.003		OLM, FR
Sofer (1990)	Actual	0.023		0.002		OLM
Sofer (1990)	Actual	0.023		0.001		OLM, FR
Lollivier & Payen (1990)	Age					
Lhéritier (1992)	Age					PR, IND, PS, NAT, EBA, REG
Boumahdi & Plassard (1992)	Potential	0.070		0.157	-0.0002	FLS, FS, CC
Boumahdi & Plassard (1992)	Potential	0.068		0.144	0.0002	FLS, FS, CC
Guillotin & Sevestre (1994)	Potential	0.130	-0.005			GD, BD
Guillotin & Sevestre (1994)	Potential	0.130	-0.005			GD, BD
Guillotin & Sevestre (1994)	Potential	0.131	-0.004			GD, BD
Guillotin & Sevestre (1994)	Potential	0.131	-0.004			GD, BD
Guillotin & Sevestre (1994)	Potential	0.111	-0.004			GD, BD
Guillotin & Sevestre (1994)	Potential	0.107	-0.004			GD, BD

Table A1. (continued)

Authors	Data	Years	Method	Sample size	Wage	Education	Schooling	Schooling sq.
Guillotin & Severstre (1994)	DAS	1970-87	Hausman-Taylor (Unbal.)	98979 obs.	Net yearly	NYS	0.130	
Guillotin & Severstre (1994)	DAS	1970-87	Breush-Mizon-Schmidt (Unb.)	98979 obs.	Net yearly	NYS	0.163	
Araï, Ballot & Skalli (1996a)	ECMOSS	1992	OLS	139239 ind.	Gross hourly	Levels		
Araï, Ballot & Skalli (1996b)	ECMOSS	1992	OLS	139239 ind.	Gross hourly	Levels		
Araï & Skalli (1996)	ECMOSS	1992	OLS	137288 ind.	Gross hourly	NYS	0.0596	
Bell, Elliott & Skalli (1996)	ECMOSS	1986, 1992	OLS			Levels		
Simonnet (1996)	ECM	1989	OLS	1061 men	Net yearly	Levels		
Simonnet (1996)	ECM	1989	OLS	687 women	Net yearly	Levels		
Simonnet (1996)	ECM	1989	OLS	1061 men	Net yearly	Levels		
Simonnet (1996)	ECM	1989	OLS	687 women	Net yearly	Levels		
Baudelot & Gollac (1997)	FQP	1976, 1992	OLS		Net yearly	Levels		
Baudelot & Gollac (1997)	FQP	1976, 1992	OLS		Net yearly	Levels		
Ponthieux (1997)	Emploi	1991, 1995	OLS (Heckman)	2646 ind.	Net monthly	Levels		

Table A1. (continued)

Authors	Exp. Measure	Experience	Experience sq.	Tenure	Tenure sq.	Other exogenous variables
Guillotin & Sevestre (1994)	Potential	0.107	-0.004			GD, BD
Guillotin & Sevestre (1994)	Potential	0.107	-0.004			GD, BD
Araï, Ballot & Skalli (1996a)	Age bands			0.0168		GD, PTR, HR, ABS, SEC, REG, MS, NAT, LC
Araï, Ballot & Skalli (1996b)	Potential			0.0132		GD, PTR, HR, ABS, SEC, REG, MS, NAT, LC
Araï & Skalli (1996)	Potential			0.0177		GD, IND
Bell, Elliott & Skalli (1996)	Age bands					IND, CC
Simonnet (1996)	Potential	0.0146		0.0037		NAT, REG, IM, XM
Simonnet (1996)	Potential	0.0045		0.0090		NAT, REG, IM, XM
Simonnet (1996)	Potential	0.0157		0.0052		NAT, REG, SM
Simonnet (1996)	Potential	0.0061		0.0060		NAT, REG, SM
Baudelot & Gollac (1997)	Age bands			Bands		PP, SEC, UU, IND
Baudelot & Gollac (1997)	Age bands			Bands		PP, SEC, UU, IND
Ponthieux (1997)						PT, LC, YE

Table A1. (continued)

Authors	Data	Years	Method	Sample size	Wage	Education	Schooling	Schooling sq.
Goux & Maurin (1997)	FQP	1992	OLS	3263 men	Net yearly	Levels		
Goux & Maurin (1997)	FQP	1992	OLS	2489 women	Net yearly	Levels		
Kaukewitsch & Rouault (1998)	EESS	1995	OLS	55745 ind.	Gross hourly	SEC		
Kaukewitsch & Rouault (1998)	EESS	1995	OLS	17262 women	Gross hourly	SEC		

Table A1. (continued)

Authors	Exp. Measure	Experience	Experience sq.	Tenure	Tenure sq.	Other exogenous variables
Goux & Maurin (1997c)	Potential 1988	0.020	-0.0004	0.005	-0.002	CC, SEC, FS88, T88, E88, FVTP
Goux & Maurin (1997c)	Potential 1988	0.014	-0.0004	0.005	0.014	CC, SEC, FS88, T88, E88, FVTP
Kaukewitsch & Rouault (1998)	Age	0.0163	-0.0002	0.0062	-0.0001	IND, FS, REG, SEC, PT
Kaukewitsch & Rouault (1998)	Age	0.0112	-0.00015	0.0073	-0.0001	IND, FS, REG, SEC, PT

Table A2. **Selected results from the pseudo-panel analysis by Baudelot & Glaude (1989). Data: 1969, 1976, 1984 FQP surveys. Net yearly wages (1984 Francs). 40,209 men.**

Education	Schooling	Schooling sq.	Schooling cb.	Exp. Measure	Experience	Experience sq.	Experience cb.	Sch.*Exp	Year
NYS	0.086	0.006	-0.0005	Potential	0.014	-0.0008	0.00002	0.0010	0.0148
SNYS	0.087	0.005	-0.0005	Potential	0.006	-0.0008	0.00002	0.0001	0.0221
NYS	0.083	0.006	-0.0005	Potential	0.012	-0.0005	0.00001	0.0003	
SNYS	0.084	0.005	-0.0005	Potential	0.012	-0.0005	0.00002	0.0002	

Table A2. **(continued)**

Year sq.	Sch.*Year	Exp.*Year	Generation	Generation sq.	Sch.*Gen.	Exp.*Gen.	Other variables
-0.0026	-0.0012	0.0001					IND, REG, NAT, FS.
-0.0027	-0.0004	0.0001					IND, REG, NAT, FS.
			-0.0007	0.0001	-0.0007	0.0002	IND, REG, NAT, FS.
			0.0066	0.0001	0.0001	0.0002	IND, REG, NAT, FS.

Note: Reference cohort entered the labour market in 1957. The average individual of this cohort stopped his schooling at age 16.26 and had 20.11 years of experience the year the survey was conducted.

Table A3. Selected results from the analysis by Goux & Maurin (1994). Data: 1969, 1976, 1984 and 1992 FQP surveys. Net yearly wages (Constant Francs). Men only. The pseudo-panel analysis is based on 48,539 men.

Year: nb. Obs.	Method	Education	Schooling	Schooling sq.	Schooling cb.	Experience	Experience sq.	Experience cb.	Exp.*Sch.
92: 5304 men	OLS	NYS	0.0891	0.0015	-0.0003	0.0213	-0.0007	0.00001	0.0004
92: 4107 men	Employer fixed effect	NYS	0.0722	0.0026	-0.0001	0.0201	-0.0005	0.00001	0.0015
92: 5304 men	OLS	SNYS	0.1059	0.0028	-0.0005	0.0194	-0.0007	0.00001	0.0009
92: 4107 men	Employer fixed effect	SNYS	0.0799	0.0035	-0.00004	0.0207	-0.0007	0.00001	0.0008
69, 76, 84, 92	Pseudo-panel	NYS	0.0899	0.0001		0.0359	-0.0007		
69, 76, 84, 92	Pseudo-panel	SNYS	0.2845	0.0106		0.0357	-0.0007		
69, 76, 84, 92	Pseudo-panel	NYS	0.0929	-0.0003		0.0360	-0.0014		
69, 76, 84, 92	Pseudo-panel	SNYS	0.2884	0.0038		0.0356	-0.0014		

Table A3. (continued)

Repeats	Non graduating	Generation	Generation sq.	Exp.*Gen.	Sch.*Gen	Sch.*Gen²	Other variables
							IND, NAT, REG.
							IND, NAT, REG.
0.0090	0.0327						
0.0088	0.0482						IND, NAT, REG.
		0.0153	-0.0001				IND, NAT, REG.
		0.0224	-0.0001				IND, NAT, REG.
		0.0157	-0.0006	-0.0011	-0.0011	-0.00002	IND, NAT, REG.
		0.0224	-0.0001	-0.0012	-0.0038	-0.00002	IND, NAT, REG.

Note: Reference generation is born in 1944. The average individual from this generation spent 10.5 at schooling and had 21.35 years of experience the year the survey was conducted.

CHAPTER 6

Returns to Human Capital in Germany: Review of the Empirical Literature

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1 Introduction

The positive link between educational attainment and individual earnings seems quite intuitive: the better-educated earn higher wages. On the other hand, schooling also entails costs in the form of foregone earnings while in education as well as direct expenses such as tuition fees. Therefore, engaging in education can be seen as an investment which aims at yielding a return in the form of increased future earnings. Assessing the amount of this return to education has been the object of numerous studies. This paper reviews and critically evaluates the empirical literature for Germany.

Most studies for Germany do not focus explicitly on the relationship between human capital and private earnings, but rather on the wage structure and its determinants as well as on wage inequality, e.g. across industrial sectors or between males and females. However, all studies of German earnings include indicators for educational attainment as explanatory variables. These studies are typically based on human capital theory and the estimation of earnings functions as proposed by Mincer (1974). Following this approach, individual earnings reflect labour productivity which is determined by previous investment in human capital; i.e., it is assumed that an individual's stock of human capital is an important determinant of his or her wage.

To test this hypothesis, an earnings function of the following form is typically estimated:

$$\ln w_i = \alpha + \beta \times Schooling_i + \gamma \times Experience_i + \delta \times Experience_i^2 + u_i$$

with ln w = log of gross hourly earnings

Schooling = years of education

Experience = years of labour market experience

u = error term

i = index for individual i.

The semi-loglinear specification of the earnings equations relates to some functional form assumptions underlying the theoretical derivation of Mincer's earnings function. More importantly, it also corresponds to the observed distribution of wages. While the schooling variable proxies human capital acquired by formal education, labour market experience is a proxy for human capital acquired on-the-job. The inclusion of labour market experience in linear and quadratic form also relates to the particular derivation of Mincer's earnings function. The error term captures all factors other than schooling and labour market experience affecting individual wages. Typically, the error term is assumed to be uncorrelated with the human capital variables.

Given this assumption holds and assuming the wage equation is correctly specified, parameter estimates obtained by OLS yield unbiased estimates of average returns to an additional year of schooling and labour market experience, respectively. Despite this common basic approach, the studies pursue very different purposes and the implementation of this standard estimation varies accordingly. Moreover, the underlying assumptions may be violated in practice and the various studies based on this general approach differ in the way the standard Mincer earnings function is extended in order to account for this.

The next section briefly summarises the most important topics related to the returns to education covered in the studies reviewed here. Section 3 explains how these studies estimate individual returns to human capital, while Section 4 summarises their main results. Finally, Section 5 provides a critical assessment of the current state of knowledge on private returns to education in Germany.

2 Main topics related to returns to education covered by previous German studies

Some of the German studies focus on the returns on human capital, but most of them focus on the wage structure or the wage distribution with respect to industrial sector, firm or gender. In these studies, human capital indicators are treated as control variables rather than as of interest *per se*. In the following, these studies are briefly reviewed under the heading of their respective main focus.

Effect of education on earnings

Bellman, Reinberg and Tessaring (1994) analyse the impact of educational expansion on the distribution of personal income. Following a descriptive statistical analysis, they estimate the returns to education in the period 1976 to 1987 on the basis of standard Mincer earnings functions. Weißhuhn and Clement (1983) also analyse the distribution of earnings in connection with the qualification structure. Franz (1996) illustrates the human capital theory with an estimation of a Mincer function of the simplest form, in order to calculate the returns to education in terms of earnings. Steiner and Wagner (1996) analyse changes in earnings inequality in West Germany during the 1980s, with special emphasis on the role of human capital measured by formal skills and labour market experience.

Gender discrimination

Bellmann and Gerlach (1984) analyse gender differences in terms of wages and occupational positions. Gerlach (1987) focuses on the gender earnings gap and assesses the extent of wage discrimination taking marital status into account.

Sectoral distribution

Hübler and Gerlach (1990) analyse sectoral wage differences in West Germany and whether these wage differentials can be explained by efficiency wage considerations. The paper also analyses in detail how sector characteristics influence individuals' earnings. Dustman and van Soest (1998) analyse wage differentials between the public and the private sector as well as the determinants of sector selection. Much attention is paid to the specification of the model taking into account that some potential wage determinants, like sector of employment, hours worked or an individual's educational level, are simultaneously determined within a more general model.

Unobserved individual effects and selectivity

In addition to Dustman and van Soest (1998), whose paper is also concerned with selectivity bias with respect to individual self-selection between the private and the public sector, Wagner and Lorenz (1988, 1989) examine the influence of self-selection and unobservable individual effects on earnings and conclude that these factors are important determinants of the earnings distribution.

3 Data sets, specification issues, and estimation procedures

Table 1 summarises the various German studies in terms of variables included, the period covered, data sets and the estimation method used. All studies in the table are based on Mincer-type earnings functions.

Departing from this summary table, the following sub-sections will provide additional details on data sets, definition of variables as well as specification and estimation issues.

3.1 Data sets

As can be seen from the table, the studies are not based on the same data sets. The main data sets used are the *Employment Statistics* of the Federal Labour Office and the *German Socio-Economic Panel*. In addition, less comprehensive data sets have been used in some of the studies.

The Employment Statistics of the Federal Labour Office (IABS)

Bellmann, Reinberg and Tessaring (1994) and Weißhuhn and Clement (1983) use data from the Employment Register of the Federal Labour Office, which is not generally available for research outside the Federal Labour Office or its research institute, the Institut für Arbeitsmarkt- und Berufsforschung (IAB). Recently, a 1% random sample of the Employment Statistics, known as IABS, has become available for research outside the Federal Labour Office. It currently covers the period 1975 to 1990; an update to 1995 is expected to become available for research soon.

The IABS contains information on employed persons covered by the social security system. Thus, it excludes the self-employed, civil servants and irregularly employed workers. Overall, the IABS represents about 80 per cent of the German workforce. It is an un-

Table 1. Previous studies for Germany based on Mincer-type earnings equations. Dependent variable: log earnings

	Bellmann, Reinberg & Tessaring (1994)	Bellmann & Gerlach (1984)	Dustmann & van Soest (1998)	Wagner & Lorenz (1988)	Wagner & Lorenz (1989)
Years/period	1976-87	1977-79	1984	1980-82, 84	1984-85
Estimation method	Cross-section	Simple pooling	Cross-section	Cross-section	Cross-section, simple pooling, fixed-effects, random-effects
Data set	Employment register	MHH	GSOEP	Allbus (80, 82, 84) Bremen (81) GSOEP (84)	GSOEP
Variables included					
Years of educ.*	x	x		x	x
Levels of educ.*	x		x		
Age					
Age²					
Exp	x	x	x	x	x
Exp²	x	x	x	x	x
Tenure					x
Tenure²					
Region		x			
Firm size					x
Industry			x		
Occupational position		x	x		
Working time			x		
Family status			x		x
Sex**		x			
Social class		x			
Interaction dummies***					
Other					x
Correction for selectivity bias					

continued ./.

Table 1. (continued)

	Steiner & Wagner (1996)	Weißhuhn & Clement (1983)	Gerlach (1987)	Hübler & Gerlach (1990)	Franz (1996)
Years/period	1984,90	1974, 77, 78	1981	1981, 84	1984-93
Estimation method	Cross-section	Cross-section	Cross-section	Cross-section	Simple pooling
Data set	GSOEP, IABS	Employ-ment register	Bremen	GSOEP (84), Bremen(81)	GSOEP
Variables included					
Years of educ.*		x	x	x	x
Levels of educ.*	x	x			x
Age				x	
Age²					
Exp	x	x	x	x	x
Exp²	x	x	x	x	x
Tenure			x	x	
Tenure²			x	x	
Region					
Firm size	x			x	
Industry	x	x		x	
Occupational position		x		x	
Working time		x		x	
Family status			x		
Sex**		x	x	x	
Social class					
Interaction dummies***	x				
Other	x	x	x	x	
Correction for selectivity bias	x				

Notes: * Those studies where both years and levels of education are ticked do not include the variables at the same time in the wage equation but alternatively.

** Either through a dummy variable in the earnings function or through separate regressions for men and women.

*** Including education or experience.

balanced panel with about 200,000 observations per year. The IABS contains very reliable information on (daily) earnings, an indicator for part-time work, quite detailed information on education and vocational qualifications and some other individual characteristics, like sex, marital status and age, as well as some information on the employment structure, in particular industry, occupation and firm size.

The German Socio-Economic Panel

Wagner and Lorenz (1988, 1989) and Franz (1996) rely on data from the German Socio-Economic Panel (GSOEP). Both restrict their analyses to the sub-sample of (full-time only for Wagner and Lorenz) working German men. Steiner and Wagner (1998) compare earnings functions based on the GSOEP and on the IABS.

The GSOEP is a longitudinal household survey conducted on a yearly basis since 1984 (14 waves until 1997). In the first wave, some 12,000 individuals in about 6,000 households were interviewed. Initially the sample only referred to West Germany, but in 1990 the sample was extended to the former German Democratic Republic. Questions are asked at the individual as well as at the household level. Individual and household identifiers make it possible to track individuals over time. The GSOEP contains information on gross and net earnings, normal and actual hours of work, education, vocational qualification and training, household structure, and other variables relevant for individual labour market behaviour. In addition to questions referring to the month preceding the interview date, the GSOEP also collects retrospective information on an individual's previous labour force state and associated incomes. For instance, there is information on an individual's employment history over the entire life span from 15 to a maximum of 65 years. There is also information coded in calendar form with up to eleven labour force states, including full-time and part-time employment and unemployment, and a corresponding income calendar referring to each month in the year preceding the current interview.

Special data sets

Wagner and Lorenz (1988) also use the GSOEP, but compare the results with other data sets (Allbus, Bremen), which they do not describe, for different years. Hübler and Gerlach (1990) compare the results coming from two data sets, the GSOEP for 1984 and the Bremen data set for 1981. Gerlach (1987) also uses the Bremen data set. This latter data set is a 10% random sample of all employed blue- and white-collar workers in the federal state of Bremen, excluding the self-employed. The sample size is about 6,000 employees. Bellmann and Gerlach (1984) use a data set collected by the Medical School Hannover (MHH) from 1977 to 1979 in Lower Saxony and Bremen, interviewing slightly less than 2,000 persons.

3.2 Definition of earnings and human capital variables

Differences in the definition of earnings and human capital variables used in the various studies described above is one obvious reason for differences in estimation results with respect to the returns to education and labour market experience. In this subsection, these differences are briefly described.

Earnings

Most studies use either (the log of) gross monthly or gross hourly earnings as the dependent variable, but there are also some studies based on net earnings. Bellmann, Reinberg and Tessaring (1994), Hübler and Gerlach (1990), Steiner and Wagner (1996), and Weißhuhn and Clement (1983) use gross monthly earnings, whereas Bellmann and Gerlach (1984), Gerlach (1987) and Wagner and Lorenz (1988, 1989) use net monthly earnings. Franz (1996) and Dustman and van Soest (1998) use gross hourly wages.

Education

Most studies use as the education variable completed years of education (schooling model), calculated by attaching an average number of years to several standardised education levels. This is the case in Bellmann and Gerlach (1984), Gerlach (1987), Hübler and Gerlach (1990), and Wagner and Lorenz (1988, 1989). Other studies, like Steiner and Wagner (1996) or Dustman and van Soest (1998) approximate an individual's educational and vocational qualification by a set of dummy variables allowing for non-linear effects of the level of education. This specification also takes into account that, for a given completed educational/vocational degree, fewer rather than more years are considered as a positive signal in the German labour market. Another set of studies including Bellmann, Reinberg and Tessaring (1994), Franz (1996) and Weißhuhn and Clement (1983) use both measures of educational attainment in alternative specifications of the earnings function.

Labour market experience

Bellmann, Reinberg and Tessaring (1994), Wagner and Lorenz (1988, 1989), Bellmann and Gerlach (1984), Franz (1996), Gerlach (1987), Steiner and Wagner (1996), and Weißhuhn and Clement (1983) all approximate actual experience by potential experience, defined as age minus years of education minus the school entrance age (5 or 6 years). Periods of non-employment remain unaccounted for in those specifications. Only Hübler and Gerlach (1990) and Dustman and van Soest (1998) compute actual labour market experience from the retrospective data of the GSOEP, which takes work interruptions into account. Except for Weißhuhn and Clement (1983), who also include a cubic term in experience, the effect of the accumulation of general human capital is approximated by labour market experience and its square.

3.3 Methodological issues

The estimation techniques vary across the studies surveyed here. This sub-section presents the way the different studies deal with some typical problems arising in the estimation of earnings functions.

Unobserved heterogeneity

Unobserved individual heterogeneity leads to biased estimates of the returns to education if some unobserved factor is correlated with educational attainment or any other explanatory variable included in the earnings equation. For instance, intelligence or work motivation may have a direct positive influence on wages, which we want to measure, or affect wages indirectly through its effects on educational attainment or labour market experience. Ignoring these indirect effects would lead to an upward bias in the estimated returns to education.

If the same individuals are interviewed repeatedly in different waves, i.e., if panel data are available, it is in principle possible to statistically control for these unobservable individual effects. Using panel data for German, Wagner and Lorenz (1989) estimate simple earnings equations and compare the results from cross-section estimation, simple pooling and random vs. fixed effects panel estimation. Typically, the estimates only using the individual variation over time, i.e. the fixed-effects estimates, yield lower returns to education than estimates based on the sample variation between individuals as well. The advantage of the fixed-effects estimator is that it does not require the assumption of individual effects being uncorrelated with the explanatory variables in the earnings equation. However, the problem with this estimator is that parameter estimates only use information on those individuals whose level of educational attainment has changed within the observation period. Given that educational attainment for most employed people with observed earnings does not change over time, the fixed-effects estimator relies on information of a very small group of people in the sample, which is often contaminated by measurement error.

Sample selection and endogeneity bias

Selectivity bias occurs when, given the set of exogenous explanatory variables, the expectation of the dependent variable differs from its expectation given these control variables and some other conditioning variable which typically represents some observed choice variable. In the context of the estimation of earnings functions, the individuals' decision to work or not will determine whether we observe their wages in our data. If the factors determining this decision were uncorrelated with the factors affecting individual wages we could simply ignore the fact that not all wages are observed. However, such an independence assumption is unlikely to hold in practice, especially for women, because women with higher market wages are probably more likely to participate in the labor force. Hence, employed women are a self-selected group whose wages may not be representative for those of all women with given observed characteristics, which could bias estimated returns to education.

There are various ways to statistically control for potential selectivity bias. Following the standard two-step Heckman procedure, Steiner and Wagner (1996) correct for selectivity bias by including a correction term (the inverse Mills' ratio) obtained from a first-stage reduced form probit equation of labour force participation as an additional regressor in the second-stage estimation of the earnings function. This procedure requires the availabilty of some credible instruments, i.e. variables significantly affecting labour force participation but having no significant direct effect on earnings. In this study, marital status, number of children and other household income were chosen as such instruments. It turned out that, although the selectivity-correction term was statistically significant in most of the specifications, its inclusion in the second-step earnings equation had very little effect on the parameter estimates.

A related problem arising in the estimation of earnings equations relates to the endogeneity of some of the explanatory variables, in particular the human capital variables. Dustmann and van Soest (1998) deal extensively with this problem. They treat an individual's educational level, the choice between public and private sector, labour market experience and the number of weekly hours as potentially endogeneous variables and try to estimate the relationship between these variables within a simultaneous equation system by Maximum-Likelihood. Although ingenious, this approach faces the difficulty of finding credible instrumental variables to identify the parameters of interest other than by functional-form assumptions.

Sensitivity analyses

Estimation results depend on the specification of the earnings function, on the estimation method as well as on the data sets used. Therefore, it is worth examining whether the results are robust to alternative model specifications and data sets.

As already mentioned, Wagner and Lorenz (1989) test the robustness of results with respect to different estimation methods. Steiner and Wagner (1998) compare results from cross-section regressions on two different data sets (IABS and GSOEP). Hübler and Gerlach (1990), who are interested in the sectoral distribution of wages, estimate earnings equations by sector. Weißhuhn and Clement (1983) analyse gender differences on the basis of OLS cross-section regressions of different specifications of the earnings function. Gerlach (1987) analyses gender differences in earnings on the basis of cross-section regressions of standard earnings functions estimated separately for married men, single men, married women and single women.

4 Results from previous studies for Germany

The estimation results of the studies presented are difficult to compare, since the data, the period considered, the specification and the estimation method are different. However, it is worth looking at the main results arising from the studies. This section reports the main estimation results as far as returns to education and to experience are concerned.

4.1 Returns to education

A distinction can be drawn between models using the years of schooling as a variable for education and those referring to educational levels, included as dummy variables in the earnings function. Table 2 presents the results of studies based on a schooling model (s.m.).

As the table shows, the estimates of returns to education range from 5 to 14% depending on the sample chosen, the specification and the estimation methods applied.

Few studies analyse changes in returns to schooling over time. The few studies with an intertemporal focus are restricted to the 1970s or 1980s, whereas there seems to be no study extending to the 1990s. Bellman, Reinberg and Tessaring (1994) study the longest time period and find constant returns to schooling at a level of about 6%. Weißhuhn and Clement (1983) find that within the period 1974 – 78 returns to education have slightly increased (decreased) for men (women). However, in their study the estimates of returns to schooling are twice as high as in the study by Bellmann, Reinberg and Tessaring (1994), which renders any comparison difficult. More research seems to be needed in this area.

Table 2. Returns to years of schooling (in %). Dependent variable: log earnings.

	Years	**Education**			
Bellmann, Reinberg & Tessaring (1994)	1976	5.7			
	1977	5.9			
	1978	6.1			
	1979	6.0			
	1980	5.8			
	1981	5.8			
	1982	5.9			
	1983	6.1			
	1984	6.1			
	1985	6.1			
	1986	6.0			
	1987	5.9			
Bellmann & Gerlach (1984)		Men	Women		
	1977-79	6.5	12.8		
Wagner & Lorenz (1988)		Allbus	Bremen	GSOEP	
	1980	9.4			
	1981		8.0		
	1982	9.4			
	1984	9.4		7.2	
Wagner & Lorenz (1989)		Pooled	FE	RE	
	1984-85	6.6	-	6.6	
Weißhuhn & Clement (1983)		Men	Women		
	1974	13.1	12.2		
	1977	13.6	11.7		
	1978	13.8	11.5		
Gerlach (1987)		mm	sm	mf	sf
	1981	7.3	8.2	5.6	7.8
Franz (1996)	1984-93	7.2			

Notes: FE: fixed effects. RE: random effects. mm: married males. sm: single men. mf: married females. sf: single females.

The great majority of previous studies concentrates on the sub-sample of men. Differences between men and women have not led to very robust results so far. For instance, Bellmann and Gerlach (1984) find that returns to education are about twice as high for women as for men (12.8% vs. 6.5%). This result, however, is contradicted by the study of Weißhuhn and Clement (1983), who find much smaller gender differences: 13 – 14% for men and 11 – 12% for women. Gerlach (1987) also finds somewhat lower returns to education for women than for men, but at a much lower level than Weißhuhn and Clement. For example, for the sub-samples of married men and women, he estimates rates of return of 5.5% and 7%, respectively. In contrast, for

Table 3. Definition of educational levels

	Bellmann. Reinberg & Tessaring (1994)	Dustman & van Soest (1998)	Steiner & Wagner (1998)	Franz (1996)	Weißhuhn & Clement (1983)
Level 1	High school	Basic schooling + apprentice-ship	Skilled	Inter-mediate school	High school
Level 2	Apprentice-ship + no high school degree	Intermediate schooling + apprentice-ship	Graduate	Technical high school	Vocational training
Level 3	Apprentice-ship + high school degree	High school / high school +apprentice-ship	-	High school	Higher specific school
Level 4	Higher specific school	Engineering school /higher specific school	-	Vocational training	University
Level 5	University	University	-	Vocational school	-
Level 6	-	-	-	Technical school	-
Level 7	-	-	-	Higher specific school	-
Level 8	-	-	-	University	-

single men and women the returns to schooling are about the same. These differing results obviously do not allow any clear conclusion to be drawn on the size of gender differences in returns to education. Here, too, more research seems needed.

Standard schooling models make the assumption that returns to education are linear in years of education. This perhaps restrictive assumption is not made in the dummy variable models (d.v.m.), where educational attainment is represented by a set of dummy variables. Table 3 summarises the definitions of educational dummies used in the studies surveyed here, where the respective category always refers to the highest educational degree obtained. The reference group, which is not indicated in the table, always refers to the lowest educational level.

On the basis of these definitions, returns to education by educational category estimated in the various studies are summarised in Table 4. For not too large returns, the reported numbers give the relative wage differentials (in per cent) between any of the education groups relative to the reference group of people with no completed educational degree.[1] Alternatively, the wage differential between any two educational levels is simply given by the difference of the respective returns reported in the table.

Given the differences in the definition of educational levels, these results are difficult to compare. At least, they all show quite unambiguously that the higher the level of education, the higher the returns in terms of earnings. One has to keep in mind, however, that years of labour market experience are likely to differ between educational levels. Taking this into account, it seems that the marginal return to education decreases with the level of education.

As to changes in returns to education over time, the estimates by Bellman, Reinberg and Tessaring (1994) show that they have increased for the higher educational groups (level 4 and level 5). As mentioned above, this result contradicts the observation by Weißhuhn and Clement (1983). For the period 1984 and 1990, Steiner and Wagner (1998) find slightly decreasing returns for the group with higher education in both data sets analysed.

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1 In a semi-loglinear earnings equation the exact wage differential is given by the exponent of the estimated parameter of the respective educational dummy variable.

Table 4. Returns to schooling by level of education (in %). Dependent variable: log earnings

	Years	Level 1	Level 2	Level 3	Level 4	Level 5
Bellmann, Reinberg & Tessaring (1994)	1976	14.3	13.2	29.6	37.7	36.7
	1977	14.5	13.0	28.8	39.6	39.0
	1978	14.9	12.8	29.3	40.6	40.9
	1979	14.6	12.7	27.2	40.1	40.8
	1980	14.3	10.0	26.3	39.0	39.8
	1981	14.8	11.1	27.0	39.1	40.1
	1982	14.5	11.8	26.6	40.4	41.4
	1983	15.0	11.3	28.8	42.0	43.5
	1984	15.4	10.8	25.6	43.1	43.5
	1985	15.3	9.8	26.9	43.2	44.3
	1986	15.1	12.8	24.8	42.7	43.8
	1987	15.0	10.8	25.8	43.2	43.2

	Years	Level 1	Level 2	Level 3	Level 4	Level 5
Dustman & van Soest (1998)	1984 private	17.2	30.5	45.9	50.7	63.1
	1984 public	27.1	61.3	83.7	90.1	100.3

	Years	Level 1 IABS	Level 1 GSOEP	Level 2 IABS	Level 2 GSOEP
Steiner & Wagner (1998)	1984	8.9	18.9	45.7	62.4
	1990	9.5	16.9	37.5	59.3

	Years	Lev.1	Lev.2	Lev.3	Lev.4	Lev.5	Lev.6	Lev.7	Lev.8
Franz (1996)	1984-93	17.1	26.8	24.9	11.3	16.9	27.8	35.6	45.3

	Years	Level 1 men	Level 1 women	Level 2 men	Level 2 women	Level 3 men	Level 3 women	Level 4 men	Level 4 women
Weißhuhn & Clement (1983)	1974	8.9	15.6	7.1	7.1	54.2	39.7	57.5	60.3
	1977	10.3	14.6	8.2	7.3	48.3	36.2	52.6	52.5
	1978	9.6	14.4	7.7	7.0	48.7	35.2	51.5	51.3

As to sectoral and gender differences, Dustmann and van Soest (1998) find higher returns at all educational levels in the public compared to the private sector of the West German economy. Weißhuhn and Clement (1983) find that returns for women with a high school degree (Abitur) are higher than for men with the same educational background, whereas they do not find gender differences for the other educational levels (except for the very small group of women with "higher specialised education").

Table 5. Returns to labour market experience (in %). Dependent variable: log earnings

	Years	Experience				Experience²			
Bellmann, Reinberg & Tessaring (1994)		s.m.	d.v.m			s.m.	d.v.m.		
	1976	1.8	1.8			-0.069	-0.069		
	1977	1.9	1.9			-0.070	-0.069		
	1978	1.9	1.9			-0.068	-0.067		
	1979	1.9	1.9			-0.065	-0.064		
	1980	1.9	1.9			-0.063	-0.062		
	1981	1.9	1.9			-0.061	-0.061		
	1982	1.9	1.9			-0.059	-0.059		
	1983	1.9	1.9			-0.058	-0.058		
	1984	2.0	2.0			-0.059	-0.058		
	1985	2.0	2.0			-0.056	-0.056		
	1986	2.0	2.0			-0.056	-0.055		
	1987	2.1	2.1			-0.055	-0.055		
Bellmann & Gerlach (1984)		Men	Women			Men	Women		
	1977-79	4.5	8.1			-0.11	-0.25		
Wagner & Lorenz (1988)		Allbus	Bremen	GSOEP		Allbus	Bremen	GSOEP	
	1980	4.5				-0.08			
	1981		4.2				-0.07		
	1982	4.3				-0.08			
	1984	3.8		4.1		-0.06		-0.08	
Wagner & Lorenz (1989)		Pooled	FE	RE		Pooled	FE	RE	
	1984-85	2.9	3.6	3.0		-0.062	-0.046	-0.063	
Dustman & van Soest (1998)		Private	Public			Private	Public		
	1984	1.3	4.4			-0.03	-0.04		
Steiner & Wagner (1998)		IABS	GSOEP			IABS	GSOEP		
	1984	2.9	3.4			-4.7	-6.3		
	1990	2.0	3.8			-2.9	-6.9		
Weißhuhn & Clement (1983)		s.m.		d.v.m.		s.m.		d.v.m.	
		m	f	m	f	m	f	m	f
	1974	4.0	12.1	3.6	10.2	-0.07	-0.09	-0.07	-0.07
	1977	4.4	13.5	3.9	10.9	-0.08	-0.09	-0.07	-0.07
	1978	4.5	13.4	4.0	10.6	-0.10	-0.09	-0.07	-0.07
Gerlach (1987)		mm	sm	mf	sf	mm	sm	mf	sf
	1981	3.0	8.2	2.4	6.5	-0.06	-0.02	-0.04	-0.01
Franz (1996)		s.m.	d.v.m.			s.m.	d.v.m.		
	1984-93	4.7	4.5			-0.07	-0.07		

Notes: FE: fixed effects. RE: random effects. mm: married males, sm: single men, mf: married females. sf: single females, s.m.: schooling model, d.v.m.: dummy variable model.

4.2 Returns to experience

Table 5 presents the estimates for the experience variables in the earnings functions. In all studies, the linear experience term exhibits a positive sign and the quadratic term a negative sign, which implies the well-known concave shape of the earnings-experience curve. The results vary less than for education, since most of the coefficients for the experience term range between 2 and 4%.

Bellman, Reinberg and Tessaring (1994) find a slightly positive time trend over the 80s. This result is confirmed, at least for the end of the 1970s, by Weißhuhn and Clement (1983). Steiner and Wagner (1998), however, find a decrease in the experience coefficient between 1984 and 1990 (from 3% to 2%) using the IABS data set and a slight increase with data from the GSOEP. Weißhuhn and Clement (1983) obtain much higher coefficients for women than for men. This result is not confirmed by Gerlach (1987). In the latter study, the opposition is rather between married and single individuals, since the effect of experience on wages is much higher for single people. Steiner and Wagner (1996) show that earnings-experience profiles depend on the level of education: the higher the level, the steeper the experience-earnings profile, which is very flat for people with no completed educational or vocational degree.

5 Conclusions

There is not much systematic research focusing on the returns to human capital in Germany. Most existing studies use quite different specifications of the basic human capital variables, and differ with respect to included control variables, data sets and time periods covered as well as estimation methods. This makes it difficult to compare results between studies. Hence, no clear conclusions on the returns to human capital in Germany can be drawn on the basis of the existing literature, and there is a clear need for further research, especially in three areas:

- *methodological approach*: most studies are based on a simple version of the traditional Mincer earnings function and ignore some important problems arising from potential selectivity bias, unobserved individual heterogeneity and the endogeneity of some of the basic human capital variables;

- *changes in returns to education over time*: it would be interesting to analyse whether returns have changed in Germany over time and, if so, how these changes can be explained (for instance, cohort effects, public policy change);
- *structural factors*: few studies analyse differences between groups, e.g. differences in returns by gender, between the public and private sector of the economy, and between natives and foreigners. Studies which focus e.g. on the gender wage differential have yielded no conclusive results so far.

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CHAPTER 7

Private Returns to Education in Greece: A Review of the Empirical Literature

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1 Introduction

The purpose of this survey is to review the empirical literature on the relationship between private earnings and education in Greece. Although the first attempt to examine this relationship can be dated back to the 1960s, the topic has not been examined in as much depth in Greece as in most other European countries, in part due to data limitations. The existing studies cover the period from the early 1960s to the early 1990s. However, due to data heterogeneity, few accurate conclusions regarding inter-temporal changes in private returns to education can be drawn. Almost all the surveyed studies estimate simple Mincerian functions using OLS.[1] Apart from returns to education in general, wage differentials between males and females, public and private sector employees as well as versions of the screening hypothesis have also been investigated.

The structure of the paper is as follows. Section 2 reports the data sources used in the studies surveyed and the estimation methods used by the researchers, while the main findings on the relationship between earnings and education are reported in Section 3. Section 4 provides a brief overview of the impact of a number of other explanatory variables on the process of earnings determination and Section 5 presents the conclusions.

2 Data and estimation techniques

The papers surveyed in the present study use a variety of data sets collected between 1957 and 1994. Different methods of information collection were employed and a number of institutions or even individual researchers were responsible for their collection. Some data sets rely on information provided by the individuals surveyed, while others use information provided directly by the firms' personnel departments; some of them cover the entire population, while others cover only the Greater Athens area or particular firms. In many cases it is not easy to assess the accuracy of the collected information and, moreover, the information collected is

1 Rates of return to education have also been estimated using cost-benefit techniques; see, for example, Leibenstein (1967), Psacharopoulos (1982) and Magoula and Psacharopoulos (1997).

not always the most appropriate for the examination of the relationship between earnings and education. A common feature shared by all data sets used in the surveyed studies is that they are cross-sectional, since no relevant panel information is available.

The most widely used sources of information are, probably, the *Household Budget Surveys* (HBSs) which are carried out by the National Statistical Service of Greece (NSSG) in regular intervals. They cover the entire population of the country with relatively large sampling fractions (2–3%) and, among other variables, they collect information on net disposable incomes (after direct taxes and social security contributions) and a number of socio-economic and labour market characteristics of the population members. The main purpose of the HBSs is the collection of information for the construction of the weights used in the Retail Price Index. As a consequence, according to the NSSG, their income information is not as accurate as the corresponding consumption expenditure information, although the information on earnings is considered reliable. Four such surveys covering the entire population of Greece have been carried out: in 1974, 1981/82, 1987/88 and 1993/94. The earnings data of the 1974 HBS were used by Kanellopoulos (1986), those of the 1987/88 HBS by Kanellopoulos (1997), while Magoula and Psacharopoulos (1997) and Magoula (1998) include in their sample the employees as well as the self-employed of the 1993/94 HBS.

A second source of information is a *Special Wages and Salaries Survey* (SWSS) carried out by the NSSG in 1977, which covered all urban areas and all (non-farm) sectors of economic activity. The sample included almost 9,000 wage and salary earners in twelve big cities and the information collected is very suitable for investigating returns to human capital. This data set was used by Psacharopoulos (1982) and Patrinos (1992a, 1992b, 1995).

Payroll data for the early 1960s and two small scale surveys carried out by Leibenstein (1967) were used, subsequently, by Psacharopoulos (1982) and Kanellopoulos (1980, 1982, 1985). Likewise, payroll data for small samples of employees working in a few large private sector firms, two Ministries and a state-controlled bank for 1975, 1981, 1982, 1985, 1986 and 1987 were used by Kioulafas, Donatos and Michailidis (1991), Lambropoulos (1990, 1992), Lambropoulos and Psacharopoulos (1992) and Patrinos and Lambropoulos (1993). Even though the information contained in some of these data sets is very rich, it is doubtful whether the picture that emerges from them regarding private returns to education is representative of all wage and salary earners in the corresponding years.

All the surveyed studies use simple OLS techniques – the standard Mincerian semi-logarithmic human capital earnings function – for the investigation of the impact of education on earnings. Education is measured both in terms of years and in terms of levels and a number of other explanatory variables are also examined (potential experience, age, socio-economic background, etc.). The only study that attempts a Heckman-type correction for selectivity bias concerning the choice of being employed in the public sector of the economy is that of Kanellopoulos (1997). Surprisingly, no study attempts a corresponding correction regarding the employment probabilities of female workers.

3 Variables and results

3.1 Dependent variable

As noted above, the dependent variable in all studies is the natural log of earnings. However, different concepts of "earnings" are used by different authors. Most of those who employ payroll data use gross monthly earnings (including overtime payments) before tax, social security contributions and other deductions or, in a few cases, gross annual earnings. Due to data limitations, those who rely on the information of the HBSs use net monthly earnings. In some studies earnings are divided by the number of hours worked, while in others hours worked enter the equation as an independent variable and in a few papers there is no standardisation at all for the hours worked. Furthermore, in some studies the sample is restricted to male employees only and in others to full-timers. Naturally, under these circumstances, it is quite difficult to compare the results reported by various authors and to draw firm conclusions regarding a number of issues.

3.2 Independent variables

Each study uses a number of explanatory variables in line with the questions it sets out to investigate. The standard variables are those included in the typical Mincer equation; that is, years of schooling, potential experience and potential experience squared, since, in almost all cases, information on actual experience is not available. In addition, dummy variables for successive levels of education are employed in a number of studies in order to distinguish between the differential impact each level of education has on the earnings determination process. Then, using this information, a number of tests are performed aiming to investigate the effect of sex, public/private sector employment, etc. on returns to education A number of studies use sets of additional explanatory dummy variables in order to capture the influence of factors such as marital status, part-time employment, firm size, firm growth rate, occupation, sector of economic activity, etc.

3.2.1 Schooling

No data set contains detailed information on actual years of schooling attended by each worker. Instead, they report the highest level of education completed.[2] However, the number of educational levels included varies considerably across data sets; in some data sets these levels are as few as three, in others they are as many as eight. Using this information, many authors transform this categorical variable into a continuous one, by assigning to each worker the minimum number of years of education that would have been required in order to complete the highest level of education actually achieved.[3] The corresponding results are reported in Table 1.

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2 A number of data sets contain information on "some years of primary education" and "some years of tertiary education".

3 Further, it should be noted that in all such transformations, it is assumed that university education lasts four years, even though in some faculties the minimum is five (engineering) or six (medicine) years and, in recent years, a considerable proportion of tertiary education graduates proceed to post-graduate studies (no separate "post-graduate" group is reported in any data set). Therefore, the relevant studies are likely to overestimate returns to tertiary education.

Table 1. Estimates of returns per year of schooling in Greece

Author / reference year	**Years of schooling**			**Marginal return per year of schooling per level of education**		
	Males	Females	All	Males	Females	All
Kanellopoulos (1982)[1] / 1960, 1964	0.066	0.065		L.sec. 0.027 U.sec. (gen) 0.080 Tert. 0.092	L.sec. 0.016 U.sec. (gen) 0.111 Tert. 0.065	
Kanellopoulos (1985) / 1960, 1964			0.078			L.sec. 0.029 U.sec.(gen) 0.075 Tert. 0.095
Psacharopoulos (1982) / 1960, 1964, 1977	0.092// 0.086// 0.058			Sec. 0.045 Tert. 0.149// Sec. 0.038 Tert. 0.144// Sec. 0.056 Ter. 0.067		
Kanellopoulos (1986) / 1974	0.069	0.077		Prim. 0.036 L.sec. 0.099 U.sec. 0.041 Tert. 0.084	Prim. 0.026 L.sec. 0.005 U.sec. 0.149 Tert. 0.187	
Kioulafas, Donatos & Michailidis (1991)[2] / 1975, 1981, 1982, 1985						Sec. 0.004/- Tert.0.12/0.11// Sec. 0.028/- Tert. 0.092/0.04// Sec. 0.025/0.025 Tert.0.075/0.037// Sec. 0.021/0.015 Tert. 0.080/0.022
Lambropoulos (1992)[2]/ 1977, 1981, 1985			0.062/ 0.070// 0.040/ 0.049// 0.033/ 0.039			
Patrinos (1992)[3] / 1977	0.058 (0.048) (0.054) (0.057)					
Patrinos (1995)[3] / 1977	0.056 (0.050) (0.051) (0.054)					
Lambropoulos & Psacharopoulos (1992)[2] / 1975, 1981, 1985						Sec. 0.008/-0.008 Tert.0.158/0.151// Sec. 0.023/-0.001 Tert.0.107/0.137// Sec. 0.009/0.005 Tert. 0.074/0.101

Patrinos & Lambropoulos (1993)[1] / 1981, 1985	0.032// 0.023	0.031// 0.028				
Kanellopoulos (1997)[1,2] / 1988				Prim. 0.005/0.022 L.sec. 0.056/0.043 U.sec. 0.044/0.008 Tert.0.054/0.030	Prim. 0.007/0.029 L.sec. 0.040/0.008 U.sec. 0.008/0.049 Tert. 0.048/0.039	
Magoula & Psacharopoulos (1997) / 1994	0.069	0.090	0.076			Prim.drop 0.162 L.sec. 0.082 U.sec. (gen) 0.067 U.sec. (tec) 0.063 Tech. Tert. 0.069 Tert. 0.087

Notes: 1 Estimate derived from "extended" Mincer equation (including other explanatory variables apart from years of schooling and potential experience).

2 Estimates refer to public/private sector.

3 Estimates in parentheses refer to persons whose fathers were, respectively, illiterate, primary education graduates and secondary or tertiary education graduates.

As anticipated, all studies report a positive and statistically significant relationship between years of schooling and (log) earnings. The estimates reported in Table 1 are not strictly comparable across studies, since, apart from differences in the dependent variable, there are also differences in the number of factors that are controlled for in each case. The general picture that emerges from the estimates reported in the first three columns of Table 1 (for males, females and all workers, respectively) is that the private rate of return per year of education in Greece declined between the early 1960s and the late 1980s and rose again in the early 1990s.[4] These findings are further confirmed by the estimates reported in the last three columns of Table 1 which display marginal rates of return per one additional year of education at each successive educational level. Moreover, these estimates imply that in all years under examination, considerable non-linearities could be observed in educational returns. In all studies, private returns per year of education appear to be higher in tertiary education than in secondary or primary education – sometimes substantially so.

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4 Nevertheless, the only estimate for the early 1990s is that of Magoula and Psacharopoulos (1997) who include in their sample the self-employed along with the employees, thus, potentially biasing their results.

Much work has been done concerning the effect that the sector of employment has on the earnings determination process. The issue is very important in Greece because, apart from the large number of civil servants, the state has a controlling stake in a considerable number of secondary and tertiary sector firms.[5] Pay structures as well as requirements for entering, are likely to differ between the public and the private sector. The evidence with respect to the rates of return to education in the two sectors is mixed, however. Lambropoulos (1992) reports higher returns to education in the private sector for 1977, 1981 and 1985 and the reported differential does not seem to change over time. Kioulafas, Donatos and Michailidis (1991) in contrast, who carry out their analysis in terms of levels rather than years of schooling, report higher returns in the public sector at both the secondary and the tertiary level of education, with the differential being larger in the case of tertiary education. In line with Lambropoulos (1992), though, they report declining rates of return in both sectors between the mid-1970s and the mid-1980s. Slightly different results are obtained by Lambropoulos and Psacharopoulos (1992) who use data for 1975, 1981 and 1985 and find that returns are consistently higher in the public sector for secondary education, while the opposite is true for tertiary education for the last two years under consideration.

The issue of differential returns to education for males and females has been dealt with in a number of studies but, once again, the evidence appears to be mixed. According to Kanellopoulos (1982), in the early 1960s returns to education were fairly similar across sexes, with females enjoying relatively higher returns to secondary education. On the contrary, Kanellopoulos (1986) reports that in the mid-1970s females had higher returns to tertiary education than males, while returns to education were higher for males at the rest of the educational levels. Patrinos and Lambropoulos (1993), after controlling for training, marital status and sector of employment (public/private), report higher returns for males in 1981 and for females in 1985, although the differences between sexes are small. The only study that reports substantially higher returns to education for females than for males is that of Magoula and Psacharopoulos (1997), which refers to the early 1990s. Finally, Kanellopoulos (1997) examines wage differentials by sex and sector of employment (public/private) simultaneously, using a correction for selectivity bias for those employed in the

5 The number of state-controlled firms was even higher in the 1980s.

public sector. Even though the estimated coefficients do not change substantially after the correction, it appears that in the public sector males face higher returns to education than females, whereas, at most educational levels, females enjoy higher rates of return to education in the private than in the public sector.

3.2.2 Experience

As noted earlier, information on actual experience does not exist in any of the data sets used. As a consequence, all papers surveyed use potential experience (and its square) in the human capital earnings functions estimated, defined as age – 6 – years of schooling.[6] The corresponding estimates are reported in Table 2. As anticipated, in all cases the relationship between potential experience and (log) earnings is found to be bell-shaped, although few workers can actually be found in the descending leg of the curve. In general, potential experience is found to be less important than schooling in the earnings determination process and, like schooling, its effect tends to decline when additional variables enter the equation (Kanellopoulos, 1985). Psacharopoulos (1982) reports a decline in the effect of potential experience on earnings between the early 1960s and the late 1970s. At least in recent years, the effect of potential experience on earnings appears to be stronger in the case of males than in the case of females, irrespective of their sector of employment (Kanellopoulos, 1997; Magoula and Psacharopoulos 1997; Magoula 1998).

An interesting attempt to examine the differential impact of potential experience on the earnings of public and private sector employees is that of Kioulafas, Donatos and Michailidis (1991). Instead of using potential experience and its square in the earnings functions, they introduce three dummies for potential experience – 6-10, 11-20 and 21-30 years – and estimate separate functions for private and public sector employees. Even though in both

Table 2. Estimated coefficients of returns to potential experience in Greece (Mincer equations)

[6] It is interesting to note that since all Greek males spend two years in the Armed Forces, their potential experience is, certainly, lower than that implied in these studies.

Author / reference year	**Potential Experience**			**Potential Experience squared**		
	Males	Females	All	Males	Females	All
Kanellopoulos (1982)[1] / 1960, 1964	0.019	0.012		-0.00016	-0.00014	
Kanellopoulos (1985) / 1960, 1964			0.045			-0.0005
Psacharopoulos (1982) / 1960, 1964, 1977	0.073// 0.059// 0.059			-0.0010// -0.0008// -0.0010		
Kanellopoulos (1986) / 1974	0.030	0.038		-0.0006	-0.0008	
Kioulafas, Donatos and Michailidis (1991)[2] / 1975, 1981, 1982, 1985			0.26/0.23 0.65/0.31 0.76/0.42// 0.22/0.17 0.56/0.29 0.76/0.40// 0.18/0.13 0.47/0.23 0.63/0.25// 0.18/0.14 0.45/0.27 0.60/0.31			
Lambropoulos (1992)[3] / 1977, 1981, 1985			0.055/0.056// 0.053/0.038// 0.045/0.049			-0.0008/ -0.0010// -0.0006/ -0.0006// -0.0008/ -0.0009
Patrinos (1992)[4] / 1977	0.059 (0.032) (0.061) (0.066)			-0.0010 (-0.0005) (-0.0010) (-0.0011)		
Patrinos (1995)[4] / 1977	0.060 (0.033) (0.061) (0.060)			-0.0010 (-0.0005) (-0.0011) (-0.0011)		
Lambropoulos and Psacharopoulos (1992)[3] / 1975, 1981, 1985			0.070/0.044// 0.053/0.037// 0.045/0.039			-0.0011/ -0.0009// -0.0006/ -0.0006// -0.0006/ -0.0009
Patrinos and Lambropoulos (1993)[1] / 1981, 1985	0.045// 0.041	0.045// 0.041		-0.0005// -0.0006	-0.0006// -0.0005	
Kanellopoulos (1997)[2] / 1988	0.033/ 0.043	0.021/ 0.036		-0.0005/ -0.0007	-0.0002/ -0.0006	

Magoula and Psacharopoulos (1997) / 1994	0.063	0.042	0.054	-0.0009	-0.0006	-0.0008

Notes: [1] Estimate derived from "extended" Mincer equation (including other explanatory variables apart from years of schooling and potential experience).
[2] Coefficients of dummies for 6-10, 11-20 and 21-30 years of potential experience in public/private sector.
[3] Coefficients for public/private sector.
[4] Estimates in parentheses refer to persons whose fathers were, respectively, illiterate, primary education graduates and secondary or tertiary education graduates.

sectors, earnings rise with potential experience, the estimated coefficients are strikingly different across sectors. Unsurprisingly, since pay structures in the public sector rely heavily on seniority, they report substantially higher returns to potential experience in the public than in the private sector of the economy.

3.2.3 Seniority/Tenure

Few of the data sets used provide information on seniority within the same firm and/or on-the-job training. Kanellopoulos (1982, 1985) reports that the effect of seniority on earnings is greater than the effect of experience, which is easily understood, if one takes under consideration that firms appreciate more experience within their own environment, instead of general experience. Furthermore, the author reports that this effect is greater for males than for females. Patrinos and Lambropoulos (1993) use a variable they call on-the-job training, which is very close to what Kanellopoulos calls seniority. They also report higher effects for males than for females but, in addition, they also report a declining trend for both males and females in the 1980s.

4 Other topics investigated

As mentioned earlier, many authors include in their earnings functions a number of other independent variables in order to improve the explanatory power. Some of these variables, such as occupation, are closely associated with education, thus blurring the effects of education on earnings. Others, such as sets of regional dummies, frequently turn out to be statistically significant, but they may simply reflect the effect of regional cost of living differentials rather than differences in productivity. Earlier studies such as those of Kanellopoulos (1980, 1982, 1985), investigated the effects of firm size and firm growth rates on earnings and found them to be very significant.

Further, a number of studies suggest that marital status affects the earnings of males positively and those of females negatively (although, in the latter case, not always statistically significantly). This finding is frequently interpreted as an implication that married men as breadwinners display a stronger labour force attachment, while married women due to child bearing and upbringing are forced to interrupt their careers at least temporarily, thus lowering their productivity. However, in the case of Greece the positive effect of marital status on the earnings of male workers may by attributed to institutional factors since, until very recently, a number of benefits were paid to married male employees but not to their spouses.

The influence of family background on earnings is investigated by Patrinos (1992a, 1992b, 1995) who examines the effect of schooling on earnings according to the socio-economic background of the worker, approximated by the schooling of the worker's father. The author distinguishes between four educational levels of the worker's father and shows that returns to education are higher for those with better educated fathers. This finding has important implications and can be attributed to a number of factors. Of course, it can be interpreted as an indication that children from a higher socio-economic background acquire human capital of better quality and, thus, are more productive, even after controlling for their education. However, it is very likely that in the Greek labour market where contacts and connections matter a lot, the specific pattern is the outcome of the exploitation of superior contacts and connections that better educated fathers preserve and "transmit" to their children.

Finally, one of the topics investigated in the surveyed studies and which is directly linked to the returns to education is whether education is used as a screening device. Kanellopoulos (1985) examines the effect of schooling on earnings within three different experience groups. The results indicate that schooling is extremely important in the first three years of experience, which reinforces the weak screening hypothesis. Returns decrease in the following years, since factors such as ability and skills influence earnings and reduce the importance of schooling. Lambropoulos (1992) further investigates the issue using mid-to-early career earnings ratios and fails to identify patterns of screening in the Greek labour market. Likewise, Magoula and Psacharopoulos (1997) and Magoula (1998) test the screening hypothesis through the use of experience-earnings profiles and the examination of the impact of an interactive term between tertiary education and potential experience on earnings and fail to identify any evidence of screening.

5 Conclusions

Due to a number of factors, particularly data limitations, it is not possible to draw firm conclusions regarding a number of issues related to private returns to education in Greece. Certainly, the findings of the studies reviewed here are in line with the basic predictions of the human capital theory. Earnings rise with education and the relationship between earnings and (potential) experience is bell-shaped. There is evidence that the rates of return per year of education vary by level of education and, in general, are higher in tertiary education, while experience matters more for the determination of earnings in the public than in the private sector of the economy. No general agreement exists regarding differences in the returns to education of males and females, whereas it appears that returns to education declined from the early 1960s to the mid-1980s and rose thereafter (although data limitations do not allow firm conclusions to be drawn). Further, marital status and socio-economic background have been found to influence earnings, whereas no strong evidence is reported in favour of the screening hypothesis.

One definite conclusion that can be drawn is that more work needs to be done in a number of areas. Trends in returns to education can be investigated more thoroughly using uniform concepts and exploiting homogeneous data sets which are already available (HBSs), issues of selectivity bias for the participation of women in the labour market need to be looked into if more efficient and reliable estimates of returns to education are to be obtained, the estimates of returns to education need to be adjusted in order to reflect the different unemployment probabilities faced by various (educational) groups of workers, and issues related to ability should be investigated, provided appropriate data sets become available. Finally, panel information using the information of new data sets (such as the European Community Household Panel) can be exploited in order to investigate a number of issues from a "dynamic" perspective.

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CHAPTER 8

Wages and Human Capital: Evidence from the Irish Data

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1 Introduction

The object of this study is to compare results on the determinants of earnings across a spectrum of studies. Previous research solely focused on the topic has been scarce up to the 1990s, but the recent emergence of a number of comprehensive data sets has allowed a relative rebirth of the topic.

The studies reviewed differ in their objectives. For example, Denny et al. (1999) explore the effects of cognitive skills on labour market earnings, Callan and Wren (1994) examine the differential in male and female earnings and Callan and Harmon (1998) investigate alternative wage specifications, such as instrumental variables. Despite the different objectives the above studies estimate the return to a year's education at around 8 per cent. Similarly, Denny and Harmon (1998), Barrett et al. (1999) and Callan and Harmon (1998) provide evidence that the marginal effect of higher qualifications is increasing in the level of those qualifications. This might appear at first glance to imply a form of increasing returns. However, as it does not take into account the number of years it takes to finish these qualifications, it does not imply increasing returns to years of education.

The following papers, unfortunately, do not give us a comparison across worker groups, for instance private versus public employees or tenure induced wage effects, but some studies allow us to differentiate between males and females. In such cases, we find that females in general, enjoy a larger income increment at higher levels of education. However, the returns to experience are not quite so well determined, due to the different proxies used for experience.

The data sets and the estimation procedures are explained in Sections 2 and 3. Section 4 gives a detailed description of the results and Section 5 examines our conclusions.

2 Data sets

The following section and Table A1 of the Appendix describe the data sets used in the surveys.

Walsh and Whelan (1976) use cross-sectional data from the Department of Labour's redundancy section. This data set provides the authors with workers who were entitled to redundancy payments during the first 3 months of 1972. With this survey, the person must have worked for two years with the same employer in order to qualify for redundancy payments. Thus females are likely to be under-represented in the sample, as women tend to switch jobs more often than males because of family commitments. Also, policies in some companies also prevented a woman from regaining her job following marriage.

Denny and Harmon (1998) and Breen et al. (1995) use the *School Leavers Survey* (SLS). This survey also has a narrow focus, concentrating on school leavers who are interviewed 10 months after leaving secondary school. For example, school leavers who had responded to the questionnaire in May 1994 had left school in June 1993. So, the survey does not allow the authors to gauge other labour market attributes such as experience and tenure. However the data set is quite useful in that it contains detailed information on performance in the state examinations for second level students.

Hannan et al. (1998) use a follow up survey from the 1985/86 school leavers to their analyses. These school leavers are interviewed again in late 1992. Consequently, the data set has some measure of experience along with a general measure of performance in exams.

The International Adult Literacy Survey (IALS) used by Denny et al. (1999) is especially interesting in that it contains a general measure of cognitive ability rather than actual performance in an exam. The IALS was administered by thirteen governments in conjunction with the European Union, the OECD, and UNESCO between 1994 and 1996. The survey encompasses a broad range of skills used in the context of working, schooling and home duties; for example, a respondent may be asked to read the dosage on a medicine label, or calculate the total return from a compound interest table on a certain amount. The IALS also has information on the amount of schooling and earnings, so the calculation of the wage equation was possible.

The 1987 ESRI Survey of Income Distribution, Poverty and Usage of State Services (SIDPSS) is the focus of Callan and Wren (1994) and Callan and Harmon (1998). This survey along with the *ESRI Living in*

Ireland Survey (LIIS), 1994, are used by Barrett et al. (1999). Denny and Harmon (1998) also use the LIIS, to provide a comparison with the SLS. These surveys are rich with regard to labour market experience, providing the authors with a measure of actual experience along with a very comprehensive list of current gross earnings, deductions and net earnings.

Some checks have been applied to the data sets to assess their reliability. For instance Walsh and Whelan (1976) find that their earnings data is somewhat unrepresentative, in that the figures for men are lower and for females are higher, than what we would expect from other data. A comparison of the ESRI Survey data and the Census of Population shows that the data is representative of the population, in terms of its age structure and other demographic characteristics. Also, the earnings data closely corresponds to that of figures by the Central Statistics Office. Given that the ESRI data is representative of the population, Denny et al. (1999) compare the IALS with this survey. They find that the IALS working sample tends to have a higher average age and fewer years of schooling than the 1994 Living in Ireland Survey, but point out that the higher average age may be the cause of the lower schooling level of the sample, as the older age cohorts tend to have less schooling.

3 Estimation procedure

Variables included in the earnings functions vary depending on the data set used and the purpose of each study. Table A2 of the Appendix summarises the equation specifications.

Walsh and Whelan (1976) conducted the first detailed analysis of earnings in Ireland. The estimation procedure used was OLS with the natural logarithm of weekly earnings as the dependent variable and the wage regression run separately for males and females and for both sexes together. The difference in male and female earnings is also explored in Callan and Wren (1994). Firstly standard Mincer (1970) equations are run separately for males and females to uncover gender-specific returns to personal characteristics such as age and experience. They then do the standard Oaxaca–Blinder decomposition of the wage gap, into that which can be explained by differences in characteristics and that which can be explained by differences in returns, usually interpreted as discrimination.

Denny and Harmon (1998) endeavour to find the effects of education on the probability of obtaining employment and the actual return to education and vocational training. Multinomial logit estimation is used to determine the effects of various factors on three labour market outcomes after leaving school – further education, employment and unemployment. Two labour market alternatives are only considered in Breen et al. (1995), thus a binary probit model is applied to establish what determines the chances of being in employment rather than unemployment.

When looking at the wage function we are obviously looking only at the working population, thus the data is non-randomly selected. Denny and Harmon (1998) deal with the non-randomness of the data by including the inverse of Mills' ratio (λ) as an additional term in their regression; λ then measures the effect of truncating the sample on the outcome. The problem is more pronounced for females, as the majority of males work whereas this is not true for females, so Callan and Harmon (1998) and Denny et al. (1999) only look at the male population.

Callan and Harmon (1998) also attempt to solve the endogenity of schooling problem. The problem lies in the fact that individuals with higher ability tend to choose more education. The disturbance term will pick up this unobserved ability. Thus, the education measure is correlated with the disturbance term resulting in downward bias estimates in OLS estimation. The instrumental variable approach may solve this problem by using another variable that is correlated with schooling but one that is uncorrelated with the disturbance term. Callan and Harmon (1998) apply this approach. Following tests of instrument validity, parental background is found to be an appropriate instrument.

Denny et al. (1999), Denny and Harmon (1998) and Breen et al. (1995) enter some measure of ability in their wage function to take account of the above mentioned unobservables. The IALS contains a range of measures of literacy, broadly defined. Denny et al. (1999) use principal components to construct from these a composite measure of cognitive ability. Denny and Harmon (1998) and Breen et al. (1995) control for results in the Leaving Certificate.

The growing preoccupation with ‘credentials’ and the rising return to qualifications brings Barrett et al. (1999) to examine the earnings dispersion between 1987 and 1994. A decomposition technique is employed to determine whether the inequality in earnings is due to education or other factors. Along the same lines, Hannan et al. (1998) analyse the match between education level attained and occupational status in order to find evidence of ‘qualification inflation’. In doing this they run the usual wage equation with dummy variables for being ‘overqualified’ and ‘underqualified’. An individual is ‘overqualified’ when in an occupational class that is more characteristic of an individual with a lower education level. For example, a person with a degree is overqualified if he/she is in an occupational class at or below the median of an occupational class that is more characteristic of a person with a sub-degree qualification.

Denny et al. (1999) depart from the above mentioned studies, in that maximum likelihood estimation techniques are employed to estimate the wage function due to the grouped nature of the dependent variable. IALS wage data is constructed on the basis of assigning individuals to the appropriate quintile of the wage distribution, providing a 5-category banded income variable. Stewart (1983) shows that better estimates are available by exploiting a distributional assumption for the continuous but unobserved variable with a maximum likelihood estimator than ad hoc procedures such as using the midpoints of the wage bands. The estimator is a natural generalisation of estimation of the censored normal, which is in turn a generalisation of the well-known Tobit estimator. It provides consistent estimation if wages are lognormal distributed.

Where not stated the dependent variable is the natural logarithm of gross hourly earnings.

4 Results

The results from returns to various labour market attributes show surprising homogeneity across studies. This is unexpected given the different data sets used and the divergent objectives of the studies surveyed. Another surprising element to the results is the complete absence from the wage equation of any distinction between public and private sector employees or tenure-induced wage effects. Tables 1–3 summarise the results from variables that explain most of the variation in earnings, which are analysed below along with other variables.[1]

4.1 Education

The Irish education system consists of three levels: Primary education, attended by children aged 5–12; Secondary and Vocational schools attended by children aged 12–18; and the Third Level. Pupils who have 3 years of post-primary education sit a State exam called the Junior Certificate. Students who continue on for a further two or three years sit another State exam called the Leaving Certificate. Prior to 1992, students who had experienced three years of Vocational schools sat a State exam called the Group Certificate. From 1992 the two junior cycle exams (Intermediate and Group) were consolidated into one exam called the Junior Certificate. The third level sector consists of non-university and university courses. The non-university or Institutes of Technology (IT) sector consists of degree and non-degree programmes, whereas the majority of university programmes are for a degree.

The use of educational levels rather than years of education is the preferred option in the studies surveyed here the reason being the absorption with the credentialist model, which requires the use of educational levels rather than years of education, to show the rising returns to qualifications. A review of the returns to education (Tables 1–3) shows the expected positive correlation between earnings and education, the higher the level of education the higher one's earnings.

Table 1. Returns to a year's education

[1] Sexton, Whelan and Williams (1988) also study the effects on earnings using a specially collected data set which examines the transition from education to working life and early labour market experience in Ireland. However, this paper is not included in this review due to different econometric specifications which do not allow comparison with other studies, specifically the dependent variable is the level not the logarithm.

	Year	All	Male	Female
Walsh and Whelan (1976) **Secondary Education**	1972	0.029	0.026	Not sig.
Walsh and Whelan (1976) **Vocational Education**	1972	0.012	0.018	Not sig.
Callan and Harmon (1998)	1987		0.083 All 0.092 Age 18-32 0.085 Age 33-49 0.88 Age 50-64	
Denny et al. (1999)	1994		0.082	
Denny et al. (1999) **Controlling for ability**	1994		0.070	

Table 1 shows findings for returns to years of education. Callan and Harmon (1998), Hannan et al. (1998) and Callan and Wren (1994) find an estimated return of 8 per cent for each additional year of schooling, which is consistent with Denny et al. (1999), despite using different estimation procedures. Callan and Harmon (1998) also find that there is a slight increased return to the younger age group. However, Walsh and Whelan (1976) find somewhat lower estimates in the returns to vocational school and secondary school, which is not surprising given the narrow sample of population covered.

The fact that the education measure may include some measure of ability, which may produce biased estimates of the returns to education, has been much discussed. Denny et al. (1999) control for this fact by including a measure of cognitive skills, which results in a lowering of the effect of education on earnings, indicating that education does indeed include some measure of innate ability.

Tables 2 and 3 show findings from educational levels. Callan and Harmon (1998), Callan and Wren (1994) and Barrett et al. (1999) provide very similar estimates of the returns to education for men. This is not surprising since the estimated year is the same (1987). Having the Intermediate Certificate increases earnings by 19% above that for a person with no qualification and a degree increases earnings by a further 60%.

Table 2. Levels of education

	Year	Men				
		Intermediate/Junior certificate	Group certificate	Leaving certificate	Diploma/ 3rd level	University
Callan and Wren (1994)	1987	0.19	0.15	0.38	0.54	0.81
Callan and Harmon (1997)	1987	0.195	0.162	0.374	0.505	0.794
Barrett et al. (1999) Spec 1	1987	0.17		0.37	0.58	0.86
Barrett et al. (1999) Spec 3	1987	0.12		0.36	0.59	0.79
Barrett et al. (1999) Spec 4	1987	0.11		0.34	0.56	0.85
Breen et al. (1995)	1988-1991	0.376		0.239		
Denny and Harmon (1998) SLS	1990-1995	0.1016		0.2455		
Denny and Harmon (1998) LIIS	1994	0.376 0.296	0.289	0.464	0.609	0.940
Barrett et al. (1999) Spec 1	1994	0.22		0.41	0.54	1.01
Barrett et al. (1999) Spec 3	1994	0.18		0.36	0.53	0.95
Barrett et al. (1999) Spec 4	1994	0.17		0.34	0.51	0.98

Note: Where results for the Group Certificate are not shown, it has been classified with the Intermediate/Junior Certificate.

Comparing the male and female results, Callan and Wren (1994) find that females enjoy a lower wage premium at the lower levels of education and a higher wage premium at higher levels of education. However, Breen et al. (1995) find that women enjoy the higher premium to the Leaving Certificate. It has to be pointed out that Breen et al. (1995) control for performance in exams. Nevertheless, Denny and Harmon (1998) also take account for performance in exams and discover that men experience higher returns to the Leaving Certificate than women. The difference in the two opposing results can be explained in the actual measure of exam achievement. Breen et al. (1995) take account of the actual grades in the exams, whereas Denny and Harmon (1998) take account of the number of papers taken at higher and lower levels. A plausible explanation for this is that actual grades make a difference for girls in the labour market, as they tend to enter into clerical or secretarial positions following secondary school, which need proof of some numeric or written ability. Whereas, males

Table 2. (cont.)

	Year	Women				
		Intermediate/Junior certificate	Group certificate	Leaving certificate	Diploma/ 3rd level	University
Callan and Wren (1994)	1987	0.17	0.15	0.44	0.74	1.10
Callan and Harmon (1997)	1987					
Barrett et al. (1999) Spec 1	1987					
Barrett et al. (1999) Spec 3	1987					
Barrett et al. (1999) Spec 4	1987					
Breen et al. (1995)	1988-1991					
Denny and Harmon (1998) SLS	1990-1995	-		0.1406		
Denny and Harmon (1998) LIIS	1994	0.332 0.308	0.291	0.477	0.609	1.04
Barrett et al. (1999) Spec 1	1994					
Barrett et al. (1999) Spec 3	1994					
Barrett et al. (1999) Spec 4	1994					

Note: Where results for the Group Certificate are not shown, it has been classified with the Intermediate/Junior Certificate.

who leave after secondary school enter into manual labour and actual results are not important to obtaining these jobs.

When Callan and Harmon (1998) and Barrett et al. (1999) break their sample into specific age cohorts, a general picture emerges whereby returns to education increase with age. This suggests that the older age cohorts enjoy a wage premium because qualifications were relatively scarce while they were attending school in the 1940s.

In addition, Barrett et al. (1999) find that returns are consistently increasing from 1987–1994. This, it could be argued, is a reflection of a society that is growing preoccupied with qualifications, a phenomenon which Collins (1979) coined as 'credentialism'. This term refers to the hypothesis that employers expect their employees to have more qualifications in the face of the rising standard of the education level of the population (Hannan, 1986). However, it is not clear that this is

Table 3. Levels of education by age cohorts–men only

	Age Cohort	Year	Inter/ Junior Certificate	Group Certificate	Leaving Certificate	Diploma/ 3rd level	University
Callan and Harmon (1998)	18-32	1987	Not sig	Not sig.	0.193	0.395	0.847
Barrett et al. (1999) Spec 2	15-32	1987	0.08		0.23	0.39	0.73
Barrett et al. (1999) Spec 5	15-32	1987	0.05		0.26	0.46	0.86
Callan and Harmon (1998)	33-49	1987	0.144	0.107	0.385	0.450	0.710
Barrett et al. (1999) Spec 2	33-49	1987	0.18		0.42	0.56	0.90
Barrett et al. (1999) Spec 5	33-49	1987	0.12		0.38	0.54	0.88
Callan and Harmon (1998)	50-64	1987	0.151	0.221	0.573	0.573	0.736
Barrett et al. (1999) Spec 2	50-64	1987	0.14		0.49	0.87	0.94
Barrett et al. (1999) Spec 5	50-64	1987	0.16		0.45	0.79	0.78
Barrett et al. (1999) Spec 2	15-32	1994	0.11		0.21	0.26	0.73
Barrett et al. (1999) Spec 5	15-32	1994	0.14		0.26	0.39	0.91
Barrett et al. (1999) Spec 2	33-49	1994	0.24		0.52	0.67	1.13
Barrett et al. (1999) Spec 5	33-49	1994	0.18		0.42	0.60	1.06
Barrett et al. (1999) Spec 2	50-64	1994	0.14		0.35	0.71	1.04
Barrett et al. (1999) Spec 5	50-64	1994	0.13		0.34	0.63	0.95

the only or indeed the best explanation. The rate of return may have simply increased because of market forces.

In addition, Table 3 shows that those having a qualification other than a degree do not seem to have experienced the same increased returns. In fact there is a slight tendency for decreased returns in non-university third level qualifications. Furthermore, Tables 2 and 3 indicate that the earnings function appears not to be very sensitive to its specification, in that returns to education do not differ greatly across alternative methods of expressing the wage function. Returns tend to be remarkably similar at lower levels of education, however there tends to be a slight difference at the upper level of education. Where standard errors are reported in the studies, we find that the differences in the returns are not statistically significant from each other.

4.2 Vocational education/training

Sitting the Group Certificate exam has a positive effect on earnings but less than the Intermediate Certificate. For example, Callan and Wren (1994) find that taking the Group Certificate will add 15% to earnings for men and women against individuals who have no qualifications, whereas this figure for the Intermediate Certificate is 19% and 17% for males and females, respectively. However, Callan and Harmon (1998) find that sitting the Group Certificate is not statistically significant for men for the younger age cohort, indicating the growing need for the younger generation to equip themselves with higher qualifications.

Denny and Harmon (1998) analyse the effect of post Intermediate and Leaving Certificate Vocational training. They find that Post-Intermediate Certificate training has no significant effect for girls but has a positive significant effect for boys. In addition Post Leaving Certificate Vocational training (PLVT) has a positive significant effect on both sexes with a slightly larger impact for boys. However, this effect for girls drops dramatically once selection bias is taken into account, as the working female population will not opt for PLVT, whereas the non-working population will. Controlling for this fact reduces the effect PLVT has on the female population. Also, the marginal effect for boys from PLVT to diploma courses is small in comparison to the marginal effect for females. This may be due, as the authors point out, to the high degree of substitution between this vocational training and sub-degree courses for males.

4.3 Experience

The School Leavers Survey focuses on individuals one year after the end of the secondary school cycle, so information on experience is non-existent in surveys that use this data set.

Table 4. Estimated coefficient: experience

		Males		Females		All	
		Experience	Experience^2	Experience	Experience^2	Experience	Experience^2
Walsh and Whelan (1976)	1972	0.012	-0.000	not sig.	not sig.	0.009	-0.000
Callan and Wren (1994)	1987	0.63	-0.98	0.71	-1.32	-	-
Callan and Harmon (1998) All	1987	0.459	-0.726				
Callan and Harmon (1998) 18-32	1987	1.211	-4.365				
Callan and Harmon (1998) 33-49	1987	0.549	-0.860				
Callan and Harmon (1998) 50-64	1987	0.851	-1.119				
Denny and Harmon (1998)	1994	0.785	-0.099	0.568	-0.071		
Denny at al. (1999)	1995	0.645	-0.059				

Walsh and Whelan (1976) measure experience as the present age minus the age when an individual left school. Experience and experience squared exhibit the expected non-linear pattern, i.e. earnings increase with experience but at a diminishing rate (see Table 4). Callan and Wren (1994) find, using actual experience, that for women the earnings/experience profile is more peaked, i.e. female earnings increase faster than males with experience but also diminish at a quicker rate. Also, Callan and Wren (1994) find that the return to on-the-job experience is greater for females, a fact that Denny and Harmon (1998), using age as a proxy for experience, do not find. The difference lies in the fact that Callan and Wren (1994) take account of interruptions in the female labour market, thus providing a more accurate measure of experience.

Callan and Harmon (1998) break the sample into age cohorts. They find that experience has a greater influence on earnings when a person is young and a lesser and more diminishing effect as the individuals grow older. Over time and across the different studies we find no trend and quite varied estimates for the returns to experience. This brings us to the understanding, that the definition of experience is important in trying to assess the sensitivity of the wage equation with respect to experience. Barrett et al. (1999) unfortunately do not give estimates for the returns to experience.

4.4 Occupation/Social Class

A male individual, whose father is from an unskilled background, experiences a 10% drop in earnings compared to another male from a professional background. This figure for females is 16% (Breen et al., 1995). Another important finding is that if one's father has a job, this increases greatly the chances of the respondent having a job one year after leaving school, as opposed to being unemployed. Denny and Harmon (1998) find that individuals from worse off backgrounds are also less likely to pursue higher education. In addition, reinforcing Breen et al. (1995) above, Denny and Harmon (1998) find that having a father who has a job, increases the probability of being either in higher education or in employment compared to unemployment.

4.5 Selection bias

The only study that addresses the issue of selection bias (see Section 3) is Denny and Harmon (1998). Using the Heckman two-step method Denny and Harmon (1998) discover that the inverse Mills' ratio is insignificant for men and significant for females. This implies that there is a problem of selection bias in the regression results for females but not for males, that is, the estimates from the OLS female equation are inconsistent.

In addition, controlling for selection bias results in a notable effect from exam performance; taking higher level papers in the Intermediate and Leaving Certificate is now significant for females. This indicates that performance in exams is important in signalling women's general literacy to employers, in the job market, more so than for males. Again, as mentioned above, the reason lies in the type of jobs females tend to enter into when they leave school. Correcting for selection bias also lowers, by half, the effect that vocational training has on earnings, which indicates that the unobserved characteristics, such as motivation and ability, are different across the working and non-working population.

5 Conclusion

A survey of the literature on the returns to education brings us to the conclusion that the specification of the wage equation and the use of different data sets do not have a dramatic effect on earnings. For example, the returns to educational levels do not vary much and the differences across years and studies are not significantly different. When years of education is used, the returns are around 8 per cent per year with the exception of Walsh and Whelan (1976). The return to experience varies a lot between the studies surveyed, which is due to the different proxies for experience used, i.e. age, potential or actual experience. Again, with Walsh and Whelan's (1976) study producing some peculiarities.

Thus, this review has also brought to light the importance of reliable data sets. Walsh and Whelan (1976) use earnings from a data set that is unrepresentative of the population distribution of wages, hence produces estimates that can be classified as 'outliers' in comparison to other studies.

However, we cannot be fully confident of these results until more estimates have been replicated, especially in terms of robustness of results to different data sets. There is a remarkable scarcity of research on returns to labour market attributes in Ireland, which is attributed to the lack of comprehensive micro-data; in the 9 papers surveyed there is only 5 different data sets used, which does not allow us to be fully confident of our results.

Further research is also warranted to explore the correct wage specification and some peculiarities especially in relation to the female wage equation. Particularly, the impact of performance in exams on success in the female labour market.

Also, as can be seen from Table A1 of the Appendix it is difficult to infer anything about the trend in the rate of return because of the timing of the data sets. While one study argues for increasing returns to credentials, there is no obvious increase (or decrease) in the return to years of education.

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Table A1. Description of data sets

	Data set used	Year	Population covered	Working sample size		
				Male	Female	Total
Walsh and Whelan (1976)	Redundancy Survey	1972	Redundant Workers			504
Barrett, Callan and Nolan (1999)	Living in Ireland Survey (LIIS)	1994	All			
Breen, Hannan and O'Leary (1995)	School Leavers Survey (SLS)	1988-1991	School Leavers	901	1030	
Callan and Wren (1994)	Survey of Income Distribution, Poverty and Usage of State Services	1987	All	1215	1030	
Callan and Harmon (1998)	Survey of Income Distribution, Poverty and Usage of State Services	1987	All	1,144		
Denny and Harmon (1998)	School Leavers Survey (SLS)	1990-1995	School Leavers	1436	1550	
Denny and Harmon (1998)	Living in Ireland Survey (LIIS)	1994	All	1808	1340	
Denny, Harmon and Redmond (1998)	International Adult Literacy Survey (IALS)	1995	All	581		
Hannan, McCabe and McCoy (1998)	Follow up Survey from 85/86 School Leavers Survey	1992	School Leavers			650

Table A2. Wage equation: variables included*

	Walsh and Whelan (1976)	Denny and Harmon (1998)	Callan and Wren (1994)	Callan and Harmon (1998)	Barrett et al. (1999)[1] spec. 1	Barrett et al. (1999)[2] spec. 3	Barrett et al. (1999)[3] spec. 4	Breen et al. (1995)	Hannan et al. (1998)
Age	✓				✓				
Age squared	✓				✓				
Experience			✓	✓		✓	✓		
Experience squared			✓	✓		✓	✓		
Years of education	✓			✓					
Levels of education		✓	✓	✓	✓	✓	✓	✓	✓
Years not worked			✓	✓		✓	✓	✓	
Years not worked squared			✓	✓		✓	✓		
Dublin	✓	✓	✓	✓					✓
Urban	✓	✓	✓	✓				✓	✓
Activity of firm	✓							✓	
Married	✓		✓	✓	✓	✓	✓		✓
Union	✓			✓					
Ill Health	✓								
Occupation	✓								✓
Training						✓	✓		
Employment situation of mother/father								✓	
Father's social class								✓	✓
Mother's educational level									✓
Selection Bias (λ)		✓							

Notes: * All studies except Walsh and Whelan (1976) use the log of gross hourly wage as the dependent variable. Walsh and Whelan use the log of gross weekly wage.

[1] Marital status has been interacted with sex i.e. single men, married women.

[2] Specification equation 2 is the same as specification 1, but with an interaction term for levels of education and the three age bands (15-32,33-49,50-64).

[3] Specification equation 5 is the same as specification 4, but with an interaction term for levels of education and the above age bands.

CHAPTER 9

Returns to Education in Italy: A Review of the Applied Literature

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1 Introduction

The current education system in Italy is composed of primary, lower secondary, upper secondary and tertiary education. Primary school is compulsory for children aged between 6 and 11 years. Lower secondary education is also compulsory, free of charge and lasts three years. Post-compulsory education is differentiated into the following categories: classical, scientific and pre-school teacher training; artistic education; technical schools and vocational education. Upper secondary education lasts from three to five years, depending on the type of school. Since 1969, the selection of the type of school does not preclude access to tertiary education.

Major post-war reforms of the education system in Italy are the 1962 reform of compulsory schools, the 1969 liberalisation of access to tertiary education and the 1985 reform of the primary school system. Graduation from upper secondary schools requires a leaving certificate examination and access to tertiary education is only conditional on passing this exam.

In the last decades, Italy has experienced a generalised increase in the level of education. In the early 1950s less than 25 per cent of the population in schooling age (over 6 years old) had completed compulsory schooling (junior high school). It took the 1962 reform of junior high schools and an additional eight years to get close to 100 per cent in the percentage of graduates among 11 year old individuals (see Figure 1). The percentage of high school graduates increased sharply, from less than 15 per cent in the early 1950s to close to 70 per cent in the 1990s (see Figure 2). After the reform of the criteria regulating access to college in 1969, the percentage of college graduates increased only mildly. While the percentage of individuals enrolled in college increased, graduation rates remained low because the average duration of completed spells before graduation increased (see Figure 3).

The growth in the percentage of individuals with a secondary (and college) education over the years, however, was not enough to close the educational gap between the North and the South of the country (the North being on average more educated than the South). Conversely, the educational gender gap progressively decreased, with a growing proportion of women enrolling in upper secondary schools and obtaining a diploma.

Figure 1. % aged 14 with junior high school diploma

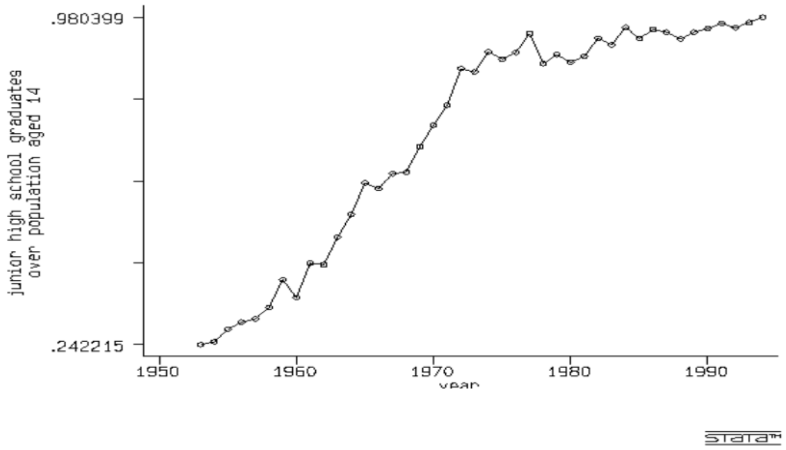
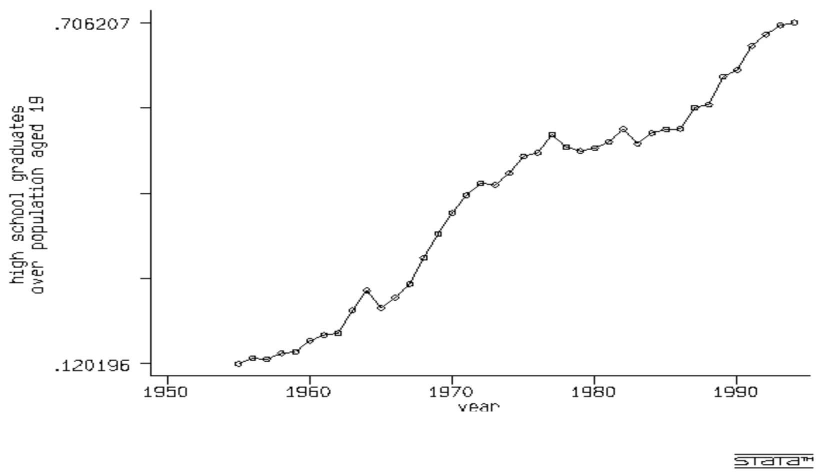
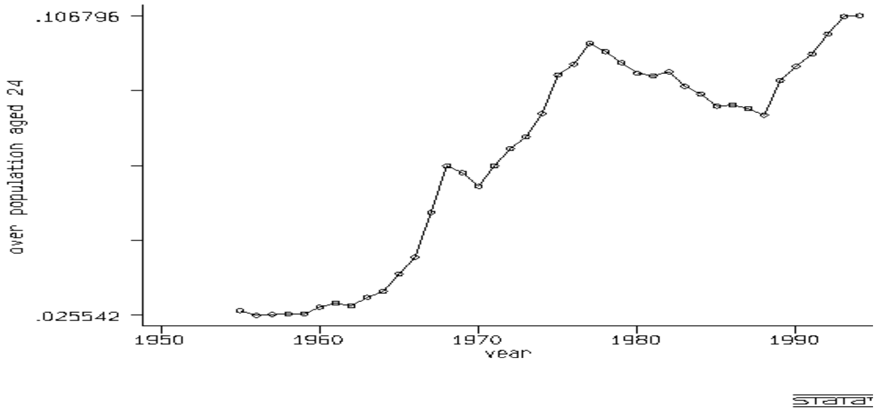


Figure 2. % aged 19 with high school diploma



Economists try to measure school quality by looking both at the inputs and the outputs of the schooling system. Starting with the inputs, commonly used measures include public (and private) educational expenditure, the pupil/teacher ratio, the intensity of schooling,

Figure 3. % aged 24 with college diploma



often proxied by the length of the school term, and average annual teachers' salary. *Ceteris paribus*, a higher expenditure on education, a lower pupil/teacher ratio, a longer term and a higher average teachers' salary are expected to improve the average quality of education. In particular, an increase in expenditure or a decrease in the pupil/teacher ratio improve the quality of instruction and lead to higher returns for each year of completed education. An increase in term length increases the amount of material covered in a school year and thereby increases the economic value of additional years of schooling. Finally, higher teacher salaries lead to improved classroom instruction by motivating teachers to perform well.

Public expenditure on education as a proportion of GDP in Italy is close to 5 per cent. While expenditure per student for primary and secondary education relative to per capita GDP is higher than the OECD average, it is lower than the OECD average for tertiary education. Turning to the pupil/teacher ratio, this ratio in Italy is about half as large as the OECD average ratio for primary schools and slightly higher than half for secondary schools. Next, consider some indicators of the intensity of schooling. According to the OECD, Italian primary and secondary schools are second only to Sweden in the relatively low numbers of hours taught per year. At the same time, average teachers' starting and maximum salaries as a percentage of GDP per capita are relatively low by European standards (see OECD, 1995).

Turning to the results of the education process, the level of attainment in Italy is dramatically lower than the OECD average. In 1992, the share of Italians aged 25 to 34 with an upper secondary education was 42 per cent, compared to 65 per cent for the OECD (inclusive of Italy). The difference was even sharper for individuals aged 45 to 54. In this age group, only 21 per cent had an upper secondary degree, compared to 50 per cent in the OECD, on average.

Another useful measure of the performance of the education system is the percentage of graduates in the population at theoretical age of graduation. Strikingly, close to 70 per cent of individuals at theoretical age of graduation had completed an upper secondary education in Italy in the early 1990s, compared to an average of 85 per cent in the OECD. For tertiary education, these percentages were, respectively, 10.5 in Italy and 20.8 for the OECD average.

These differences are partly explained by the very high drop-out rate in the Italian system. According to a study by CENSIS (1992), in a cohort of 100 individuals entering the first year of lower secondary education, only 80 individuals enrol in upper secondary schools. Of these, 49 graduate after five years and 33 enrol in a university course. Among those entering tertiary education, only 10 individuals graduate.

The importance of drop-outs in the Italian system is also highlighted by the net enrolment rate in schools by individuals aged 16 and 17. While in Italy only 6 teenagers out of 10 are still in school at 16, this proportion is close to 9 for the OECD average. The high drop-out rate in the Italian educational system could be interpreted as an indicator of the system being very competitive and selective. This is hardly the case, however. Given the relatively low private cost of education, we speculate that many teenagers enrol only temporarily in school because of the problems they encounter in finding a satisfactory job match in the labour market. When an acceptable job offer turns up, they simply drop out of school.

The evidence discussed so far suggests that the Italian educational system uses substantial resources to produce disappointing results in terms both of intensity of education and graduation rates. According to a recent report by the Italian Association of Employers (Confindustria, 1998), this outcome is partly to be attributed to the lack of competition both among schools and pupils, to excessive red tape and centralisation and to poor personnel management.

Even a very broad evaluation of the performance of the education system in a country requires that we consider the interaction between schooling and labour market performance. In most developed countries, individuals with a lower level of educational attainment are more likely to be unemployed than those with a higher level of attainment. This is apparently not the case for Italy, however, where individuals aged 14 to 25 experience substantially high unemployment rates, quite independently of the level of education. In this context, (expected) returns to education have not offered great advantages in terms of job opportunities and remuneration (OECD, 1999).

A number of empirical studies, in recent years, have studied the returns to education in Italy. This chapter reviews the main results of available applied research. It is probably worth stressing that while education is an important aspect of human capital, 'off-the-job' and 'on-the-job' training are also key determinants of human capital accumulation. Despite substantial theoretical research on the relationship between training and wages, however, very little has been done to evaluate the returns to training in Italy, mainly because of the lack of data. Henceforth, we shall restrict our attention to the empirical evaluation of economic returns to education.

Research on these issues has made significant progress – in the Italian context – in the past few years, both in terms of data used and in terms of empirical methodology. While the studies carried out in the late 1980s and early 1990s were based on OLS estimates and on unrepresentative data sets, recent studies use nationally representative samples and employ more suitable econometric techniques, such as IV (instrumental variables) methods. The key result of the most recent crop of studies is that the estimated (private) returns to education are significantly higher than previously suggested.

The remainder of this paper is organised as follows. Section 2 presents an overview of the Italian literature. Section 3 describes the data. Section 4 identifies the methodological options and shows the estimation results. Section 5 is devoted to a brief illustration of the changes over time in the returns to education and Section 6 concludes.

2 Overview of the literature

The literature concerning empirical analysis of the economic returns to education, in recent years, has expanded significantly mainly due to improved access to better-quality data as well as to a more appropriate methodology of investigation. We document this evolution by reporting, in Table 1, the main features of the available empirical research. While some contributions focus explicitly on the issue at hand, other contributions have a different focus but also present empirical estimates of earnings functions that include education as an explanatory variable. We look at them in order.

The studies devoted to estimating the (private) returns to education deal in an explicit way with methodological issues and try to disentangle the effects of education from those of other (mainly unobservable) factors affecting economic returns (such as individual ability). This group of studies includes Cannari and D'Alessio (1995), Colussi (1997) and Brunello and Miniaci (1999).

Other studies discuss the returns to education as a by-product of broader issues. Antonelli (1987), for instance, studies the transition from school to work in a large Italian region (i.e. Emilia Romagna located in Central Italy) and runs earnings regressions both for the private and the public sector. The study of wage differentials in the private and public sectors is the focus also of Brunello and Dustmann (1996).

Another line of research has looked at regional wage differentials. Cannari, Pellegrini and Sestito (1989) estimate standard Mincer earnings functions by region. Manacorda (1996) considers the evolution of earnings differentials in the North and the South of Italy and tries to explain it as the result of the interaction between the supply and demand for education. Lupi and Ordine (1999) study regional wage differentials using quantile regressions, based upon partitions of the empirical distribution of wages.

Yet another angle of research is wage differentials by firm size. Both Lucifora (1993b) and Brunello and Colussi (1998) estimate earnings functions to explore the relationship between earnings and firm size. Gender earnings differentials is the topic studied by Biagioli (1989), Ghidoni (1989), Lucifora and Reilly (1990), Erickson

Table 1. Data set description

Authors (year)	Data set	Years	Estimated equations	Number of obs.
Antonelli (1987)	Federindustria (Emilia Romagna)	1977	Private sector: 1419 obs. Public sector: 375 obs.	1795
Biagioli (1989)	Unità Sanitaria Locale	1983	Males: 280 obs Females: 462 obs	742
Ghidoni (1989)	Personal survey	1983	Males: 271 obs Females: 115 obs	386
Cannari, Pellegrini & Sestito (1989)	B. I.	1986	Sample used for all the specifications: 5650 obs	5650
Lucifora & Reilly (1990)	ENI-IRI	1985	Males: 18549 obs Females: 4223 obs	22772
Sestito (1990)	B. I.	1977/1987	From 2325 in 1977 to 5305 in 1987	-
Lucifora (1993b)	ENI-IRI, Mediobanca	1985	5 different sectors	19318
Erickson & Ichino (1992)	B. I.	1978-1987	(For 1987) Males: 3192 obs Females: 1797 obs	-
Cannari & D'Alessio[1] (1995)	B. I.	1989/1991 /1993	Panel 1989-1991: 334 obs 1993: 2041 obs	-
Brunello & Dustmann (1996)	B.I.	1993	Public sector: 935 obs Private sector: 1382 obs	2317
Manacorda (1996)	B. I.	1977-1993	North: 1817-3746; South: 508-1569	-
Flabbi (1997)	B. I.	1991	Males: 3801 Females: 1933	-
Colussi (1997)	B. I.	1993	North-Centre: 1498 South-Isles: 817	2315
Brunello & Colussi (1998)	B. I.	1993	Large firms: 633[2] Small firms: 777[2]	1410
Brunello & Miniaci (1999)	B. I.	1993-1995	Mixed sample for 1993,1995: 2943 obs Panel(1991-1995): 590 obs	-
Lupi & Ordine (1999)	B.I.	1995	Quantiles by region	1554[3]

Notes: [1] Cannari and D'Alessio (1995) consider three separate sub-samples: male full-time full-year employees in the 1989-1991 panel (334 obs); male full-time, full-year employees aged from 16 to 30 and still living with their parents (520 obs); 1993 household heads younger than 60 (2041 obs).

[2] Firms with less than 100 employees are small firms; firms with at least 100 employees are large firms.

[3] Males and females aged at least 17 and working in the private sector.

and Ichino (1992) and Flabbi (1997). Biagioli (1989) investigates the structure of wage differentials within a large state-owned service firm (i.e. national health) and considers earnings differentials by occupation and gender. Ghidoni (1989) and Lucifora and Reilly (1990) fit separate earnings regressions for men and women and use a standard Oaxaca decomposition to measure discrimination. Lucifora and Reilly (1990) also control, in their estimates, for female occupational intensity and try to capture the effect of gender occupational distribution (segregation) on wage determination. A comparison between Italian and US labour market performance can be found in Erickson and Ichino (1992), who focus on how labour market institutions affected earnings differentials by skill during the period 1978 to 1987. Finally, Flabbi (1997) evaluates the robustness of the frequent result that female returns to schooling in Italy appear to be higher than male returns.

3 The data

As shown in Table 1, the data set used by most of the reviewed studies is the *Bank of Italy Survey on Household Income and Wealth (BI)*. This is the only micro data set available for a reasonable period of time (1977–95) that covers the entire nation and includes information on schooling. The data are cross-sections but a panel component has been added since 1987, based on a sub-sample of individuals re-interviewed in later surveys.

Information on educational attainment in the survey consists of the highest degree attained at school. There is no direct information on the number of years spent at school. Given that irregular students are frequent in Italy and that the expected duration of a college degree is much higher than the statutory duration, the computed number of years spent in school, the standard variable used in earnings functions, carries an important measurement error, especially for higher educational attainment.

The measure of earnings available in the BI data set is annual earnings net of taxes (both payroll and income taxes). Additional information on the average number of hours worked per week and on the number of months worked per year can be used to construct an estimate of the hourly net wage, the measure used by most empirical studies. The Bank of Italy has run this survey since 1965. Information before 1977, however, is not reliable and difficult to obtain. The survey has been carried out on a yearly basis until 1987 (with the exception of 1985) and every two years afterwards.

Table 1 reports the years of the BI data used in the estimates carried out in each single study. In most cases, the authors use the core labour force, consisting of 18 to 65 year old males working as employees the whole year in the non-agricultural sector. The sample size of the BI data has sensibly increased over the years: it was about 3,000 households in 1983, 4,000 households in 1984 and doubled to over 8,000 from 1986 onwards. The size of the panel component was about 1,200 households in 1987–89, 2,200 in 1989–91 and over 3,500 in 1991–93 and 1993–95.

Some of the authors listed in the table use different data sets that are less representative of the whole economy. Antonelli, for instance, uses regional data (Emilia Romagna, collected in 1977). Biagioli (1989) uses data collected from a large firm operating in the national health sector. Ghidoni (1989) uses an ad hoc data set for men and women employed in the Modena area in 1983. Lucifora and Reilly (1990) and Lucifora (1993b) use a data set based upon the ENI and IRI earnings surveys, which were discontinued in 1986 and covered only the manufacturing sector.

4 Estimated returns to schooling

We distinguish between two generations of studies. The first generation overlooks the fact that differences across individuals in (unobserved) ability and quality can affect in a significant way the estimated returns to education. The second generation, in line with more recent international research, tackles this issue head on.

Table A1 of the Appendix is devoted to the first generation of studies on the returns to education in Italy and lists the explanatory variables used in each earnings regression. As mentioned above, the dependent variable is based on net rather than gross earnings, because only the former measure is available in the raw data. As previously discussed, the range of control variables included in the empirical specifications is quite varied and the results

Table 2. Estimation results from OLS regressions[a]

	Variables[b]									
Authors (year)	Year	S	Exp	Exp^2	T	T^2	A	A^2	Sub-sample used	[c]
Antonelli (1987)	1977	4.9	5.5	-0.08	-	-	-	-	Private sector: 1419 obs	P
		4.7	3.4	-0.05	-	-	-	-	Public sector: 375 obs	
Biagioli (1989)	1983	5.46	-	-	0.91	0.013	-	-	All: 742 obs	
		6.00	-	-	1.30	0.023	-	-	Male: 280 obs	O
		3.52	-	-	1.99	-0.05	-	-	Female: 462 obs	
Ghidoni (1989)	1983	2.21	2.21	-0.02	-	-	-	-	Male: 271 obs	O, I,U F
		1.37	0.94	-0.01	-	-	-	-	Female: 115 obs	
Cannari, Pellegrini & Sestito (1989)	1986	4.62	4.98	-0.08	-	-	-	-	All: 5650 obs	O,I,H,P,G
Sestito (1990) & (1992)	1977/ 1987	4.5/ 2.7	2.6/ 4.3	-0.19/ -0.07	-	-	-	-	2325/5305	P,G[d]
Lucifora & Reilly (1990)	1985	3.55	1.49	-0.02	-	-	-	-	Male: 18549 obs	P,O,I[e]
		3.92	1.48	-0.01	-	-	-	-	Female: 4223 obs	
Lucifora (1993b)	1985	4.5	1.7	-0.02	-	-	-	-	All: 19318 obs	O,S,F
Erickson & Ichino (1992)	1978/	3.5/ 2.9	3.4/ 4.1	-0.03/ -0.05	-	-	-	-	Male: 1767/ 3192 obs	p[d]
	1987	3.7/ 3.0	1.8/ 3.0	-0.02/ -0.05	-	-	-	-	Female: 838/ 1797 obs	
Brunello & Colussi (1998)	1993	4.0/ 5.0	-	-	-	-	2.0	-0.01	Large Firms: 663 obs	I,G,T
		2.0/ 3.0	-	-	-	-	3.0	-0.03	Small Firms: 777 obs	

Notes: [a] All the coefficients reported in the table have been multiplied by 100. All the paramenters are significant at the 1% level.

[b] S=schooling (in years); Exp=Experience; Exp^2=Experience squared; T= Tenure; T^2=Tenure squared; A=Age; the A^2=Age squared.

[c] Additional control variables in the specification reported are:
O=occupation dummy; P=EXP is potential experience; I=sector of activity; industry; U=unionisation; F=firm characteristics; H=position in the household; G=geographical dummies; T=town size

[d] Coefficients range within the time period considered.

[e] Regressions also control for 'female occupational intensity' (i.e. proportion of females in narrowly defined occupational categories).

sults concerning the returns to human capital variables are in part affected by the choices made. In order to highlight the range of estimates obtained in these early contributions, in Table 2 we present the results of parameter estimates limited to education, experience and tenure. In this table, education is measured by the number of years required to complete a degree. The studies that use education dummies rather than years of schooling are reported in Table 3.

Starting with the illustration of Table 2, Cannari, Pellegrini and Sestito (1989) investigate and discuss methodological aspects of the earnings function approach and test among different functional forms using a Box-Cox transformation. Their findings confirm the results by Heckman and Polachek (1974) that the best empirical specification has a semi-logarithmic form. In their general specification they use dummies to control for industry, region, town size, occupation, gender and position in the household. They also use the two-step Heckman estimation procedure to address the endogenous selection of industry. This methodology is standard in the empirical literature and applies when some attribute (such as industrial sector) is not assigned but chosen by individuals. According to their estimate, one additional year of schooling increases hourly earnings by 4.6 per cent.

Lucifora (1993b) estimates an augmented earnings equation by including both the standard human capital variables and the following set of firm characteristics: profits per employee, sales per employee, value added per employee and the capital-labour ratio. His results show that large firms and firms with higher capital-labour ratios pay, on average, more than other firms. He also shows that the key determinants of earnings are schooling, product market structure and the firm's financial structure. His estimated return to schooling is 4.5 per cent per year of school, very close to the value found in the previous study.

Brunello and Colussi (1998) use BI data for 1993 to estimate earnings functions by firm size. They consider the endogenous allocation of workers by firm size by estimating both a probit and a multinomial logit, that includes self-employment as an option, and estimate earnings functions by firm size after including the estimated inverse Mills' ratio to correct for the endogenous selection of firm size by employees. One finding of the study is that the returns to education are higher for workers employed in firms with more than 100 employees (in the range of 4 to 5 per cent per year) than for workers employed by firms with fewer employees (in the range of 2 to 3 per cent). They also find that individuals with higher educational attainment are more likely to work in larger firms and less likely to be self-employed.

The other studies in the table obtain estimates of the returns to education ranging from the relatively low 2 per cent for males in Ghidoni (1989) to the relatively high 6 per cent for males by Biagioli (1989). These differences are driven, at least in part, by differences in the data being used. One interesting feature of these estimates is that in a number of cases the marginal return to education is higher for females than for males.

Table 3. Estimation results from OLS regressions

Authors (year)	**Variables[a]**								
	Year	S[b]				Exp	Exp^2	Sub-sample used	c
		I	II	III	IV				
Manacorda (1996)	1977/ 1993	-4.2/ 31.8	8.1/ 42.5	12.9/ 53.9	59.5/ 25.0	-	-	N1817/ 3746	O,I[d]
		-1.7/ 28.8	6.1/ 33.4	13.0/ 40.4	13.1/ 47.9	-	-	S508/ 1569	
Brunello & Dustmann (1996)	1993	-	9.4	23.6	45.9	2.7	-0.04	Public sector	O[e]
		-	10.7	19.8	37.3	2.3	-0.03	Private sector	

Notes: All the parameters are significant at the 1% level.

[a] S=level of education; Exp=Experience; Exp^2=Experience squared; T= tenure; T^2=tenure squared; A=age; A^2=age squared.

[b] Levels of education: I: Primary, II: Junior High, III: Secondary, IV: Tertiary.

[c] See footnote c in Table 2.

[d] Manacorda uses 4 age ranges rather than age. Noschool is in the constant term. N in the column of sub-samples means North, S means South. The table gives the parameter range within the time period considered.

[e] Primary school in the constant term.

Turning to Table 3, that lists studies using educational dummies, Brunello and Dustmann (1996) estimate (gross) earnings in the private and public sectors in Italy and Germany and explicitly model the selection of employees to each sector. They use the same set of regressors in the two countries and produce a standard Oaxaca decomposition of earnings differentials. There are two interesting findings: first, the returns to education in Italy are larger in the private sector than in the public sector, especially for tertiary education. In particular, they estimate that four years of college add more than 20 percentage points to the expected returns to education in the private sector, which is equivalent to about 5 per cent a year. Expected returns in the private sector are lower for upper secondary education that adds about 14 percentage points in 5 years of school (less than 3 per cent per year). Second, there is some evidence that the estimated earnings profiles are not very stable over time.

Manacorda (1996) investigates the evolution of regional wage differentials from 1977 to 1993 and studies the impact of personal characteristics on these differentials. In the table we report the range of estimates (min/max) for the period under consideration, separating out the returns in the North and the South of Italy. The empirical evidence shows that the returns to education are higher in the Northern regions for lower education levels and lower for higher educational attainment levels and that these differences are statistically significant.

Table 4 and Table A2 of the Appendix are devoted to the second generation of studies that use instrumental variable methods to estimate returns to education. The idea is simple. If individual earnings are affected both by measured ability (education) and unobserved ability, then given that observed and unobserved ability are correlated the standard estimates of returns to education are biased. The bias can be avoided if there are valid instruments that are correlated with education and uncorrelated with earnings. When ability is time invariant, the bias can also be avoided by using longitudinal data, that follow individuals over time, and by taking first differences which difference out the fixed individual effects.

Table A2 of the Appendix lists the explanatory variables used in these studies, including the instruments used, whereas Table 4 shows the key estimated coefficients, separately for studies using IV estimates and for studies using panel data. Cannari and D'Alessio (1995) use family background variables (mother, father, the spouse's age and education) to instrument education, measured by years of education. Family background is a valid instrument if it affects wages only indirectly, by affecting educational achievement. They show that the IV estimates of returns to education are significantly higher than the OLS estimates, thus confirming the standard result in the literature (see Card, 1994, for a review). Similar results are obtained by Colussi (1997), who uses IV methods and a similar set of instruments (mother's and father's age and education and a dummy indicating whether or not the individual went to school during the years 1942–48, during and just after the last war).

Table 4. Estimation results from IV regressions

	Variables[a]						
		Levels of education					
Authors (years)	Year	S	Junior High	Second-ary	Tertiary	Exp	Exp^2
IV Estimates							
Cannari & D'Alessio (1995)	1993	5.03	-	-	-	-	-
		6.08	-	-	-	-	-
Flabbi (1997)	1991	2.2F 1.7M	-	-	-	0.86F 1.04M	-0.016F -0.020M
		5.6F 6.2M	-	-	-	0.84F 1.78M	-0.05F -0.021M
Colussi (1997)	1993	6.2	-	-	-	2.9	-0.03
		7.6	-	-	-	2.0	-0.01
Brunello & Miniaci (1998)	1993-1995	-	9.6	26.7	58.5	-	-
		-	15.1	36.4	73.5	-	-
Brunello & Miniaci (1999)	1993-1995	4.8	-	-	-	-	-
		5.7	-	-	-	-	-
Panel Data							
Cannari & D'Alessio (1995)	1989/1991	4.3	-	-	-	-	-
		3.44	-	-	-	2.91	-0.042
Brunello & Miniaci (1998)	1991/1995	-	18.17	40.0	68.79	-	-

Table 4. (continued)

Authors (years)	Variables[a]						
	Year	T	A	A^2	Method	Sample size	Notes[b]
IV Estimates							
Cannari & D'Alessio (1995)	1993	-	2.5	-0.017	OLS	Sample C, 2041 obs	c
		-	2.3	-0.013	IV	Sample C, 2041 obs	
Flabbi (1997)	1991	0.5F 0.3M	-	-	OLS	974 F 2085 M	d
		0.5F 0.2M	-	-	IV	974 F 2085 M	
Colussi (1997)	1993	-	-	-	OLS	2315 obs	I,P,G,O
		-	-	-	IV	2315 obs	
Brunello & Miniaci (1998)	1993-1995	-	1.2	-0.1	OLS	2943 obs	G
		-	1.3	-0.1	IV	2943 obs	
Brunello & Miniaci (1999)	1993-1995	-	1.2	-	OLS		
		-	1.2	-	IV		
Panel Data							
Cannari & D'Alessio (1995)	1989/1991	0.5	5.21	-0.052	OLS	668 obs	G[e]
		0.42	-	-	OLS	668 obs	
Brunello & Miniaci (1998)	1991/1995	-	-0.26			590 individuals; 770 obs	

Notes: [a] S=schooling in years; Exp=experience; Exp^2=experience squared; T=tenure; A=age; A^2=age squared;

[b] Equation augmented by: I=sector of activity, Industry, G=geographical dummies, P= Exp is potential experience, O= occupational rank.

[c] Cannari & D'Alessio (1995) consider three separate sub-samples: male full-time full-year employees in the 1989-1991 panel (334 obs); male full-time full-year employees aged from 16 to 30, still living with their parents (520 obs); 1993 household heads younger than 60 (2041 obs)

[d] F: females, M: males.

[e] Cannari & D'Alessio estimate alternative specifications, using either Exp or Age.

Flabbi (1997) also uses IV methods to check the robustness of the frequent finding that female returns to schooling are higher than male returns. He uses two exogenous events, *province* (i.e. province of birth) and *reform* (i.e. the reform of the Italian schooling system of 1962) as instruments of schooling and finds that, after controlling for the endogeneity of education, men turn out to have higher returns to schooling than women. Brunello and Miniaci (1999) combine both exogenous events (the 1962 reform and the 1969 reform of access to college) and family background variables as instruments and find that the estimated return to schooling is higher with IV estimates. More in detail, they find that the use of instrumental variables increases by close to 20 per cent the estimated marginal return to schooling.

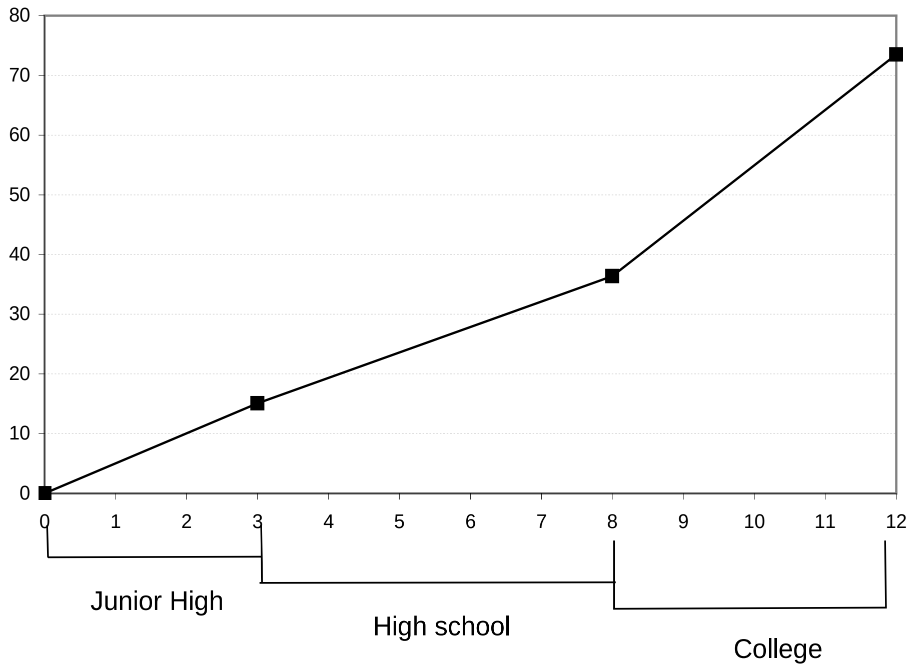
Brunello and Miniaci (1998) use the methodology discussed by Vella and Gregory (1996) and Harmon and Walker (1995) and apply it to cross-sectional BI data for 1993 and 1995 (i.e. the latest available survey). Their technique consists of two stages. In the first stage, they estimate the assignment of individuals to educational attainment levels using an ordered probit model. In the second stage, they augment the standard earnings function with the estimated score and apply OLS. They use educational dummies and find that OLS significantly underestimates the returns to education. This study also uses panel data for the years 1991, 1993 and 1995 and finds that wage differentials by education increase with individual age. This result indicates that education generates permanent and increasing earnings differentials.

To conclude, the available IV estimates of returns to years of schooling range in this literature from 5.7 per cent in Brunello and Miniaci to 6.2 per cent for males and 5.6 per cent for females in Flabbi, to 6.1 per cent in Cannari and D'Alessio, and to 7.6 per cent in Colussi. Estimated returns are lower when longitudinal data are used. In particular, Cannari and D'Alessio (1995) find that the expected return from an additional year of schooling can be as low as 4 per cent. With the exception of Flabbi, the percentage gap between IV and OLS estimates in these studies ranges between 19 and 23 per cent, slightly lower than for the US, where it ranges from 28 per cent to 33 per cent (see Card, 1994).

Using years of schooling as a measure of accumulated human capital can be overly restrictive when marginal returns are not constant but vary with the level of schooling. As shown in Figure 4, empirical estimates by Brunello and Miniaci (1998) suggest that the average expected return from a year of tertiary education is 7.9 per cent, much higher than the expected return from a year in upper secondary school (4.3 per cent) and in junior high school (5 per cent).

A cursory comparison with the estimated returns to schooling in the United States shows that the returns estimated for Italy are sensibly lower. According to Card (1994), IV estimates of the marginal return to a year of education in the US range from 6.6 per cent to over 15 per cent.

Figure 4. Marginal returns to additional levels of education in Italy in 1993



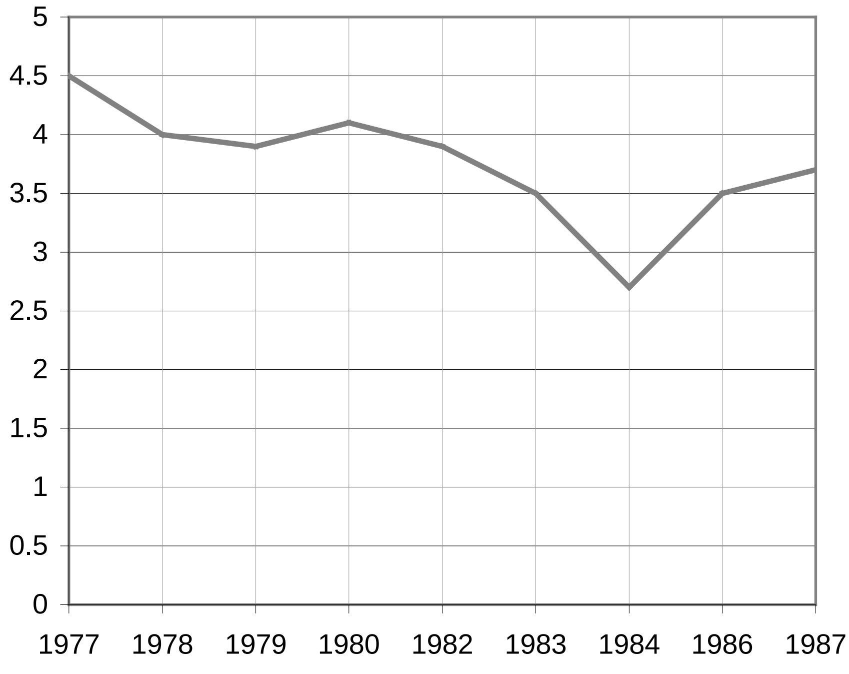
Note: Excluded education category: elementary or less.
Source: Brunello and Miniaci (1998)

5 Changes over time in the estimated returns to education

Is there any evidence that the estimated (private) returns to education have changed over time? In a study carried out in the early 1990s, Sestito (1992) estimates the returns to years of education using the BI dataset for the period 1977 to 1987. As illustrated in Figure 5, he finds evidence that these returns have mildly declined over time, and especially so in 1984. Whether these differences are significant remains, however, an open issue in the absence of statistical confidence intervals about the estimated parameters.

Manacorda (1996) presents estimates over time of the returns to college education in the Northern and Southern regions of Italy. As illustrated in Figure 6, there is some evidence of a decline in these returns in the North. Returns in the South are more or less

Figure 5. Returns to education in Italy, 1977-1987

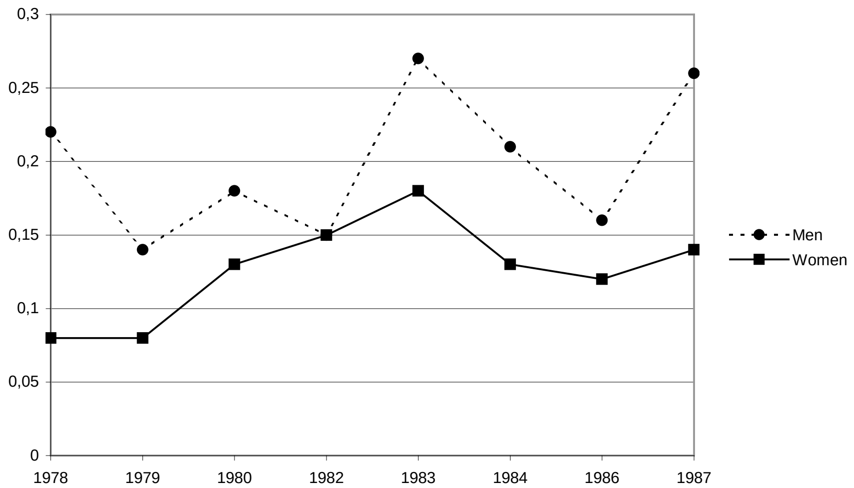


Source: Sestito (1992)

Figure 6. Percentage of returns to tertiary education: North vs South

Note: Excluded education category: noschool.
Source: Manacorda (1996)

Figure 7. Returns to tertiary education in Italy: Men vs. Women



Note: Excluded education category: high school.
Source: Erickson and Ichino (1992)

flat. In contrast, Erickson and Ichino (1992) find that returns estimated for males and females have mildly increased over the years (see Figure 7).

6 Concluding remarks

Applied research on the economic effects of education has made significant progress in recent years both in terms of data used and methodology employed. In this study we have reviewed the literature on the returns to education for the Italian labour market. Early studies were mainly based on unrepresentative data sets and had clear methodological limitations. More recent research, conversely, has used nationally representative data and more suitable econometric techniques, thus providing more reliable results.

The general picture that emerges from the Italian empirical literature shows a substantial stability in the returns to education over time and, *ceteris paribus*, moderate earnings differentials across different educational levels. The results also point to the existence of substantial dispersion of returns across various groups of individuals. Returns to education in Italy appear to differ by gender, by sector (public, private) and by region (North, South). In particular, there is some evidence that the returns are higher for females as compared to males. This difference, however, significantly declines when the endogeneity of educational choice is explicitly taken into account. Also, it emerges that the private sector grants higher educational wage premia as compared to the public sector, especially for tertiary education. Regional differences underline higher returns in Northern regions particularly for lower educational levels.

Finally, as suggested by those studies having used IV estimation techniques and panel data, it appears that unbiased estimates of returns are higher than suggested by the first generation studies, though still lower than those generally reported for the US. The above evidence has frequently been explained by referring to institutional aspects that characterise the educational system and wage formation in Italy. In particular, it has been argued that the prevalence of both widespread public education and national collective agreements significantly contributed to shape the structure of the returns and to reduce wage dispersion.

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Appendix

Table A1. Specification and variables used in OLS estimations

Variables	Authors (year)					
	Antonelli (1987)	Biagioli (1989)	Ghidoni (1989)	Cannari Pellegrini Sestito (1989)	Sestito (1990) (1992)	Lucifora Reilly (1990)
Dependent variable used	Log of annual earnings	Log of annual earnings	Log of monthly earnings	Log of net annual earnings	Log of net annual earnings	Log of gross actual yearly earnings
Gender				x		
Age					x	
Age Squared					x	
Year Of Education	x	x	x	x	x	x
Levels Of Education	x	x				
Potential Experience[1]	x			x	x	x
Potential Experience Squared	x			x	x	x
Experience	x	x	x			
Experience Squared	x	x	x			
Tenure		x				
Tenure Squared		x				
Job Qualification	x	x	x	x	x	x
Sector Public/Private			x			
Firm size						x
Region				x	x	
Sector of activity/ Industry			x	x		x
Other		x	x	x		x

Note: [1] Potential experience = [Age – years of schooling – 6]

Table A1. (continued)

Variables	Authors (year)						
	Lucifora (1993b)	Erickson Ichino (1992)	Brunello Dust-mann (1996)	Mana-corda (1996)	Brunello Colussi (1998)	Lupi Ordine (1999)	Brunello Miniaci (1999)
Dependent variable used	Log of gross annual earnings	Log of net annual earnings	Log of net hourly wage	Log of net annual earnings	Log of net hourly wage	Log of net hourly wage	Log of net hourly wage
Gender	x					x	
Age				x	x		x
Age Squared					x		x
Year Of Education	x				x	x	x
Levels Of Education		x	x	x			
Potential Experience[1]	x	x	x				
Potential Experience Squared	x	x	x				
Experience						x	
Experience Squared							
Tenure						x	
Tenure Squared							
Job Qualification	x		x	x		x	
Sector Public/Private				x		x	
Firm size	x					x	
Region				x	x		x
Sector of activity/ Industry	x			x	x		x
Other	x		x	x	x	x	x

Note: [1] Potential experience = [Age – years of schooling – 6]

Table A2. Variables included in the IV estimations

	Cannari & D'Alessio (1995)	Flabbi (1997)	Colussi (1997)	Brunello & Miniaci (1998)	Brunello & Miniaci (1999)
Variables:					
Dependent variable	log hourly net wage	log annual net earnings	log hourly net wage	log hourly net wage	log hourly net wage
Age	x		x	x	x
Age Squared	x		x	x	x
Marital Status			x		
Years Of Education	x	x	x		x
Level Of Education				x	
Potential Experience[1]	x		x		
Potential Experience Squared	x		x		
Experience		x			
Experience Squared		x			
Tenure	x	x			
Job Qualification		x	x		
Hours Worked In A Week		x	x		
Firm Size			x		
Region	x	x	x	x	x
Town Size		x	x	x	x
Sector Of Activity/ Industry		x	x		
Position In The Household		x			
Other	x	x			x
Instrumental variables:					
Age			x	x	x
Age Squared			x		
Father's School Degree (Years)	x		x		
Mother's School Degree(Years)	x		x		
Father's Schooling				x	x
Mother's Schooling				x	x
Mother's Age	x				
Father's Age	x				
Partner's Age	x				
Partner's Years Of School	x				
Father's Occupation				x	x
Mother's Occupation				x	x
Reform		x		x	x
Provinces		x			

Note: [1] Potential experience = [Age – years of schooling – 6]

CHAPTER 10

Private Returns to Education in the Netherlands: A Review of the Literature

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1 Introduction

Since Becker (1964) and Mincer (1958, 1974), many papers have been devoted to measuring the costs and benefits of education in terms of the internal rates of return of investments in education. By definition, the expected internal rate of return (IROR) is the rate of discount that equates the present value of the expected investment stream to the present value of the expected (additional) benefits stream. The *private* rate of return to education takes account only of privately borne costs and private gains in terms of higher post-tax earnings. The *social* rate of return includes both private and public costs and benefits. In this chapter only attention will be paid to the private returns to education.

In the Netherlands, calculation of the internal rate of return on investment in education has a long tradition (Oosterbeek and Odink, 1990). Several authors estimated 'precise' IRORs, taking into account indirect costs (foregone earnings) as well as direct costs (books, school fees) and grants, child allowances, etc. (De Wolff and Ruiter, 1968; De Wolff and Van Slijpe, 1974; De Boer and Van Ingen, 1981; Odink and Van Breemen, 1983; Odink, 1985; Koss-Fisher, 1988; OSA, 1994). Other authors took a more simple approach and estimated earnings equations with years of education as one of the explanatory variables. This chapter focuses mainly on this last group of studies.

We start with a description of the main features of the Dutch educational system. Next, we discuss the data sets that have been used for research on returns to education in the Netherlands. In Section 4, the empirical literature on returns to education in the Netherlands is reviewed. For each study, we briefly discuss the specification of the earnings equation, the data set(s) used, and the main results. Special attention will be paid to some recent studies using instrumental variable (IV) techniques, and to a comprehensive trend study, conducted by Hartog, Oosterbeek and Teulings (1993), in which coefficients of Mincerian earnings equations are estimated for the period 1962–1989. These coefficients are based on the same model specification and on rather well comparable data from the Dutch Structure of Earnings surveys and the OSA panel. We will also discuss some papers focussing on the human capital versus screening interpretation of the relationship between education and income and on the issue of under- and overeducation. Finally, in Section 5, the main findings for the Netherlands are summarised and some general conclusions will be drawn.

2 The Dutch school system

A recent overview of the Dutch school system can be found in Odink and Kunnen (1998), on which this section heavily leans. Useful information on the Dutch educational system can also be found in Groot and Oosterbeek (1994) and on the website of the Dutch Ministry of Education, Culture and Science (http://www.minocw.nl/english/kern/kern99gb/index.htm).

One of the most striking features of the Dutch system is the combination of the almost complete centralisation of the administration by the state, along with the fact that the great majority of basic and secondary schools are private. This is due to the school struggle between Roman Catholics and Protestants in the nineteenth century, which resulted in the right for every (e.g. religious) group to have its own schools financed by the same system as the public schools. Hence, the private schools in the Netherlands are subsidised for just under 100 per cent. As a result, there are hardly any differences in school quality between different schools of the same type, nor between private and public schools.

In the Dutch educational system, *Primary education* consists of a uniform programme of eight years (age 4–11) of which the first two years are early childhood education and of which seven years are compulsory (age 5–11).

Secondary education consists of another six compulsory years of schooling; four years full-time (age 12–15) and another two years (age 16–17) full-time or part-time apprenticeship (LLW).

During the first three years of compulsory education, all the secondary schools now have to teach the same 15 subjects, although at different levels. These subjects are almost all non-vocational. After primary education the pupil may choose between two different levels of secondary education, which last four to six years before graduating: *Lower secondary*, consisting of four years of pre-vocational education (VBO) or four years of junior general secondary education (MAVO), and *upper secondary*, consisting of five years of senior general secondary education (HAVO), or six years of pre-university education (VWO). Students with a VBO or MAVO certificate are entitled to enter senior secondary vocational education (MBO).

Tertiary education in the Netherlands implies in general four additional years of higher professional education (HBO) or at least four years of university education (WO).

Standard and alternative paths

Within the Dutch educational system, there are many (re)switching opportunities for the pupil. Many schools combining more than one type of secondary education start with a transition period of one or two years before the children have to choose between the types. At the end of each school year, pupils generally are allowed to choose for one level lower without loosing a year, even if they failed to pass. After the first year, they may choose for one level higher if they have good marks. After graduating from secondary school, they have the right to choose for another secondary school, one level higher, which will cost them one year. And there are many other alternative paths from which Dutch students may choose (see for example Groot and Oosterbeek, 1994).

Standard (short) paths are the paths where the highest possible level is chosen that is allowed according to the secondary school exam. These standard paths are:

VBO -> MBO
MAVO -> MBO
HAVO -> HBO
VWO -> WO

Within the system longer paths than the standard paths are allowed: *stacking paths*, *long educational paths*, and *roundabout paths*. Stacking means that after completing a certain path, the student may take a second course. For example, after MBO the students may go to HBO, after HBO they may go to university, and even the path MBO -> HBO -> university is possible. Long paths start at a level that is lower than necessary for the final level attained. The first type of general education is followed by a higher type of general education. For example, MAVO -> HAVO -> HBO or HAVO -> VWO -> university. Both paths cost an additional year of schooling compared to the standard path. Roundabout paths are paths which include an unnecessary intermediate stage. For example, HAVO -> VWO -> HBO costs two additional years.

Finally, it should be mentioned that graduating gives formal rights. A VWO exam, for example, entitles the student to choose, among other things, for a study of law at any of the nine Dutch universities with a law department and for a study of economics at any of the six universities with a department of economics. The university departments have not the right to select students. Selection takes place at the end of the first year. As a result, the dropping out rates are high at Dutch universities.

3 Data sets

Several studies of the rate of return to education in the Netherlands use data from the *Structure of Earnings Survey* (SOE) of the Dutch Central Bureau of Statistics (CBS). In 1962, 1965, 1972 and 1979, large cross-sectional employer surveys were held in which information on gross earnings, educational level, sex, age, and industry of employees was gathered. In 1985 and 1989, the same information was obtained by gathering additional educational information for a sub-sample of the yearly *Wage Survey*, which is an employer survey normally including no information on education. In 1995, the Structure of Earnings Survey was created by combining information at the individual level of three different data sources: the 1995 Employment and Wages Survey, the 1995 Insured Persons Register, and the 1994–1996 Labour Force Surveys. The number of respondents in the SOE was very large (more than 100,000) in the period 1962–1979, about 10,000 in 1985, about 30,000 in 1989, and about 125,000 in 1995.

Another important data source for the estimation of returns to education is the *OSA panel*, a panel survey conducted by the Organisation for Strategic Labour Market Research (Organisatie voor Strategisch Arbeidsmarkt Onderzoek), or OSA. The first wave of this OSA panel was held in 1985 and subsequent waves were held in 1986, 1988, 1990, 1992, 1994, and 1996. This survey pertains to individuals aged 16 to 64, and contains detailed information on (changes in) labour market situation and education. The number of respondents is about 4,500.

Other data sets that have been used for this kind of research are the *NPAO labour market survey*, the *Brabant cohort*, and the *Socio-Economic Panel*. The NPAO survey is a cross-sectional data set with information on occupational mobility, earnings and schooling of 2,677 respondents. It was conducted in 1983 by the National Program for Labour Market Research (NPAO). The Brabant data contain information on schooling, family background, and intelligence for a one-year cohort of pupils who in 1952 were in the sixth grade. In 1983 1,613 of the 1,879 original male respondents were re-interviewed and information on their education, labour market situation and earnings was gathered. In 1993, these respondents were approached again, to collect new information about their labour market experiences in their 40s and to collect information on the educational attainment of their children. The Socio-Economic Panel (SEP) of the Dutch Central Bureau of Statistics started in 1984 and was held twice a year until 1989. From 1990 until now, the survey among 5,000 households (13,000 individuals) has been held once a year. It contains a broad set of variables on personal and household characteristics including education, wage and income.

4 Review of the empirical literature

4.1 Cross-sectional findings

In Table 1 an overview is given of previous studies in which earnings equations were estimated with education and (an indicator of) experience among the explanatory variables. In each of these studies the dependent variable is the natural logarithm of the gross or net hourly wages. Some of the analyses (Hartog and Oosterbeek, 1988; Hartog et al., 1993) are focussed specifically on the estimation of rates of return to education and use the standard Mincerian model specification:

$$ln(W) = a + b * EDUC + c * EXP + d * EXP^2$$

where W is the hourly wage rate, EDUC is education, defined as years of schooling (after primary education), and EXP is potential experience, defined as (AGE – EDUC – 12). Other studies were conducted for other purposes and deviate to some extent from the standard Mincerian form, by using levels instead of years of edu-

Table 1. Overview of previous studies including earnings functions for the Netherlands with years or level of schooling as (one of the) independent variables

Author(s)	Code	Year(s)	Data set	N	Wage	Educ	Exp/ age*	Exp²/ Age²*	Other var.**	Gender
Ordinary Least Squares (OLS):										
Schippers (1986)	S86	1982	NPAO	703	gross	Years	1,3	3	4	separate
Schippers & Siegers (1986)	SS86	1982	NPAO	681	gross	Years	1,3	3	4	separate
Hartog & Oosterbeek (1988)	HO88	1982	NPAO	540	net	Years	3	3	1	separate
Bierens & Hartog (1988)	BH88	1979	LSO	2000	gross	levels	1,3		4	dummy
Mekkelholt & Hartog (1989)	MH89	1986	OSA	1981	net	levels	1,3		31	dummy
De Wit & Van Winden (1989)	WW89	1983	Brabant	1061	net	years	3		13	dummy
Hartog, Oosterbeek & Teulings (1993)	HOT93	1962-89	LSO, NPAO, OSA	varies	gross/ net	years	2	2	1	males
Gelderblom et al. (1994)	GEA94	1990	OSA	1737	net	years	1	1	3	dummy
De Koning et al. (1996)	KEA96	1994	OSA	2211	gross	years	3	3	3	dummy
Odink et al. (1997)	OEA97	1994	OSA	2211	gross	years	3	3	7	dummy
Instrumental Variable (IV):										
Kalwij (1996)		1986-89	SEP	5592	gross	years	3	3	2	males
Levin & Plug (1998)		1983	Brabant	741	net	years	2	2	2/3	males
		1994	OSA	1320	net	years	1	1	2	males

Notes: Educ=Education; Exp.=Experience.
* 1=Age; 2=Potential experience; 3=Actual experience.
** Number of explanatory variables other than schooling.

cation, by using age or actual experience instead of potential experience, and by adding extra explanatory variables to the equation. Most studies use ordinary least squares (OLS), but a few recent ones (Kalwij, 1996; Levin and Plug, forthcoming) present Instrumental Variables (IV) estimates. One study (Hartog et al., 1993) presents comparable schooling and experience coefficients for more than one point in time. The results of the IV analyses and of the trend analysis will be discussed separately.

The coefficients of the schooling variables found in the Dutch studies are presented in Tables 2, 3 and 4. Schippers (1986) and Schippers and Siegers (1986) used the 1982 NPAO labour market survey to estimate earnings equations with the gross hourly wage as the dependent variable. Besides education in years, their equation included actual experience, actual experience squared, age and some other explanatory variables. Schippers (1986) found the rate of return to one year of extra schooling for males to be 6.5 per cent in the private sector of the economy and 4.4 per cent in the public sector. For females the rate of return was somewhat higher in the private sector, 8.6 per cent, and somewhat lower in the public sector, 3.9 per cent. Schippers and Siegers (1986) found the rate of return to be 6.3 per cent for married males and 5.5 per cent for married females. Hartog and Oosterbeek (1988) also used the NPAO survey, but took the net hourly wage as dependent variable. As explanatory variables they used education in years, actual experience and actual experience squared. These authors found the rate of return to be 6.5 per cent for males and 4.7 per cent for females.

Bierens and Hartog (1988) estimated the effect of the *level* of education on gross hourly wages for all employed persons on Structure of Earnings survey data from 1979. Using seven educational levels, they found the rate of return to education to be 13.3 per cent. Mekkelholt and Hartog (1989) also used educational levels instead of years. They found a much lower rate of return, 3.2 per cent. But their analysis differed from Bierens and Hartog's in the data set that was used (OSA 1988), in the use of net instead of gross hourly wages as the dependent variable, and in the use of much more (31) other explanatory variables in the equation.

De Wit and Van Winden (1989) found the rate of return to one year of extra education in terms of net hourly wages to be 3.2 per cent for employees and 3.0 per cent for self-employed workers. These

Table 2. Estimation results for rates of return to education in previous research using OLS

Code	Year(s)	Hourly wage	Sample	Education	Adj. R^2
S86	1982	Gross	Males private sector	0.061	41
	1982	Gross	Males public sector	0.044	40
	1982	Gross	Females private sector	0.086	50
	1982	Gross	Females public sector	0.039	38
SS86	1982	Gross	Married males	0.063	26
	1982	Gross	Married females	0.055	30
BH88	1979	Gross	All	0.133	58
HO88	1982	Net	Males	0.065	33
	1982	Net	Females	0.047	32
MH89	1986	Net	All	0.032	41
WW89	1983	Net	Employees	0.032	37
	1983	Net	Self-employed	0.030	10
GEA94	1990	Net	All	0.030	43
KEA96	1994	Gross	All	0.051	39
OEA97	1994	Gross	All	0.064	42

authors used the 1983 wave of the Brabant cohort data set. Their analysis differed from the foregoing ones in that it has IQ and social status of family background among the explanatory variables. The low rate of return to education in this study might also be due to the fact that all respondents in the Brabant cohort are of the same age (43 in 1983). This might lead to an underrepresentation of the higher income groups and hence to an underestimation of the returns to schooling.

A rather low rate of return to education in terms of net hourly wages was also found by Gelderblom, Hoen and Koning (1994), using the OSA 1990 data. These authors estimated a simple model with, besides education in years, age, age squared, working hours, working hours squared and a dummy for gender. They found the rate of return to one extra year of education to be 3.0 per cent. Somewhat higher rates of return, in terms of gross hourly wages, were obtained by De Koning et al. (1996) and by Odink et al. (1997), who found rates of return of 5.1 and 6.4 per cent, respectively. These two studies used the same data (OSA 1994) but the specification of the educational variable differed in that De Koning et al. used the real number of years of schooling of the respondents, whereas Odink et al. used the normal number of years it takes to complete the highest educational level attained by the respondents.

4.2 Trends

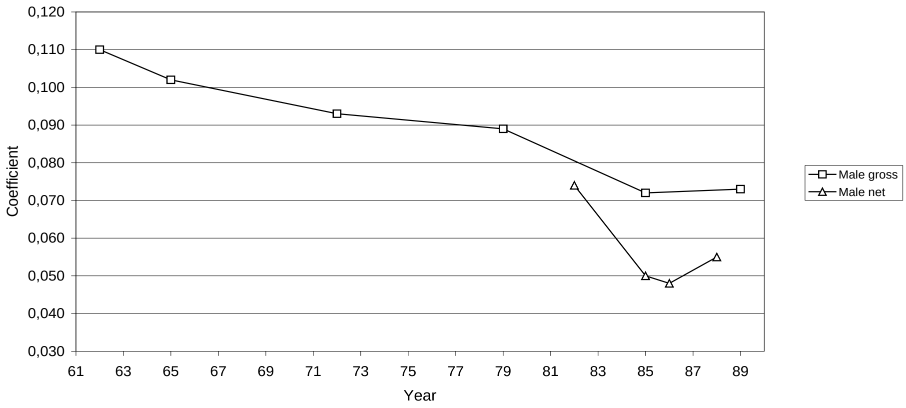
A comprehensive analysis of the trend in returns to education in the Netherlands was conducted by Hartog et al. (1993). These authors estimated 14 Mincerian earnings equations for the period 1962–1989, using crosstabulations from the Structure of Earnings surveys and individual-level data from the 1982 NPAO survey and the 1985, 1986 and 1988 OSA panel waves. In Table 3 and Figure 1 their major findings are presented. We see that from 1962 to 1985 the returns to education in terms of the gross hourly wages of males show a gradual decrease from 11 per cent to slightly more than 7 per cent and from then on to 1989 remain about stable.

Table 3. Mincer models for the log hourly wages of Dutch males, 1962-1989

Year	Wage	Sample	Const.	Educ.	Exp.	Exp.^{2}
Structure of Earnings Survey						
1962	Gross	White collar >25	-0.320	0.110	0.059	-0.077
1965	Gross	White collar >25	0.095	0.102	0.057	-0.076
1972	Gross	White collar >25	0.838	0.093	0.056	-0.080
1979	Gross	All >25	1.450	0.089	0.038	-0.054
1985	Gross	All >25	1.740	0.072	0.038	-0.052
1989	Gross	All >25	1.740	0.073	0.040	-0.056
NPAO/OSA Surveys						
1982	Net	All	1.283	0.074	0.040	-0.050
1985	Net	All	1.480	0.050	0.040	-0.060
1986	Net	All	1.624	0.048	0.032	-0.040
1988	Net	All	1.410	0.055	0.040	-0.050

Notes: Educ=Education in years; Exp.=Potential experience; Exp.^{2}=Exp^2/100.
Source: Hartog, Oosterbeek & Teulings, 1993: Table 8.4.

Figure 1. **Effect of one additional year of education on the log hourly wage of male workers in the Netherlands**



Source: SOE 1962-1989; NPAO 1982; OSA 1985-1988)

In the analyses with the (log) net hourly wage as the dependent variable, we see a rather strong decrease between 1982 and 1985, (which may be an artefact caused by the use of different data sets) and a small increase between 1985 and 1988.

4.3 Human capital versus screening

According to human capital theory, returns to education are due to the fact that schooling is productivity augmenting. Education pays because valuable skills are learnt in school. An alternative explanation, however, focuses on the information about individuals generated by schooling. Completing an education is indicative of the individual's learning ability, stability of character and perseverance. Education functions as a screening or signalling device. To differentiate between these explanations, Hartog (1983) compares the earnings of individuals who attended a certain educational level but did not obtain a diploma, with the earnings of individuals who graduated from that level and did not continue to the next higher level. He uses data from a nation-wide survey held in 1977.

For the lower and intermediate educational levels no significant effect of graduation is found. Hence, at these levels the diploma seems not to be used as an effective screening device. At the tertiary level, a significant negative effect of the graduation gap – that is, the number of years short of graduation for those who did not graduate – is found. The effect of a year of nongraduation turns out to be of about the same size as the earnings gain per year at school. This result is compatible with a gradual skill-augmenting view of education, and hence with the human capital model.

Evidence in favour of the human capital theory is also found by Groot and Oosterbeek (1994). Using the 1983 wave of the Brabant cohort data they study the effect of dividing actual years of schooling into effective years, repeated years, skipped years, inefficient routing years and drop-out years. They find a negative effect of class-skipping, a neutral effect of class-failing and a positive effect of years spent in schooling without obtaining a diploma; all in line with the predictions of the human capital hypothesis and contrary to what was expected on the basis of the screening hypothesis.

4.4 Undereducation and overeducation

To capture the effects of the individual's overeducation and undereducation, Hartog and Oosterbeek (1988) and Oosterbeek and Webbink (1996) use the so-called ORU specification of the standard earnings function (Hartog, 2000), with separate variables for Over-, Required, and Undereducation. Hartog and Oosterbeek use the 1982 NPAO labour market survey and Oosterbeek and Webbink the IALS data (OECD, 1995). In both studies the returns to overeducation are found to be significantly positive, but somewhat smaller than the returns to required education. The returns to undereducation are found to be negative, and to be smaller than the returns to required education and to overeducation. These findings are largely in line with the results of studies on the effects of over- and undereducation for other countries (Hartog, 2000).

4.5 Ability bias and endogeneity of schooling

Several problems might bias the estimation of returns to schooling using the standard Mincerian earnings equation: the endogeneity of the schooling decision, the lack of adequate measures for ability, and measurement errors with regard to the schooling variable (Card, 1999). It is very well possible that the choice for a certain type of schooling is related to one's earnings potential. Individuals with higher ability may take more years of schooling or, alternatively, they may leave school earlier because they can make a lot of money anyway. Institutions for higher education may also select their students on the basis of ability test scores or their performance in primary or secondary education.

In an early study on the internal rate of returns to education in the Netherlands, De Wolff and Van Slijpe (1974) used Swedish data to make an estimation of the proportion of the difference in income between educational levels that can be attributed to education (see also De Wolff & Van Slijpe, 1974). They found this proportion to be 31.4 per cent. More recently, Kalwij (1996) and Levin and Plug (forthcoming) have employed instrumental variable (IV) techniques, to control for the endogeneity of schooling. The results of their analyses are presented in Table 4.

Table 4. Estimation results for rates of return to education in previous research using Instrumental Variable techniques (IV)

Code	Year(s)	Wage	Sample	Technique	Instrument	Education	Adj. R^2
K96	1986-1989	Gross	Male	OLS		0.069	31
	1986-1989	Gross	Male	IV	Age	0.148	14
LP98-Brabant	1983	Net	Male	OLS		0.024	27
	1983	Net	Male	IV	Family background	0.045	23
	1983	Net	Male	IV	Season of birth	0.164	22
	1983	Net	Male	IV	School leaving age	0.027	23
LP98-OSA	1994	Net	Male	OLS		0.036	36
	1994	Net	Male	IV	Family background	0.050	27
	1994	Net	Male	IV	Season of birth	0.040	25
	1994	Net	Male	IV	School leaving age	0.064	23

Kalwij (1996) exploits the fact that older individuals on average have less schooling than younger individuals, to construct an instrument to control for the endogeneity of schooling. He uses the 1986, 1987, 1988 and 1989 waves of the Dutch Socio-Economic Panel and finds the rate of return to education to be 6.9 per cent in a baseline OLS model and to increase to 14.8 in the IV model. Levin and Plug (forthcoming) experiment with three different instruments: family background (parental education and job level), season of birth, and changes in compulsory school leaving age. Their data sources are the 1983 Brabant Survey and the 1994 wave of the OSA panel. As can be seen in Table 4, the rate of return in their IV models is higher than in the baseline OLS models. The family background instruments – parental education and job level – perform best in the Dutch situation. These instruments have significant influence on schooling while exerting a negligible influence on earnings.

The general conclusion of the IV analyses is that in the Netherlands, as in most other countries (e.g. Card, 1999; Ashenfelter, Harmon & Oosterbeek, 1998), using OLS to estimate the rate of returns to education leads to an underestimation of the true schooling effect.

5 Conclusions

Given the results of the previous analyses of the rates of return to education in the Netherlands, some general conclusions can be drawn:

- The rate of return to education in terms of the gross hourly wage of males in the Netherlands was about 11 per cent in 1962. From then on it decreased to about 7 per cent in 1985, and remained at about that level between 1985 and 1989.
- The rate of return to education in terms of the net hourly wage is generally somewhat lower than the rate of return in terms of the gross hourly wage.
- There are only a few studies in which comparable equations for males and females were estimated and these studies all use the same data set: the 1982 NPAO labour market survey. The

results of these studies suggest that in the early 1980s the average rate of return to education for females was somewhat lower than for males.

- The results of tests of the human capital explanation of the relationship between education and earnings versus the screening explanation of this relationship tend to support the human capital explanation of the relationship.
- The returns to overeducation are positive, but somewhat smaller than the returns to required education. The returns to undereducation are negative, and smaller than the returns to required education and to overeducation.
- Estimates of rates of return to education on the basis of instrumental variable techniques are higher than estimates based on OLS.

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CHAPTER 11

The Return to Human Capital in Norway: A Review of the Literature

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1 Introduction[1]

The aim of this article is to review the existing Norwegian evidence on private returns to human capital, that is, formal education, labour market experience, tenure and on-the-job training. We concentrate on the period from the beginning of the nineteen eighties and we restrict the discussion to studies using econometric methods.

In recent years, many studies have been published which contain evidence with regard to the returns to human capital in Norway. The studies pursue a variety of subjects which, of course, affect the data sets used, the econometric specifications, and the definitions of variables. Some of the studies focus specifically on wage differences and gender and consequently run separate estimations for men and women. Another main issue is the difference in the wage structure between the private and the public sector. Some studies try to explain the stable wage dispersion in Norway after 1980, and discuss the role of changes in the educational systems as well as the wage setting institutions in this context. The variety of subjects and approaches makes the overall impression more comprehensive, but impairs the comparability of results over time and between data sets.

Most of the reviewed studies concentrate on the discussion of returns to formal education. Even though all studies control for experience and seniority, if available, only a few focus specifically on the returns to these other aspects of human capital. This emphasis on returns to education in the Norwegian literature is reflected in this review as well.

The returns to different types of human capital are determined by conditions on the supply and the demand side of the labour market. On the demand side, technology and international trade patterns are fundamental in the long run, while business cycles have a more temporary influence. On the supply side, demographics and the di-

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mensioning and quality of the educational system are decisive. Since the returns to different types of human capital are clearly interrelated, the shaping of the educational system not only influences the returns to formal education but also the returns to other types of human capital as well. If formal education and on-the-job training are alternative factors of production, a reduction in the quality of formal education may increase the returns to work experience. However, when these factors complement each other in the production process, a reduction in returns to experience may be the result.

Wage differentials are also influenced by the wage setting systems and bargaining regimes in force. Norway has a rather centralized bargaining system, with varying degree of possibilities of local adjustments. In Norway there have also been clear differences between the private and the public sector in this respect. Very roughly speaking, we may say that the wage formation in the public sector is characterized by rigid professional structures and scales of payment decided on a centralized level. In the private sector the wage formation has been more decentralized and, specifically with regard to highly educated people, the use of individual wage setting more widespread.

In this chapter we review the results from the last fifteen years, interpreted within a framework of both changes in supply and demand and of changing institutions. The chapter is organized as follows. In Section 2 we present a description of the main data sets used in the Norwegian studies of returns to human capital and give a short overview of the statistical techniques utilized. In Section 3 we review the reported results. In 3.1 we consider returns to formal education in relation to structural shifts in supply and demand, institutional changes in the wage setting system, and business cycles. In 3.2 we review the reported results on returns to labour market experience, tenure and specific on-the-job training. In Section 4 we make some concluding remarks.

2 Data sets and statistical techniques

2.1 Data

Roughly speaking, the existing studies of returns to human capital in Norway are based on two types of data: register based data sets and survey based data sets.

2.1.1 Register based data sets

These data sets are based on population registers established for administrative purposes. The registers are integrated into a register based data system (*Current System for Social Data, CSSD*) linked by Statistics Norway. To establish the data sets for research purposes, register files are merged to yield information about personal characteristics, income, industry affiliation and place of residence, among other things. The most commonly used registers are the register of employees and employers in connection with the register of salaries and taxes and the register of education. Even though it is quite possible to establish panel data sets from administrative registers, the data sets used in the Norwegian studies on returns to human capital are mainly cross-sectional, or only the cross-sectional properties of the data sets have so far been utilized.

The register based data sets may contain information on the total population or a random sample from one register. Typically the register based data sets involve large amounts of observations and, consequently, more significant differences between separate samples are found. While the register data has its shortcomings, particularly with respect to the measurement of hourly wages (see below), the large size enables the researcher to compare rather small sub-samples and various specifications in more detail.

The *income* observations in the register based data sets are based on declarations sent by employers to the tax authorities. This source gives information from each employer about the individual's yearly income (wage) including most types of compensations, such as fringe benefits and overtime payment.

Hours worked are collected from the register of employers and employees and are recorded in rather broad categories: Full-time (more than 29 hours a week), long part-time (between 29 and 20 hours a week) and short part-time (between 19 and 4 hours a week). To avoid serious supply of hours bias, most studies based on this type of data use only full-time workers. Thus, the observation of *hourly wage* is calculated from yearly gross earnings divided by normal hours or average hours for full-time workers. In the following we call this variable *calculated hourly wage.*

Even if only full-time workers are included in the analysis, we must be aware of that a supply of hours bias may arise in the estimates of returns to different types of human capital, when the calculated hourly wage is used as the dependent variable. More precisely, we over(under)estimate the returns to schooling if "overtime" in full-time work increases (decreases) with the human capital variable studied. In some of the register based studies effort has been made to diminish this supply of hour bias. In the study by Longva and Strøm (1998) the hourly wage is calculated by dividing annual income by normal hours for full-time workers plus mean overtime for each gender. Individuals who were registered for more than one job, and those who earned more than four times the standard deviation of the mean hourly wage were omitted. In the twin-study of Raaum and Aabø (1999) both full-time and long part-time workers are used in the wage estimations. The number of hours worked within each category are calculated as the means from the 1992–93 Labour Force Surveys, stratified by gender.[2]

The *educational* variable is based on a five digit code of highest completed education, which is merged from the administrative register recording the highest education of citizens. The register is updated on the basis of information from officially approved educational institutions, and covers completed degrees and exams from courses of at least 300 hours. The register is maintained and controlled for public assistance and student loan purposes, and should include very little measurement error. Years of schooling are usually defined as the standard number of years required to fulfil the individual's highest educational level.

One of the data sets we refer to as register based, is actually a combination of a register based data set and a survey. This is the so-called *Norwegian Flexible Study* (NFS). The starting point is an establishment level survey for a sample of Norwegian firms, conducted by the Institute for Social Research and Statistics Norway during the Spring of 1997. The sample is representative for private and public establishments in Norway with more than 10 employees. The net sample consists of 2,130 firms. To this sample register information on all employees working in these firms during the period November 1995 to February 1997 has been linked. The register data contain information on labour market related issues, including information on employment, wages, education and sen-

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2 A description of the Labour Force Surveys is given in Labour Market Statistics, Statistics Norway.

iority with the present employer. The sample of wage earners consists of 164,102 individuals in 1,755 private and public establishments, who worked with the same employer during all of 1996 (see Barth and Schøne (1999) for a closer description).

Another register based data set is a twin sample established by matching several administrative registers of Statistics Norway (see Raaum and Aabø (1999) for a closer description). Twins are defined as individuals born at the same time (same day, next/previous day), by the same mother. The register matching procedure identifies about 80 per cent of Norwegian twins born in the period 1946–1965. After sample restrictions, altogether about 3,000 twin pairs of the same sex, with satisfactory income information, are recorded in the data set.

The main properties of the data used in the register based studies on returns to human capital in Norway are summarized in Table A1 of the Appendix.

2.1.2 Survey based data sets

The survey based studies of human capital endowment and wage formation in Norway employ two data sets:

The Norwegian Survey of Organizations and Employees (NSOE) was undertaken in 1989 and 1993. Each NSOE contains about 4,000 wage observations.

NSOE 1989 was a survey among Norwegian employers and employees, conducted by the Institute for Social Research and Statistics Norway. First, 1,050 employers were sampled with a probability proportional to the square root of the number of employees. Next, employees were drawn from each employer with a probability proportional to the square root of the number of employees. The sample is a self-weighting sample of all wage earners in Norway in 1989. Both employers (managers, personal managers and union representatives) and employees were interviewed.

In 1993 the same individuals were interviewed again (NSOE 1993). In addition, the sample was expanded with employees hired by the employers in the period between 1989 and 1993 in such a way as to make the sample representative of wage earners in 1993. NSOE 1993 was not supplemented with interviews at the employer level.

Level of Living Surveys (LLS) which is an ongoing project at Statistics Norway, surveying a sample of the Norwegian adult population. In the period we cover, this survey has been undertaken in 1980, 1983, 1987, 1991 and 1995. In 1980 the sample was drawn among households. From then on, the samples have been drawn from individuals. LLS is a panel, with the addition of young persons in every wave. Every LLS contains about 5,000 individuals, comprising around 2,500 wage observations.

Since the NSOE copied a host of labour market related questions from the LLS, the two types of surveys may be used together and comparatively over time.

The *income* observations, in both data sets, are based on self-reporting among full-timers and part-timers. The individuals are asked to report their usual monthly/weekly/hourly gross wage.

Hours worked are observed as self-reported usual number of hours worked in the relevant period of time (month, week), including usual level of overtime. Thus, the *hourly wage* variable is calculated as reported monthly/weekly/hourly gross wage divided by the number of hours worked in the appropriate period. In the following, this variable is referred to as *actual hourly wage*.

The *education* variable in both LLS and NSOE is based on a three or five digit code of highest completed education. In the LLS surveys from 1980 to 1987, the variable is coded from self-reported completed education. In the LLS and NSOE surveys from 1989 and onwards, the educational variable is merged from the administrative registers described above.

One difference between the two surveys is that in the NSOE the individuals are asked to report their *actual work experience*, while in the LLS the number of years in the labour market must be calculated from school years and age, that is, as *potential experience*.

Even though both these data sets are panels, only one of the studies we review (Schøne, 1996) has utilized this property so far. With regard to the LLS surveys this may be due to a rather small size of the panel.

The main properties of the data used in the survey based studies on returns to human capital in Norway are summarized in Table A2 of the Appendix.

2.2 Statistical procedures

In nearly all the studies a semi-logarithmic specification of the wage equation is chosen, that is, the dependent variable is the logarithm of hourly (or yearly) wages (actual or calculated), which is regressed on a varying number of personal, market and job related characteristics. An exception is the study by Longva (1995) who uses a straightforward linear specification of the wage equation.

Given the semi-logarithmic specification, the estimated coefficient has an approximate interpretation as the per cent change in hourly (yearly) wages resulting from one unit of change in the independent variables. Thus, assuming that the semi-logarithmic specification is valid, i.e. that each additional year of formal education has the same proportional effect on earnings, the estimated coefficient (x100) for years of schooling expresses the per cent change in hourly wages resulting from one additional year of schooling.[3] In the economic literature this coefficient is conventionally referred to as the return to schooling, and this is also the terminology used in this paper. However, it only coincides with the internal rate of return to school investments given quite strict assumptions (see Willis, 1986, and Heckman et al., 1999). It should be emphasized that when using the concept return to schooling, or returns to other human capital variables, we always refer to average income effects, even though the effects may vary between individuals.

The dominant estimation technique is straightforward ordinary least squares (OLS). It is well known that this procedure ignores the fact that one or more of the explanatory variables may be endogenously determined, or that the dependent variable is truncated. Non-random selection into education and training, and into different labour market states, may arise from this endogeneity. The non-random selection may be the result of individual choice, i.e. self-selection, or other types of selection procedures, such as entrance requirements to schools and on-the-job training courses, or market failures, such as unemployment.

The problems associated with selection into education and training reflect that the population is heterogeneous with regard to *"innate earning ability"* (the intercept of the earnings function) and

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3 The exact formula is $(e^{\beta}-1)$x100, where β is the estimated coefficient.

the *return to investment in human capital* (the slope of the earnings function)(see Card, 1998). If these factors influence, or are correlated with, the individual's choice of – and access to – levels and types of training and formal education, the OLS procedure produces biased estimates of the returns to human capital. Taking years of schooling as an example, the question is whether the observed rate of return to years of schooling is a measure of wage differentials arising from different types of individuals choosing different numbers of school years, or whether it is a genuine measure of the return to education which could be obtained by anyone who chooses a specific number of school years.

Economic theory – optimal schooling models of the Becker type – clearly predicts that people with a higher expected return to education tend to acquire more schooling. Thus, the bias due to heterogeneity in returns is most likely positive as a result of self-selection. If the high earners tend to take more years of schooling, the bias resulting from heterogeneity in innate earning ability is positive, as well. However, different models – within the same optimal schooling approach – predict opposite results with regard to the relationship between innate earning ability and marginal costs of schooling. The same models, accordingly, give opposite results with regard to the direction of the bias in the OLS estimator due to this type of heterogeneity. One major argument substantiating a negative bias is that those who make a lot of money anyway have higher alternative costs to education since they give up a higher income while going to school (Griliches, 1977). Arguments pointing in the opposite direction are based on proposed negative relationships between the individual characteristics generating high earning ability and the necessary effort required (extent of sacrifice) to attain a good result in schools or universities.

Optimal schooling models consider the process of self-selection and assume no entrance restrictions to schools and universities. In Norway enrolment into colleges and universities is rationed on the basis of previous schooling performance. Empirical results from different countries (Kjellström, 1997) reveal a positive relationship between test results at young age and future earning abilities. Thus, the selection taking place at the entrance of higher education in Norway may bias the OLS estimator in a positive direction.

Different methods have been proposed to deal with this issue of endogeneity. Hægeland et al. (1998) estimate the return to years of schooling in 1980 and 1990. By using a two-step instrumental variable approach, they take the endogeneity of school years into consideration. Using an ordered probit procedure they estimate the probability distribution of school choice in the first step: They utilize region during adolescence and parental educational attainment as determinants of schooling and predict generalized residuals (selection terms). In the next step, these are included in the wage equation to correct for the selectivity bias. In line with the international literature reporting on the use of IV methods, they conclude that the OLS estimates tend to be downward biased due to the endogeneity of school choice.

Raaum and Aabø (1999) use a large representative sample of twins to estimate the causal effect of schooling on earnings in Norway. Using a within family (twin pair) OLS estimator, they remove the biasing influence from heterogeneity in initiate earning ability and in returns to schooling which prevails *across families*. They find that the standard OLS estimates of the effect on male hourly earnings are upward biased. While they report a return to schooling of 0.05 for hourly earnings for male twins in Norway, the corresponding within family coefficient is 0.032. They do not find a similar bias for women.

These findings are in line with most international evidence based on twins (see Card, 1998). It seems that the results from studies using instrumental variables techniques, like Hægeland et al. (1998), suggest that there is a downward bias, while twin studies suggest that there is an upward bias in the standard OLS estimates. There are potential problems with both methods. The instrumental variable method fails if those individuals most likely affected by the instruments have a different return to education compared to the average individual, or if ability is affected by the instruments. In the international literature, family background variables have been criticized as instruments for schooling due to correlation with abilities that are valued in the labour market. The twin method fails if the reduction in the total variance of schooling, going from the full sample to a comparison within pairs of twins only, is larger than the reduction in the correlation between schooling and earnings (see Bound and Solon, 1999). One of the objections to twin studies is that they are not representative, that is, twins are different from other people. In the Norwegian study this does not seem to be a problem, since the twin sample is equally distributed as the population sample with regard to individual characteristics. All in all, we have to settle on the conclusion that the Norwegian studies find results similar to those from other countries, and that the nature of the biases thus is likely to be similar to those found elsewhere. But the debate over the direction of the bias remains unsettled.

Schøne (1996) uses an ordinary Heckman two-stage procedure to remove the selectivity bias in the estimates of the returns to *on-the-job training*. He concludes that the hypothesis of no selectivity bias cannot be rejected.

The problem of selectivity may also arise due to the fact that the wage equation is estimated conditional on labour market states. Assume, as a relevant example, that the wage equation is estimated on full-time workers only, and that the individual's choice of this labour market state is influenced by unobservable variables which increase the wage premium from full-time work. The direction and the degree of bias in the estimated coefficients of the observable human capital variables then depend on the structure of correlation between the unobservable wage determinants and the value of these human capital variables. If this correlation is zero, only the constant term is affected, and no problem arises. However, when this correlation is positive (negative) the returns to the human capital variables is over(under)estimated.

In the Norwegian case, most of the register based studies estimate the wage equation from full-time workers, while the samples used in the survey based studies (LLS, NOSE) are representative for the whole group of wage earners. Thus, the problem of selectivity, due to labour market state, is more present in the register based studies.

In their estimation of returns to levels of education, Hægeland et al. (1998) use a sample consisting of full-time workers only. In their wage equation the inverse Mills' ratio, from the estimation of a binary probit model describing full-time labour force participation, is added to correct for this problem. The probit equation for self-selection into full-time work includes the number of children in the family and several socio-demographic characteristics. In these estimations they use a sample of all grown-ups in the relevant age categories. They conclude that not controlling for employment choice, i.e. by using a one-step OLS procedure, gives an upward bias in the returns to education. However, they also conclude that the upward bias due to labour market state, seems to be cancelled out by the downward bias due to the endogeneity of educational choice.

By a multi-step procedure, Longva (1995) estimates wage equations on a register based sample of full-time workers in 1990 and 1991. He uses a sample of grown-ups to estimate the probability distribution of different labour market states. For this purpose a multinomial logit procedure is chosen. In the wage equation estimation, the predicted probability distribution is used to construct selection terms which correct for bias due to endogeneity of labour market state. Quite contrary to Hægeland et al. (1998), Longva concludes that not controlling for employment choice when using a sample consisting of full-time workers only, gives a downward bias in the estimated rate of return to education.

The statistical techniques used in the different studies reviewed are summarized in Tables A1 and A2 of the Appendix.

3 Results

3.1 Returns to formal education in Norway

We focus on the same issues as the studies we review, that is, international comparison, development over time from the beginning of the eighties, differences between sectors and the gender gap. In explaining the different patterns discovered, the authors focus on shifts in supply and demand, gender specific labour markets and wage setting systems. The emphasis of this presentation is given by the focus of the existing literature.

Table 1 summarizes the Norwegian studies with regard to returns to school years in the labour market as a whole, and for men and women separately. The estimated rates of return to additional school years fall within the interval 3.2 and 7 per cent. It is notable that the extreme values of this interval are contributed by the two studies which, in quite different ways, try to correct for the endogenous choice of schooling.

Comparable results from most OECD countries seem to range between a 5 and 10 per cent wage premium for each additional year of schooling above compulsory education (OECD, 1997; Asplund et al., 1996). Thus, with regard to the return to years of formal education, the estimates in Table 1 place Norway at the lower end, but within the range of other countries.

The estimates provided by the studies using register based data sets (Barth and Dale-Olsen, 1999; Barth and Schøne, 1999; Hægeland et al., 1998) seem to be slightly higher than the estimates from the survey based studies. This is probably due to a supply of hours bias resulting from a positive correlation between the level of education and the hours worked in a full-time (or part-time) job (Nørstenes, 1998). As described in the preceding section, the register based studies use calculated hourly (or yearly) wages as the dependent variable. Thus, systematic differences in hours worked between full-time workers at different levels of education tend to bias the estimates of return to school years. However, this type of positive bias does not seem to affect the estimates provided in the register based studies of Longva and Strøm (1998) and Raaum and Aabø (1999). The reason may be that these studies have a stricter sample selection rule and use measures of average hours worked for each gender, instead of normal work hours, when calculating hourly wages from yearly earnings.

The separate estimations for men and women, shown in Table 1, give ambiguous signs for the gender difference in returns to formal education, and in all the studies the gender gap is quite small. Thus, the studies provide no support for the hypothesis that the return to education varies between men and women in Norway. This is contrary to the results from similar studies for the other Nordic countries, which indicate higher returns to education in the male population (Asplund et al., 1996).

In order to investigate whether it is reasonable to assume that the level of education enters the earnings model in a linear fashion, dummy variables are used to represent the main classes of education, in Asplund et al. (1996). From the results reported in Table 2, the authors conclude that the linear specification is a reasonable approximation for Norway. The majority of studies adding a quadratic term for school years (S^2) to the linearly specified models reported in Table 1, indicate that the relationship between wage increases and additional school years is slightly decreasing.

Table 1. Returns to years of schooling in Norway for all, men and women. Dependent variable: log hourly wage[1]

		All	Men	Women
Asplund et al. (1996)	1989	.040 (.002)[7]	.041 (.003)	.039 (.003)
Barth and Zweimüller (1992)	1989		.053 [2] a_1=.054 (.008) a_2=-.0001 (001)[z]	.046 [2] a_1=.046 (.013) a_2=.0003 (.002)[z]
Barth and Dale-Olsen (1999)[3]	1990	.056 [2] a_1=.060 (.001) a_2=-.0007 (.000)		
Longva and Strøm (1998)	1991		.046 [2] a_1=.037 (0.001) a_2=.0004 (.000)	.040 [2] a_1=-.002 (.002)[z] a_2=.002 (.000)
Hægeland and Klette (1998)[4]	1980	.07		
	1990	.07		
Kahn (1998)[5]	1980		.032	.049
	1983		.047	.055
	1987		.043	.062
	1991		.042	.053
Barth and Mehlum (1993)	1980	.055		
	1983	.061		
	1987	.054		
Barth and Kongsgården (1996)	1991	.054		
	1995	.055		
Raaum and Aabø (1999): OLS, non-twin sample OLS, twin sample twin approach	1992/93		 .049 (.000) .050 (.002) .032 (.004)	 .044 (.000) .044 (.006) .040 (.006)
Barth and Schøne (1999) [6]	1989		.045[2] a_1=.056 (.007) a_2=-.00.2 (.000)	.039[2] a_1=.039 (.008) a_2=-.0002 (.001)[z]
	1996		.061[2] a_1=.071 (.001) a_2=-.0019 (.000)	.048[2] a_1=.043 (.002) a_2=.0010 (.000)

Notes: [z] signifies that the estimated coefficient is not significantly different from zero on a 5 per cent level.

1 When nothing else is noted, the estimates are generated by the models described in Tables A1 and A2 of the Appendix.

2 The equation estimated is: $\log(w)= c+a_1S+a_2S^2+Zg+u$. The value is calculated for the sample mean value of schooling (S).

3 In this study the log yearly wage is the dependent variable.

4 The figures reported by Hægeland et al. (1998) are calculated average effects. The calculations are kindly done by T. Hægeland.

5 The figures reported by Kahn (1998) are calculated effects based on mean values of school years within the intervals he uses for the educational dummy variables. Our calculations.

6 The reported figures are the results of pooled OLS estimation.

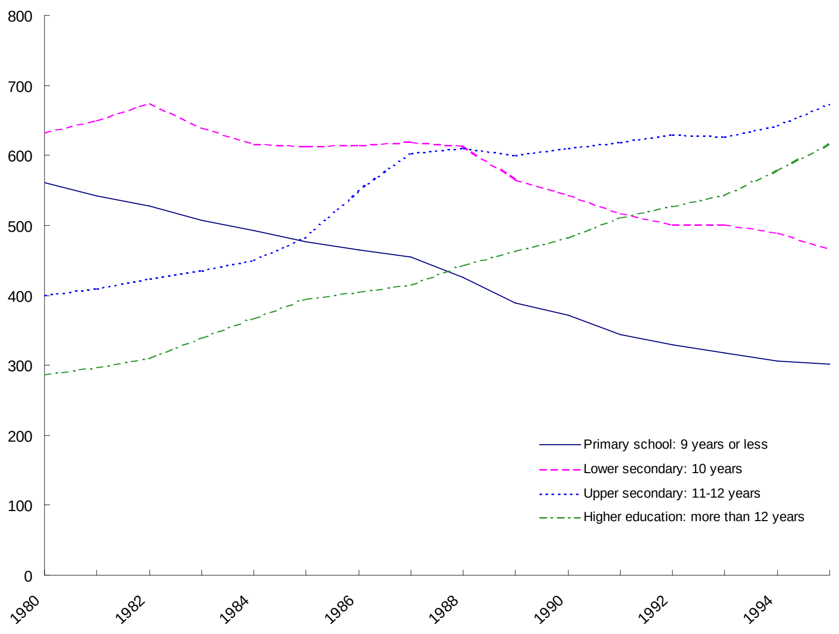
7 Standard errors in parenthesis when available in the publications.

Table 2. **Returns to educational degrees, the omitted variable is Primary School (9 years or less). Dependent variable: log hourly wage**[1]

	Year		All
Asplund et al. (1996)	1989	Vocational	.109 (.011)[2]
		Short non univ.	.269 (.015)
		BA-level	.304 (.017)
		Graduate	.442 (.020)

Notes: [1] This is not the model referred to in Appendix Table A2.
[2] Standard errors in parenthesis.

Figure 1. **Number of employed persons (in 1000), 16 to 67 years of age, 1980 to 1997, by educational level**



Source: Labour Market Statistics, Statistics Norway

Both Hægeland et al. (1998) and Raaum and Aabø (1999) estimate flexible non-linear models with dummies for 9 to 18 years of schooling. Raaum and Aabø conclude that linearity can be rejected for the male population. They find that the returns to school years are specifically high at 12 and 16 years of schooling. In the female population they find specifically high returns at 13 and 16 years of schooling, but the hypothesis of linearity cannot be rejected. Hægeland et al. (1998) do not test for linearity, but find relatively high marginal returns at 12 and 16 years, as well, in their gender pooled estimations.

Tables 3 and 4 report returns to years of schooling estimated separately for the private and the public sector. The results clearly indicate higher returns to education in the private sector. Swedish and Danish studies, reporting results from the late eighties, describe the same pattern. Finnish studies from the same period report the opposite result, that is, higher returns to education in the public sector (Asplund et al., 1996).

Table 3. Returns to years of schooling in the private and the public sector. Dependent variable: log hourly wage[1]

	Year	Private sector	Public sector	
			State	Local
Yin (1994)	1989	.042 (.003)[3]	.028 (.003)	.032 (.004)
Barth and Yin (1996)	1987-90		.044[2]	
	1991-94		.038[2]	
Schøne (1997)	1991		.039[2]	
	1992		.034[2]	
	1993		.042[2]	
	1994		.042[2]	
	1995		.041[2]	
	1996		.042[2]	
Barth (1997)	1989	.060 (003)		
Barth and Kongsgården (1996)	1991	.063	.050	
	1995	.074	.043	

Notes: 1 When nothing else is noted, the estimates are generated by the models described in Appendix Tables A1 and A2.

2 The equation estimated is: $\log(w)= c+a_1S+a_2S^2+a_3SxE+Zg+u$. The value is calculated for the sample mean value of schooling (S) and experience (E), the standard errors of the estimated coefficients are available in the publications.

3 Standard errors in parenthesis when available in the publications.

Table 4. Returns to years of schooling in the private and the public sector, men and women. Dependent variable: log hourly wage[1]

		Private sector		Public sector	
	Year	Men	Women	Men	Women
Barth and Mastekaasa (1993)	1980-82	.0516	.0592	.0497	.0545
	1983-87	.0705	.0677	.0402	.0573
	1989-91	.0649	..0611	..0431	.0507
Asplund et al. (1996)	1989	.0639 (.002)[2]	.0558 (.003)	.0413 (.003)	.0456 (.002)

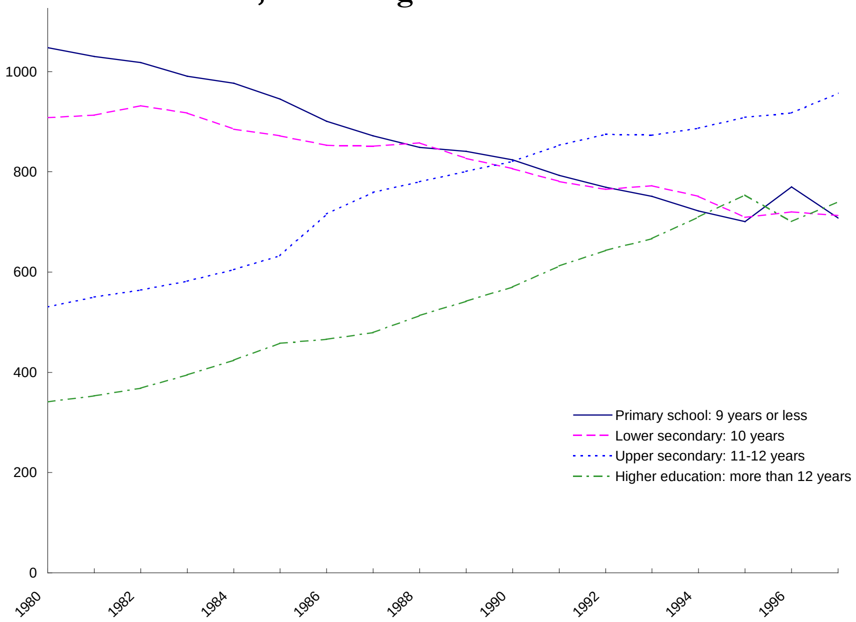
Notes: [1] When nothing else is noted, the estimates are generated by the models described in Appendix Tables A1 and A2.
[2] Standard errors in parenthesis when available in the publications.

Table 4 reports returns to years of schooling in the private and public sectors, estimated separately for men and women. The results indicate that while males have a slightly higher return to education in the private sector the situation is the opposite in the public sector. However, the differences are not significant.

During the last decades many countries in the OECD area have experienced increasing returns to education and increasing earnings inequality. When trying to explain this development, researchers have focused on technological changes and increased trade, which have increased the relative productivity of – and thus the relative demand for – labour with a higher education.

The increased demand for education has come into force in the Norwegian labour market as well. Figure 1 shows the number of employed persons, 16 to 67 years of age, from 1980 to 1995, according to the level of education. It is apparent that a strong increase in the demand for workers with a higher education has taken place during the last two decades. This development indicates that, other things equal, structural changes on the demand side of the Norwegian labour market have increased the relative shortage of workers with a higher education. However, the strong expansion of the Norwegian educational system in the same period has worked in the opposite direction. Figure 2 shows the total number of persons in the Norwegian population according to the level of education. As pointed out in Hægeland et al. (1998), the increasing capacity of the

Figure 2. Total number of persons (in 1000) in the Norwegian population, 16-67 years of age, 1980-1995, according to level of education



Source: Labour Market Statistics, Statistics Norway

educational system may result in a downward pressure on educational premiums, not only due to the supply effect. As higher proportions of each cohort are enlisted, the selection into higher education becomes less strict with regard to previous school performance and the standard of teaching and training may decrease. Thus, the expansion may involve a reduction in the average quality of education.

The estimates reported in Table 1, from the studies of Barth and Mehlum (1993) and Barth and Kongsgården (1996), indicate that the return to education in Norway increased in the early eighties, that is, from 1980 to 1983, and then dropped again from 1983 to 1987, after which it levelled out. The study of Kahn (1998) gives a similar impression, except that the increasing trend from the early eighties lasts longer in the female population.[4]

However, the overall impression given by Table 1 is stability and thus, that the Norwegian economy has not been affected by

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4 These trends must be interpreted with caution since the standard errors are not reported.

the much reported international trend of increasing rates of return to education. This impression is supported by the study of Hægeland et al. (1998), who estimate wage equations for 1980 and 1990 across sectors and different cohorts, and conclude that the return to education has been stable between 1980 and 1990.

If the return to education has been more stable in Norway than in many other OECD countries, a possible explanation may be that the expansion of the Norwegian educational system has been particularly strong (Jørgensen, 1993; OECD, 1997) and thus, that the income development of people with higher education has been influenced more strongly by a negative supply effect. Kahn (1998) examines the supply and demand conditions for high and low skilled workers in the period 1987 to 1991. He concludes that the market conditions for low skilled workers were actually less favourable in this period, compared to earlier periods in Norway and to a similar period in Sweden.

Controlling for education-specific experience effects on wages and cohort-specific selection into education, Hægeland et al. (1998) find that younger cohorts have higher returns to years of schooling than older cohorts. From this result they conclude:

"This later result contrasts the popular belief that the quality of the educational system has declined over time. It may be due both to a persistent shift in the primary education for younger cohorts or an improvement of the quality of education above primary level."

The study by Barth and Kongsgården (1996), reported in Table 3, shows divergent trends in the private and public sector during the nineties; while the returns to education decrease in the public sector they seem to increase in the private sector. These results suggest that the stability in the economy as a whole may be a result of different development patterns in the two sectors. However, Hægeland et al. (1998) find that this is not the case with regard to the development between 1980 and 1990.

Several of the studies, e.g. Kahn (1998), Barth and Kongsgården (1996), Barth and Yin (1996), have emphasized the role of the wage setting system, and its interaction with the business cycles, in explaining the earnings distribution and returns to education in Norway. The discussions have focused on the degree of centralization in wage formation. By increasing the possibilities for different wage outcomes across firms, and the opportunity by individual firms to use favourable wage offers to attract human capital, a more decentralized bargaining system is hypothesized to increase wage inequality and returns to education. In Norway, the major union federation (LO) has placed great emphasis on a fair (equal) income distribution among different groups of wage earners. In periods with wage bargaining at the national level this ideal has gained higher priority from the workers' side.

In general, the Norwegian wage setting and bargaining system has been characterized as relatively centralized in comparison to that of other countries (Calmfors and Driffill, 1988; Kahn, 1998). To substantiate this description the authors point to the large proportion of the labour force covered by collective bargaining and the fact that the large unions and the employer federations often sign national agreements, involving also government participation.

The degree of centralization has changed to some extent over the period we study. Norway moved towards a more decentralized bargaining system in the beginning of the eighties. The first half of the eighties may be characterized as an economic boom period with low unemployment and increasing prices. Unemployment, however, rose quite sharply among low skilled workers (basic education only), from nearly 2 per cent of the labour force in 1980 to 4 per cent in 1983, while the unemployment of high skilled persons (educated above secondary education) remained stable at a level below 1 per cent of the labour force. Thus, the combination of a relatively decentralized system of wage setting and an increasing relative shortage of highly skilled workers may have contributed to the rise in returns to education indicated in the studies by Kahn (1998) and Barth and Mehlum (1993) for this particular period. The favourable economic conditions and the decentralized system of wage setting continued from 1983 to 1987. At the same time the studies reported in Table 1 indicate a decline in the returns to education. However, contrary to the preceding period the unemployment among low skilled decreased quite sharply from 1983 to 1987. After 1987 unemployment rose dramatically in the whole labour force and the system of wage setting re-centralized in response to the economic depression. From 1988 to 1990 the normal bargaining system in Norway was replaced by wage laws.

The wage setting system in Norway also varies between the private and the public sector. In the public sector the system has been characterized by a rigid wage structure, determined at a central level. In the private sector wage formation has been more decentralized and individual wage agreements are more common, especially in relation to workers with a college or university education. The diverging pattern with regard to returns to education between the private and public sectors in the 90s may be viewed in light of the changes in the bargaining system. In the private sector, the increased demand for skills has put a pressure on high-skills wages, and a decentralization of wage formation has allowed this to show up in relative wages. However, in the public sector, the still centralized system of wage bargaining has not allowed skills differentials to increase in the early 90s. There has, though, been some movement towards a larger degree of decentralized wage setting even in the public sector in the 90s. It remains to be seen how the public sector will react to the increasing gap between relative wages in the two sectors.

3.2 Returns to other forms of human capital

The reviewed studies on returns to education all include controls for experience and seniority if available. Only Asplund et al. (1996), Arai et al. (1998), Barth (1997), Barth and Schøne (1999) and Schøne (1996) focus specifically on the returns to these other aspects of human capital. Barth (1997) and Schøne (1996) also include the returns to job specific on-the-job training. Table 5 reports the coefficients for experience, age, seniority and on-the-job training from these five studies.

We find a concave age-earnings profile in Norway as in most other places in the world. The experience-earnings profile is concave as well. Panel data is required to sort out the difference between potential cohort effects involved in the interpretation of these earnings profiles. The earnings profile is slightly steeper in Sweden and Norway than in the other Nordic countries (Asplund et al., 1996).

Arai et al. (1996) find that particular low-wage occupations are characterized by flat age-earnings profiles, while the rest of the labour market displays the usual concave relationship. They conclude that low wages are largely a matter of occupation and not only of age,

Table 5. Returns to on-the-job training in Norway. Dependent variable: log hourly wage[1]

	Age	Age²x100	Experience	Experience² x100	Seniority	Specific OJT
Arai et al. (1998)	.22	-.05				
Asplund et al. (1996)[2]			.021 (.002)	-.004 (.000)	.003 (.001)	
Barth (1997)[3]	.017	-.010	.010 (.003)	-.017 (.001)	.005 (..002)	.046 (.012)
Barth and Schøne (1999):						
NFS			.028 (.001)	-.05 (.001)	.012 (.000)	.036 (.002)
NSOE			.017 (.001)	-.03 (.002)	.003 (.001)	.032 (.004)
Schøne (1996)	.016 (.005)	-0.02 (.000)	.008 (.003)	-.01 (.000)	.001 (.000)	.033[4]

Notes: 1 When nothing else is noted, the estimates are generated by the models described in Appendix Tables A1 and A2.

2 Separate estimates for women are reported. The separate estimates for men are nearly similar.

3 The within firm estimate is used. Barth (1997) also includes two interaction terms between firm specific OJT and seniority (-0.0016) and experience (0.0005).

4 The equation estimated is: $\log(w_{93}) = c + c_1 OJT_{89} + c_2 JS_{89\text{-}93} + c_3 OJT_{89} x JS_{89\text{-}93} + bZ$. $OJT_{89}=1$ if formal on-the-job training in 1989, JS=1 if job stability from 1989 to 1993. The value in the table is calculated as: c_1+c_3 , where c_1=.073 (.024), c_3=-.040 (.026).

and that certain occupations may be characterized as low-wage ‘traps’ in the labour market.

The returns to seniority are smaller than the returns to experience, and if interpreted in terms of returns to specific and general human capital (Becker, 1964) most of the on-the-job training is general. However, an upward sloping seniority profile may be interpreted in terms of turnover models and as an incentive device as well (Lazear, 1995). The figure reported in Barth (1997) is a within-firm estimate of the seniority profile, which assures us that the returns to seniority actually arise within firms and not only as a statistical artefact from job-to-job mobility.

Ranging from 4.6 per cent within firms in the private sector to 3.2–3.6 per cent for the whole economy, the returns to on-the-job training requirements are actually not very far from the range of returns to education in Norway. Barth and Schøne (1999) show that the level of on-the-job training requirements may be negatively related to the level of turnover in the establishment, indicating that a regime with large job-to-job movements may be detrimental to firm-specific investments in training.

Schøne (1996) uses different measures for training at work. His study suggests that having participated in formal training during the last 12 months adds approximately 3 per cent to the wage level. The results also show that the return to training depends on the point in time when the training took place. Training activities back in time had a larger impact on wages than recent training activities, indicating that training affects both the level and the growth rate of wages. His study is particularly concerned with the distinction between general and specific training. A main conclusion is that in Norway training financed by the firm seems to contain a large portion of general and transferable skills.

Barth and Yin (1996) decompose the seniority-wage profile within large public-sector firms into wage growth arising from promotions versus within-position wage growth. They find, among other things, that job promotions are necessary for keeping up with the wage growth of newcomers. Within-firm wage growth is thus mainly a question of promotions and career development between job titles.

4 Conclusions

Wages are more compressed in Norway than in most other industrialized countries. This shows up in comparisons of returns to human capital as well. The studies reviewed here indicate a private return to education between 3.5 and 7 per cent. Most of the studies using standard OLS procedures on some measure of hourly wages indicate returns to education in the neighbourhood of 5 per cent. In the OECD area, these estimates place Norway in the lower half, but within the range of other countries with regard to private returns to school years.

The studies we review give no clear conclusion concerning the gender gap in returns to education in Norway. Depending on the data set and the statistical technique used, women seem to have lower, equal, or higher returns to education than men. However, the different studies seem to agree that the return to education in Norway is lower in the public than in the private sector.

The studies we review put different emphasis on the role of demand shifts, supply shifts and changes in the bargaining system for explaining the development of relative wages over the last two decades. The interaction of these forces has, however, produced a relatively stable situation with respect to the overall return to education. In other countries increasing returns to education during the last decades, have been interpreted as the result of demand shifts resulting from technological development and changing trade patterns. In the early nineties there may be some indications – in the private sector – that this underlying demand shift is working in Norway as well. However, the general impression is that wage differentials have been kept in place by both a considerable increase in the supply of more educated people and a re-centralization of wage bargaining in the late 80s and early 90s, both of which may be regarded as a response to the recent recession. As the economy booms and the bargaining system is being decentralized, we may expect these demand forces to play out more freely also in Norway.

What should be on the research agenda? First of all, it would be very useful to understand the causes and consequences of a relatively compressed wage structure. It may be that we have a relatively low return to education in Norway, measured in this way, simply because education is inexpensive for the students in Norway. Education is more or less free in Norway. However, the relatively high unskilled wages make it costly to stay out of work for one year. It may also be noted that the lower unemployment risk is not included as a part of the return to education, as measured in the studies reviewed here. The supply boom of education, in recent decades, suggests that low returns have not prevented young people from study longer, which is after all the real concern with low returns to education. Down to very recently the capacity of universities and colleges seems to have been the main impediment with regard to the growth in the level of education in the Norwegian population. However, in the last year there have been signs that the queue to higher education has been shorter and that some fields of studies do not utilize their total capacity.

The relatively low return to education in Norway, compared to other countries, indicates that the highly educated Norwegian citizens might receive an income premium if moving abroad. However, studies of labour migration from Norway suggest that migration out is low and that return migration is high among those who move. Thus, from this point of view, a low relative return to education seems to pose a very small threat to the stock of highly educated workers in Norway (Røed, 1996a; Schröder, 1996). Studies of the international migration from Norway also show that temporary migrants may gain an income premium from working abroad after returning to their home country (Røed, 1996b). This suggests that some level of migration – stimulated by low relative wages – may actually be productive for the Norwegian economy.

Another important question is in what manner private returns to education affect the overall income distribution in the population.

While analysis of the development of the return to education over time within a country requires a focus on *changes* in labour market conditions and the market for education, the comparison of returns to human capital between countries needs to focus on *differences in the levels* of different features of the labour market and the educational structure. The continuation of the PURE project will hopefully give us a better understanding of the causes of the different returns to education across the nations of Europe.

Next we have the issue of identifying the causal effects of schooling. Are we really measuring the returns to education, and do we do it right? A number of specification tests should be made. Hægeland et al. (1998) conclude that controlling for endogeneity does not improve much on the estimates and, furthermore, that the lack of such a control does not impair comparisons over time to any significant degree. That is comforting. However, the results from the twins' study of Raaum and Aabø (1999) suggest that the OLS estimates are upward biased and that this bias may matter significantly, at least for men. Obtaining clear-cut results with respect to the direction and magnitude of the bias in the measurement of the causal effect of education still seems to be far off into the future.

The human capital literature is dominated by supply side considerations. Of course, the demand side is equally important. It must be the case that more educated workers are more productive in performing certain tasks compared to unskilled workers, otherwise employers would not hire them at the higher price. Still, studies of the relationship between productivity and human capital are in high need. Does a low private return to education in Norway imply that education adds less to productivity in our country than in other countries? The results from Hægeland et al. (1997) seem to suggest this, since they find a close correspondence between relative productivity and relative pay in Norway.

Recent literature on productivity and growth, on the other hand, suggests that education may have positive external effects, which are not picked up by the estimated private returns to education. Further study of the productivity effects of education is clearly warranted.

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Table A1. Summary of register based studies on private returns to human capital in Norway

	Raaum and Aabø (1999)	Barth and Schøne (1999)	Longva and Strøm (1998)	Hægeland et al. (1998)	Barth and Dale-Olsen (1999)	Schøne (1997), Barth and Yin (1996)	Longva (1995)
Sample	Full, part-time (long) wage earners	Full-time wage earners	Full-time wage earners	Full-time wage earners	Full-time wage earners	State employed	Full-time wage earners
Years	1992/1993	1996	1991	1980, 1990	1990	1987-1996	1990, 1991
Equation	$\log(w)=c+a_1S_j+b(S_1+S_2)+Zg+u$	$\log(w)=c+a_1S+a_2S^2+Zg+u$	$\log(w)=c+a_1S+a_2S^2+Zg+u$	$\log(w)=S(a_y+s_1 l_y)D_y+s_2h+Zg+u$	$\log(w)=c+a_1S+a_2S^2+Zg+u$	$\log(w)=c+a_1S+a_2S^2+Zg+u$	$w=c+a_1S+a_2S^2+Zg+h+u$
Symbols	j=twin 1,2			D_y= dummy school year, y = 9-18			
	w=calculated hourly (yearly) wage, c=constant term, S=years of schooling, Z=other explanatory variables, u=residual						
Selection terms	School years: (S_1+S_2)			School years: l_y Labor supply: h			Labor supply: h
Variables (Z):							
Experience (E),E^2	Actual	E=A-16-S		E=A-7-S , E xD_y	E=A-16-S	E=A-16-S, E x S	
Age (A), A^2			x				x
Tenure (T) T^2		x			x	x	
Other	Marital status Children Region Gender	On-the-job training Gender	Industry Unemployment Marital status Gender	Industry Type of education Gender	Industry Region Unemployment Firm size Marital status Gender	Part time Gender	Region Unemployment Marital status Gender
Procedure	Twin approach	OLS	OLS	IV	OLS	OLS	IV

Table A2. Summary of survey based studies on private returns to human capital in Norway

	Barth and Mastekaasa (1993)	Kahn (1998)	Asplund et al. (1996)	Arai et al. (1996)	Barth and Mehlum (1993)	Barth and Kongsgården (1996)
Data	LLS + NSOE	LLS	NSOE	LLS		LLS
Sample	Wage earners					
Years	1980-82, 83-87, 89-91	1980, 83, 87, 91	1989	1987, 91	1980, 83, 87, 91	1991, 95
Equation	$\log(w)=c+a_1S+Zg+u$	$\log(w)=c+a_1D_h+a_2D_l+Zg+u$	1: $\log(w)=c+a_1S+Zg+u$ 2: $\log(w)=c+3a_dD_d+Zg+u$	$\log(w)=c+a_1S+a_2S^2+Zg+u$	$\log(w)=c+a_1S+Zg+u$	
Symbols		D_h=years of schooling>12 D_d=dummie educational degrees D_l=years of schooling<10				
		w=actual hourly wage, c=constant term, S=years of schooling, Z=other explanatory variables, u= residual				
Variabls (Z):						
Experience (E), E^2	E=A-16-S	E=A-6-S (1983-1991)	Actual		Actual	E=A-16-S
Age (A), A^2		x (1980)		x		
Tenure (T), T^2			x			
Other	Sector Gender	Occupation Gender Industry		Occupation Gender	Sector	Gender
Procedure	OLS					

Table A2. (continued)

	Schøne (1996)	Barth (1997)		Barth and Schøne (1999)		Yin (1994)	Barth and Mastekaasa (1996)	Barth and Zweimüller (1992)
Data	NSOE							
Sample	Wage earners	Wage earners, private sector		Wage earners			Wage earners, private sector	
Years	1993	1989						
Equation	$\log(w)=c+a_1S+Zg+l+u$	$\log(w)=c+a_1S+Zg+u$		$\log(w)=c+a_1S+a_2S^2+Zg+u$		$\log(w)=c+a_1S+Zg+u$	$\log(w)=c+a_1S+Zg+u$	$\log(w)=c+a_1S+a_2S^2+a_3SxM+Zg+u$
Symbols	w=actual hourly wage, c=constant term, S=years of schooling, Z=other explanatory variables, u= residual, M=marital status							
Selection terms	On the job training: 8							
Variables (Z):								
Experience (E), E^2	Actual							
Age (A), A^2	x	x				x		
Tenure (T), T^2	x	x, (PR) xT		x			x	
Other	On-the-job training (OJT) Firm size Marital status Union member Sector (privat/public) Gender Region	OJT Pace rate (PR)	Gender	OJT Gender	Gender	Occupational position Marital status Union member Sector Part time Region Gender	Occupation Union member Firm size Working condition Region Gender	Marital status Occupation Industry Gender
Procedure	Two-stage Heckman	OLS						
		Within firm Pooled		Within firm Pooled			Between firm Within firm	

CHAPTER 12

Wages and Human Capital: Evidence from the Portuguese Data

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1 Introduction[1]

The aim of this study is to analyse the applied research into wage formation in the Portuguese labour market. The paper focuses on wages and endeavoures to determine if the results of several research studies are similar, that is, if they are robust to different data sets, equation specifications and estimation procedures. Additionally, the paper gives the opportunity to gain deeper insight into the behaviour of the labour market in Portugal.

The estimation results come from market wage functions. The unit of observation in the data sets is the individual. The estimation of individual's wages shows results that are similar, not only in the direction, but also in the magnitude of the individual's human capital endowment influence on wages. Years of education, experience and tenure have positive estimated effects that hold the same magnitude from one study to another. Of the three, education has the highest influence on wages. Regularities can also be found in the influence of the individual's age, firm size, job qualification and region.

Wage differentials by gender can be decomposed into two effects: the proportion of the differential due to different endowments of personal attributes – the attribute effect; and the proportion of the differential due to different returns to the personal attributes – the price effect. The decomposition of the wage differential by gender in price effects and attribute effects leads to the conclusion that the former effect is the stronger one. Wage inequality seems to have increased in the last years. In addition, analysis of the wage structure shows that the workers at the upper end of the wage distribution have a higher return to the years invested in school.

All the studies estimate wage functions for Portugal and discuss the process of wage formation, especially the role played by hu-

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man capital. Each of the studies then focuses on the analysis of specific points or adds insights on related topics, as is briefly highlighted in what follows.

Cardoso (1998) studies the impact of the employers' heterogeneity on wage inequality.

The fact that the worker's attributes are not equally rewarded over the wage distribution is addressed in the papers of Hartog et al. (1998) and Machado and Mata (1998).

In Hartog et al. (1995) the wage formation in the Azores is related to the wage bargaining settings and labour market institutions.

In the work of Kiker et al. (1997) and Santos (1995) the influence of overeducation and undereducation on wages is fully elaborated – a topic also studied in Kiker and Santos (1991).

Wage differentials by gender are analysed in Kiker and Santos (1991), Martins (1991), Vieira (1992) and Vieira and Pereira (1993) with a decomposition into attribute effects and price effects in order to assess the existence or not of discrimination by gender. Kiker and Santos (1991) undertake this decomposition in relation to wage differences by sector of employment in addition to gender.

Lima et al. (1996) provide some results regarding females' behaviour in the labour market. The determinants of the decision to participate in the labour market and the supply of working hours are estimated and discussed. The study by Martins (1996) is also about females' behaviour in the labour market. The author proves that the estimation results are sensitive to the economic and statistical specification of the females' labour supply. Both studies consider married women.

Pereira and Lima (1996) estimate a market wage rate and hours-of-work functions. The study is carried out for both male and female partners in a couple. The same set of questions about him/her and about his/her partner was directed to only one member of the couple. The main point was to verify whether or not both sets of answers were coherent with the same model.

The tax system influence on females' labour market participation is discussed in Marques and Pereira (1995a,b) and Marques (1993). Different fiscal simulations are carried out to study womens' sensitivity to the income tax. Marques and Pereira (1995b) extend the results of their previous study (1995a) in order to include the estimation of a labour supply function. Several estimation methods are implemented and discussed.

Psacharopoulos (1981) estimates the returns of education, both private and social returns, and discusses the differences between the private and the public sector.

Santos (1995) follows the generalisation of the human capital model in including the role of occupation. This topic is also found in Vieira (1992) and Vieira and Pereira (1993). The authors analyse the wage differential determinants in the Azores islands.

Vieira et al. (1997) study the wage structure and job level allocation in Portugal and their evolution during the 1980s and early 90s. The results of the research are matched with the transformations of the Portuguese economy during this period.

The role of education and human capital in general is analysed in Silva (1985). The author surveys several education systems and relates them to the labour demand. São Pedro and Baptista (1992) also study the role of education as an accumulation of human capital and discuss the impact of education on labour productivity. The private sector and the public administration sector are analysed separately.

This chapter is organised as follows. Section 2 introduces the estimation procedures that can be found in the research papers reviewed. The third section describes the several data sets used. The estimation results are analysed in the fourth part of this chapter. Finally, some concluding comments are made.

2 Estimation procedures

The basic procedure to estimate wage functions is the ordinary least squares (OLS) technique. Some of the studies extend this estimation procedure due to the different issues that are analysed therein. The objective of this section is to point out these main extensions. The fourth section, where the results are discussed, gives more information about these procedures. Table A1 in the Appendix lists the variables used in the estimation of wage equations in each of the studies reviewed.

The estimation procedure in Cardoso (1998) consists of the implementation of a multilevel regression model that allows the presence of employer-specific characteristics. This model accounts for the different wage policies followed by each firm, that is, the rewards of each of the workers' human capital components. The data used matches the employer with the employee.

Hartog et al. (1998) and Machado and Mata (1998) make use of quantile regression techniques, a breakthrough from the OLS estimation.

Kiker and Santos (1991), Santos (1995), Vieira (1992), and Vieira and Pereira (1993) use a two-step estimation procedure to address the impact of job qualification (occupation) on wages.

Lima et al. (1996), Marques (1993), Marques and Pereira (1995a,b), Martins (1996) and Pereira and Lima (1996) use estimation procedures to correct for the selection bias that arises when the wage is only observable for those individuals that work, as is the case of women, whose participation rate in the labour market is far less than one.

The wage variable is classified by categories in Lima et al. (1996) and Pereira and Lima (1996). The problem is solved by the use of an algorithm instead of the OLS.

In Marques (1993) and Marques and Pereira (1995a) a human capital wage function is estimated at 20 and 40 hours of work in order to compute an after-tax wage. Marques and Pereira (1995b) extend these results in order to include the estimation of a labour supply function. Several estimation methods are implemented and discussed.

3 Data sets

The data sets are all cross-sectional. In Portugal there is a scarcity of data available for research, and although some studies use more than one year of data, it is impossible to track the individuals from one year to another. Table A2 in the Appendix shows the sample sizes by gender, survey year and the source data set.

The survey, *Quadros de Pessoal* (QP), that the Ministry of Employment annually collects from the Portuguese firms is the data source used in several studies. These surveys include the data collected in questionnaires that are sent to Portuguese firms every year. Every firm with more than five employees (one employee after 1994) gives information about the workers' personal characteristics and a firm characterisation. The firm is required by law to respond to the survey.

The data set studied in Lima et al. (1996) and Pereira and Lima (1996) comes from a survey ordered by the *Direcção-Geral da Família* (DGF), in 1994. The total sample comprises 706 couples with at least one child under 18 years of age living at home, and is fully analysed in Mendes et al. (1995). It is a sample broken down by region and populational dimension by place, and obtained by direct interview in the residence of the individuals. At least one of the couple members is between 25 and 54 years of age.

In Marques and Pereira (1995a,b) and Marques (1993) the data set is *Inquéritos aos Dados do Emprego* (IE), 1990, third quarter, from the Portuguese national institute of statistics (*Instituto Nacional de Estatística*). In the sample used, only married women whose husbands participate in the labour market are considered. The same type of data set is used by Martins (1996) but for 1991.

São Pedro and Baptista (1992) use two sets of data. One of the sets is for public servants from a survey conducted by the *Direcção Geral da Administração Pública* (DGAP) in 1988. The other is for workers in the private sector from two surveys, both conducted in 1988: *Quadros de Pessoal* mentioned above and *Inquéritos Anuais às Empresas* (IAE) from the Portuguese national institute of statistics.

4 Estimation results

The main estimation results of the research are discussed in this section. The findings related to the estimation of wage equations are numerous as a result of the extended set of explanatory variables.

The dependent variable in the estimations of the wage equation is the logarithm of the individual's wage – in most studies defined as the gross monthly wage. The individual receives this wage from his/her supply of hours to the labour market. The results presented in the following tables show the estimated coefficients of these wage equations; that is, the marginal increase in wages, in per cent, caused by an increase in the corresponding variable: education, experience, tenure or age.

The variable pertaining to education refers to attendance in formal schooling. Experience refers to the years of labour market experience in general (or otherwise specified) and tenure refers to the years of experience in the current firm. These variables can be considered as proxies of the individual's endowments of human capital.

4.1 Education, experience, tenure and age

The estimated coefficients associated with education, total working experience and tenure can be considered as being fairly robust, as demonstrated by their values in Tables 1, 2 and 3, respectively. Notice that the origin of the data that generated the results of the estimation is diverse and that the estimation procedure implemented is not always the same. Nevertheless, some issues must be noted.

The results from Vieira (1992) are for the Azores, and one should thus presume a different labour market setting.

The definition of the experience variable is not uniform across the several wage equations estimated. In Pereira and Lima (1996) the variable measures the total working years that the individual reported in the survey. In all of the other studies the lack of this variable in the data sets led to the construction of a variable defined as the individual's age minus six (years) minus years of education, and, in Kiker and Santos (1991), Santos (1995) and Silva (1985), minus years of tenure. Pereira and Lima (1996) include the individual's age as an independent variable in the wage equation because that variable captures additional information given that the individual's experience is directly observed. In Tables 2 and 4, the lower coefficients associated with men's experience, when compared with the values obtained in other studies, can be highlighted with the coefficients associated with men's age.

When the wage equation is extended to include variables such as firm size, the individual's occupational level inside the firm, and sector of activity, the coefficients associated with years of education are lower and fall into the range [3.5% – 6.5%]. This fact can explain the lower coefficients found in Vieira et al. (1997), where the wage equation includes firm size, firm age and firm ownership in the set of explanatory variables. The specification of the wage equation considered in Tables 1–4 is what could be labelled as basic, given that it includes only the variables related to the individual's human capital characteristics, and the major exception is the study just mentioned.

In Martins (1996) the interaction term between experience and education included as an independent variable can explain the higher coefficients found in that paper.

The estimated coefficients from São Pedro and Baptista (1992) in Tables 1 and 2 are for workers in the private sector. When the data set with public servants is used, the coefficients are 5.7, 3.4, and -0.04, respectively.

Note that some of the studies mentioned in the introduction do not appear in Tables 1–4: Lima et al. (1996), Marques (1993), Marques and Pereira (1995b), and Vieira and Pereira (1993). That

Table 1. Wage equation: Years of Education

	Year	**Education (%)**		
		Female	Male	All
Martins (1991)	1977	8.0	7.3	-
Psacharopoulos (1981)	1977	8.4	7.5	9.1
Machado and Mata (1998)	1982	-	-	7.1
Vieira et al. (1997)	1982	-	-	6.2
Silva (1985)	1983	9.1	8.9	9.1
Kiker and Santos (1991)	1985	10.4	9.4	10.0
Santos (1995)	1985	9.6	9.0	9.5
Vieira et al. (1997)	1986	-	-	5.9
São Pedro and Baptista (1992)	1988	-	-	8.3
Hartog et al. (1995)	1989	-	7.0	-
Vieira (1992)	1989	8.9	10.8	9.6
Marques and Pereira (1995a)	1990	11.1	-	-
Martins (1996)*	1991	14.0	-	-
Vieira et al. (1997)	1992	-	-	7.2
Machado and Mata (1998)	1994	-	-	7.7

Note: * The equation includes an interaction term between education and experience with an estimate equal to -0.24.

Table 2. Wage equation: Years of Experience

	Year	Experience (%)			Experience Squared (%)		
		Female	Male	All	Female	Male	All
Martins (1991)	1977	3.3	5.4	-	-0.04	-0.1	-
Psacharopoulos (1981)	1977	-	-	5.1	-	-	-0.07
Machado and Mata (1998)	1982	-	-	4.4	-	-	-0.06
Vieira et al. (1997)	1982	-	-	4.2	-	-	-0.1
Silva (1985)	1983	3.0	3.6	3.7	-0.06	-0.07	-0.07
Kiker and Santos (1991)	1985	2.4	2.5	2.9	-0.04	-0.04	-0.05
Santos (1995)	1985	2.3	2.4	2.9	-0.04	-0.04	-0.05
Vieira et al. (1997)	1986	-	-	3.9	-	-	-0.09
São Pedro and Baptista (1992)	1988	-	-	4.8	-	-	-0.06
Vieira (1992)	1989	3.2	5.1	4.5	-0.05	-0.08	-0.07
Marques and Pereira (1995a)	1990	3.0	-	-	-0.03	-	-
Martins (1996)*	1991	5.4	-	-	-0.06	-	-
Vieira et al. (1997)	1992	-	-	3.4	-	-	-0.07
Pereira and Lima (1996)	1994	3.4	1.7	-	-0.08	-0.04	-
Machado and Mata (1998)	1994	-	-	3.0	-	-	-0.04

Notes: Years of experience are defined as the individual's age minus six (years) minus years of education, and, in Kiker and Santos (1991), Santos (1995), and Silva (1985), minus years of tenure.

* The equation includes an interaction term between education and experience with an estimate equal to -0.24.

Table 3. Wage equation: Years of Tenure

	Year	Tenure (%)			Tenure Squared (%)		
		Female	Male	All	Female	Male	All
Psacharopoulos (1981)	1977	3.5	3.1	-	-0.06	-0.05	-
Machado and Mata (1998)	1982	-	-	1.0	-	-	-0.01
Vieira et al. (1997)	1982	-	-	0.7	-	-	-0.04
Silva (1985)	1983	5.4	5.5	5.2	-0.10	-0.10	-0.10
Kiker and Santos (1991)	1985	3.3	3.7	3.5	-0.04	-0.05	-0.04
Santos (1995)	1985	3.4	3.7	3.6	-0.10	-0.10	-0.04
Vieira et al. (1997)	1986	-	-	0.8	-	-	-0.07
Hartog et al. (1995)	1989	-	1.0	-	-	-	-
Vieira (1992)	1989	1.4	1.1	1.9	-	-	-
Vieira et al. (1997)	1992	-	-	0.8	-	-	-0.08
Machado and Mata (1998)	1994	-	-	1.2	-	-	-0.02

Table 4. Wage equation: Age

	Year	Age (%)			Age Squared (%)		
		Female	Male	All	Female	Male	All
Hartog et al. (1995)**	1989	-	7.2	-	-	-0.08	
Pereira and Lima (1996)	1994	2.8*	4.6	-	-0.03*	-0.04	-

Notes: * Coefficient not significant at any reasonable level.
** The equation does not include experience.

is because they have roughly the same results as those reported by, respectively, Pereira and Lima (1996), Marques and Pereira (1995a), and Vieira (1992).

The signs of the coefficients in Tables 1–4 are as expected. Education has a positive effect. The influence of the variables mentioned in Tables 2–3 is a quadratic one, indicating diminishing returns to on-the-job training.

It is relatively hard to draw conclusions about the *difference by gender* in the coefficients. Kiker and Santos (1991), Martins (1991), Vieira (1992) and Vieira and Pereira (1993) study wage differentials by gender in relation to the wage equation. The results indicate that the price effect explains a higher proportion of the wage differential. A possible interpretation can be the existence of discrimination against women in the Portuguese labour market. The analysis carried out in Martins (1991) is somewhat different but the results indicate that the differential is due to different returns to experience and not to different returns to education for the year 1977. Additionally Machado and Mata (1998) found that women earn less than men do over the whole wage distribution and that these wage differentials are higher in better paid jobs.

When the wage estimation uses *education levels* instead of education years the results are difficult to compare due to different level definitions and equation specifications. Some consistencies can be found, however, such as: one more level completed leads to a wage increase; the higher wage increase is associated with the attendance at technical (baccalaureate, 3 years in the university) and university levels (5 years in the university); and during the 1980s and early 90s, the wage premium increased, especially in the case of those with higher levels of education, while individuals with fewer years of education saw a tendency towards lower wage premiums.

The results in the above tables are ranked by survey year. There is no clear trend on the human capital rewards, which reveals the need for more research on this issue.

The *wage distribution* is a closely related topic. Hartog et al. (1998) and Machado and Mata (1998) estimate the wage equation at specific points of the wage distribution, namely the points that define the deciles of the distribution. This mode of estimation, the quantile regression, is richer and allows assessing the impact of the covariates at these specific points. Instead of getting one coefficient for each covariate, as shown in Tables 1–4, both studies produce a range of coefficients for each covariate. The range of coefficient values clearly demonstrates that an ordinary least squares estimation masks the differences in the returns to education: workers in the higher quantiles of the wage distribution have higher returns.

The estimation performed in Cardoso (1998) reveals that *wage inequality* has risen from 1983 to 1992. The change in the employers' wage policies leads to this result. That is, the worker's attributes, namely schooling, tenure, gender and newly-hired, were rewarded in a more inequalizing way.

4.2 Undereducation and overeducation

Kiker et al. (1997), Santos (1995) and Kiker and Santos (1991) include variables in the wage estimation that capture the individual's undereducation and overeducation. Santos (1995) provides several over(under)education indicies and performs alternative wage estimation with them. The same line of research is pursued and extended in Kiker et al. (1997). These variables are related to the matching between the individual's education and the skills requirement of his/her job. The results are as follows: an individual with an overeducation earns less than if he/she was adequately assigned with respect to his/her educational skills; an overeducated individual earns more than individuals assigned to the same job but with the required level of education; the reverse is true for the undereducated workers.

Hartog et al. (1998) use quantile regressions to address the problem of mismatch between the required level of education and the level of education acquired by the worker. The results confirm the ones mentioned above. In addition, one can assess how the coefficients change along the wage distribution. The difference between the rewards of the overeducated and the penalties of the undereducated increase from the lower to the higher quantiles.

4.3 Sample selection bias

The fact that only wages for those individuals that participate in the labour market are observable leads to a sample selection bias in the wage estimation. This bias is more pronounced when the participation probability is far less than one, as is the case for women. As a result, a measure of this selection bias, the so-called inverse Mills' ratio or hazard rate, should be included in the right-hand side of the wage regression. The studies by Lima et al. (1996), Lima and Pereira (1996), Marques (1993), Marques and Pereira (1995a,b) and Martins (1996) are the ones that include this variable in order to correct for sample selection bias in female wages. The other studies do not use selection bias corrected regression because the data sets contain only individuals who supply a positive amount of hours to the labour market. Nevertheless, the first mentioned studies are not conclusive: for example, Pereira and Lima (1996) and Marques and Pereira (1995b) both find positive coefficients, but in the former study the coefficient is not statistically significant while in the latter, it is.

4.4 Other variables

The wage equations are usually extended to include other factors that cannot be labelled as components of the individual's stock of human capital. Nevertheless, they are instruments for the behaviour of firms, among other things, and so add information about how the pay policies can vary. The comparison of basic human capital regressions with those that include this type of variables shows also that the estimated coefficients associated with the human capital variables are in some cases sensitive to this inclusion. As a result the following variables are discussed: job qualification, region, firm size, firm age, and hours of work.

Job qualification

In the surveys from the Ministry of Employment there is a classification of occupations (jobs) according to the task performed and the skills required. From this classification a measure of the job complexity and responsibility is constructed, that is, the job qualification (level). Each job level could be considered as a layer in a hierarchy defined in terms of increasing responsibility and task complexity. It is a variable defined at a point scale where each point corresponds to a job level, as in Kiker and Santos (1991). It is also defined as a set of dummies, each dummy being related to a job level. This last definition appears in all of the other studies that use job qualification (see Table A1 in the Appendix). There are three sets of results from these studies: the coefficients associated with the variable job level included in the wage equation; the coefficients associated with several variables affecting the allocation probabilities across job-level equations; and the coefficients of specific wage equations, one for each job level and corrected for selectivity bias. The results are described below.

Firstly, when the individual moves to a higher job level, he/she receives a higher wage. Secondly, years of education have a positive effect on the individual's probability of being allocated to a higher job level. Experience and tenure have a weaker positive effect, although a conclusive statement is harder to assert. Finally, the coefficients associated with years of education, experience and tenure are positive in all of the level-specific wage equations. In nearly all cases, the move to a wage equation that corresponds to a higher job level increases the coefficients. This is especially true concerning years of education.

The individual's wage is only observed given his/her job assignment. This selectivity can give rise to a problem of inconsistent least squares estimates. The variable that corrects for this selectivity bias has an associated coefficient that, in most cases, is not statistically significant. This means that the individual's probability of being allocated to a specific job level is not correlated with the error term of the wage equation for that level.

Region

Dummy variables for the different Portuguese regions are found in Kiker and Santos (1991), Santos (1995), and Vieira et al. (1997).

The principal conclusions that can be drawn from the associated coefficients are: in Lisbon wages are higher than in the other regions of Portugal; the North and Centre of Portugal have the lowest wages, especially in the 1990s when compared with the mid-80s; in the South (the regions of Alentejo and Algarve) there is an intermediate situation.

Kiker and Santos (1990) run one equation on each Portuguese region and find different coefficients for the same variable set leading to an interpretation that there is a regional imbalance.

Firm size

Firm size is defined in relation to the number of employees in each firm. The coefficients of the dummies that characterise firm size and that are included in the wage estimations all point in one direction: the larger the firm is, the higher are the individuals' wages. Vieira et al. (1997) and Hartog et al. (1995) use the logarithm of firm size and arrive at the same result. In Vieira et al. (1997), the logarithm of *firm age* is also included. The associated coefficient is negative.

Hours of work

Hours of work is a variable used in the studies referred to in Table A1 of the Appendix. The variable is defined as the logarithm of working hours. The estimated coefficients associated with this variable are positive and less than one. The only exceptions are the studies by Vieira (1992) and Vieira and Pereira (1993), where the coefficient is negative in the female wage equation. Note that this result is for the Azores islands.

5 Conclusion

The estimation results of the applied research on Portuguese wages are robust. The reviewed studies use different estimation settings. The data sets, equation specifications and estimation procedures differ, but some important results for the labour market in Portugal are achieved nevertheless. If the findings are the same in the various studies, then one can be more confident that they are a true approximation of the real picture.

Years of education, experience, tenure, age, firm size and job qualification are all variables with a positive influence on the individual's wage. The region where the individual lives has a precise influence: wages increase if the worker lives in Lisbon and decrease if he/she lives in the North or Centre of Portugal, other things being equal. The squares of experience, tenure and age have a negative impact on wages. The different rewards for the individual's attributes are more important in explaining higher male wages than are the individual's different endowments of attributes.

The specific pay policies of the employers are one of the explanations for the rise in wage inequality. The studies on the wage structure also point to the existence of different pay policies along the wage distribution. Workers with higher wages have higher returns to education.

These results are an encouragement to do future research. A comparison with other countries shows the need to pursue the study of the Portuguese labour market.

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Appendix

The following table presents all of the variables used in the reviewed studies. It does not mean that they were all included in the same equation at the same time.

Table A1. Wage function: variables included

	Cardoso (1998)	Hartog et al. (1998)	Hartog et al. (1995)	Kiker et al. (1997)	Kiker and Santos (1991), Santos (1995)	Lima et al. (1996), Pereira and Lima (1996)	Machado and Mata (1998)
Age			×			×	
Age squared			×			×	
Years of Education	×	×	×	×	×		×
Levels of Education			×			×	
Experience	×	×		×	×	×	×
Experience squared		×		×	×	×	×
Tenure	×	×	×	×	×		×
Tenure Squared		×		×	×		×
Job Qualification					×		
Log Working Hours		×		×	×		
Sector Public/ Private				×	×		×
Firm Size		×	×	×	×		×
Region		×		×	×	×	
Sector of Activity/ Industry		×	×	×	×		
Other	×	×	×	×	×	×	×
Select. Bias Correction					×*	×**	

Notes: * job level allocation (analysis not made by Kiker and Santos, 1991)
** labour market participation

Table A1. (continued)

	Marques (1993), Marques and Pereira (1995a,b), Martins (1996)	Martins (1991)	Psacharo-poulos (1981)	São Pedro and Baptista (1992)	Silva (1985)	Vieira (1992), Vieira and Pereira (1993)	Vieira et al. (1997)
Age					×		
Age squared					×		
Years of Education	×	×	×	×	×	×	×
Levels of Education			×	×	×	×	×
Experience	×	×	×	×	×	×	×
Experience squared	×	×	×	×	×	×	×
Tenure			×		×	×	×
Tenure Squared			×		×	×	
Job Qualification						×	×
Log Working Hours			×	×	×		×
Sector Public/ Private							×
Firm Size						×	×
Region							×
Sector of Activity/ Industry							×
Other	×	×					×
Select. Bias Correction	×**					×*	×*

Notes: * job level allocation
** labour market participation

Table A2. Sample size

	Data set	Year	Female	Male	Total
Cardoso (1998)	QP	1983 1992	- -	- -	26 480 36 313
Hartog et al. (1995)	QP	1989	-	7 891	7 891
Kiker et al. (1997)	QP	1991	11 130	19 206	30 336
Kiker and Santos (1991)	QP	1985	10 346	21 823	32 169
Santos (1995)	QP	1985 1991	10 116 11 130	21 742 19 206	31 858 30 336
Lima et al. (1996)	DGF	1994	480	-	480
Pereira and Lima (1996)	DGF	1994	431	431	862
Machado and Mata (1998)	QP	1982 1994	- -	- -	4690 4974
Marques (1993)	IE	1990	2 322	-	2 322
Marques and Pereira (1995a,b)	IE	1990	2 322	-	2 322
Martins (1991)[a]	QP	1977	308	392	700
Martins (1996)	IE	1991	2 100	-	2 100
Psacharopoulos (1981)	QP	1977	8 756	39 454	42 347
Silva (1985)	QP	1983	85 445	202 988	288 433
São Pedro and Baptista (1992)[b]	QP and IAE DGAP	1988 1988	- -	- -	844 694 226 891
Vieira (1992)[c]	QP	1989	1 900	2 094	3 994
Vieira and Pereira (1993)[c]	QP	1989	1 900	2 094	3 994
Vieira et al. (1996)	QP	1982 1986 1992	- - -	- - -	57 737 55 175 54 307

Notes: [a] Uses mean values of individual observations.
[b] First row, private sector and second row, public administration.
[c] Data only for the Azores.
DGAP - Direcção Geral da Administração Pública; DGF - Direcção Geral da Família; IAE - Inquéritos Anuais às Empresas; IE - Inquéritos aos Dados do Emprego; QP - Quadros de pessoal.

CHAPTER 13

Returns to Human Capital in Spain: A Survey of the Evidence

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1 Introduction

The objective of this survey is to review the evidence for Spain of the effect of different forms of human capital on earnings. In the Spanish case, econometric work on this topic is fairly recent. The first published material appeared in the second half of the 1980s. A lack of adequate data sets is behind this gap with respect to other European countries. The availability of the Household Budget Surveys of 1980/81 and 1990/91 as well as other *ad hoc* data sets during the late 80s and 90s, explains that a considerable amount of work has been published during the last ten years.

A large part of the work done has focused on the analysis of pay differentials by gender and sector. A few papers have covered some other topics like ability, family background, sheepskin and screening effects, overeducation or the effect of unemployment on returns. Some papers have tried to track returns through time but, as we will see later, the data available allows doing this only in a partial way. Additionally, no work has been done to control for the existence of endogeneity of schooling. In spite of the availability of new survey data, the main reason for the lack of work on those topics is related to the limited nature of the information provided in these surveys.

The chapter is organised as follows. Data sets used in the literature are described in the second section. Next, a description is done of the different works, explaining the estimation procedures used. In the following section, an evaluation of the results is made in terms of the topics related to human capital returns. Finally in the last section, some conclusions are drawn in an attempt to obtain some stylised facts on the Spanish case.

2 Data sets

As was explained above, several data sets became available during the 80s and 90s. In what follows a description of each is done. The most widely used surveys are the *Household Budget Surveys* (Encuesta de Presupuestos Familiares, EPF). These surveys, available for 1980/81 and 1990/91[1], give data on family expenditure and income

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1 The period of elaboration of the survey spans from March to March of those years.

for a sample of about 20,000 households. The most detailed one is that of 1990/91 which provides data for all the members of the household on educational attainment (levels) and earnings (net annual earnings[2]) as well as on labour market status (employed/unemployed, industry, occupation, employee/self-employed). It has no information on working hours but states whether the individual worked more or less than thirteen hours during the period of reference. The 1980/81 survey provides earnings information for all the individuals but detailed information on individual characteristics (including educational attainment) and on labour market status is available only for the head of the household. This means that all the comparative work on returns between 1980/81 and 1990/91 is constrained to the sub-sample of heads of households.

Additionally, since 1985 a *Continuous Household Budget Survey* (Encuesta Continua de Presupuestos Familiares, ECPF) is undertaken on a quarterly basis and with a smaller sample size (3,000 households). This survey has a rotating panel structure in which one-eighth of the sample is rotated every quarter. It includes the same variables as EPF 90/91 but only for the heads of households. Nevertheless, it should be mentioned that the income data provided by the survey is the joint household income.[3]

Apart from these sources, some authors have used other surveys designed for *ad hoc* purposes. First, the *Living and Working Conditions Survey* (Encuesta de Condiciones de Vida y Trabajo, ECVT). This is a survey conducted in 1985 with a sample size of 60,000 individuals. It provides information on the educational attainment (both years and degrees), labour status and labour history of each individual. This survey was commissioned by the Ministry of Economy to obtain an estimate of the quantitative importance of informal employment. It also contains questions on the perceived skill requirements of the job. The wage definition of the survey is net monthly. However, it has the disadvantage that the wage data are given as intervals, not as a continuous variable. Therefore, studies using this data set take as wage observation the mid point of the interval.

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2 Net, in this case, refers to take home income, that is after income tax deductions and social security contributions. Hence, there are differences, in some cases large, between this net income and the after tax income.

3 This means that only those households in which the head is the only working member can be used as observations of the sample.

Secondly, the *Pilot Earnings Survey* (Encuesta Piloto de Ingresos, EPI). This is an earnings survey made up of a sub-sample of the Labour Force Survey (LFS) for the second quarter of 1990 (the Spanish LFS does not contain questions on earnings). It was intended as an experimental survey addressing additional earnings questions to 2,000 households out of the 60,000 household sample of the Spanish LFS, but had no continuity afterwards. The wage definition of the survey is gross monthly earnings.

Finally, the *Survey on Class Structure, Consciousness and Biography* (Encuesta de Estructura, Conciencia y Biografía de Clase, ECBC) is a survey conducted in 1991 and addressed to individuals with questions on labour market status, job characteristics, labour history and family background. The sample, 6,629 individuals, is not representative for the whole country because of the higher than proportional weight of the region of Madrid in the sample.[4] Moreover, individuals with secondary and higher education have a disproportionate representation in the sample. However, the survey includes a scheme of weighting factors to overcome the two problems.

3 Introduction to the research and estimation procedures

The studies reviewed cover different topics. They are ordered in terms of the main objective. Basically it is possible to distinguish among the following: returns to human capital across gender and sector and change over time, gender wage discrimination, and other topics which include ability and screening, and overeducation.

3.1 Returns to human capital by gender and sector

As different authors have used different data sets we first order the works in terms on the databases used. Afterwards, we describe the main objective of each paper as well as the estimation procedure.

Calvo (1988) use the EPF 1980/81 while San Segundo (1996), Las-

4 The regional government of Madrid commissioned the elaboration of this survey jointly with the Institute of Statistics and The Woman Institute.

sibille (1998) and Oliver et al. (1998) use data from EPF 1990/91. On the other hand, Andrés and García (1991) as well as Cañada (1993) obtain their data from ECVT, and Ullibarri (1996) and García et al. (1997) from ECBC. Finally, Cañada (1993) and Alba and San Segundo (1995) drew their samples from EPI.

Calvo (1988), Andrés and García (1991) and San Segundo (1996) run OLS regressions. Calvo (1988) estimates an equation for a sample of heads of households drawn from EPF 1980/81, including both employed and unemployed. A dummy to control for unemployment is included and agrarians self-employed were excluded from the sample. Andrés and García (1991) study different aspects in relation to the supply side of the Spanish labour market. One of the points they deal with is the possibility of a segmented wage determination process vs. human capital. They use an aggregation of six industries as segments to estimate Mincer equations by sector. San Segundo (1996) uses EPF 1990/91 to estimate earnings equations by gender and sector of employment (self-employment, public and private employment).

Cañada (1993), Alba and San Segundo (1995), Ullibarri (1996), García et al. (1997), Lassibille (1998), and Oliver et al. (1998) introduce some form of self-selection control. Cañada (1993) tests the effect of different types of variables like parental background, tenure, previous spells of unemployment, sector of employment and type of contract on the individual wage. Additionally, the selection bias due to the participation decision is controlled for. But once the decision is made to participate, a second decision is considered: the type of job conditions. This decision is modelled with an ordered probit where the explained variable is a categorical variable ordered according to the degree of employment informality. Alba and San Segundo (1995) estimate OLS models for different samples (self-employed, wage earners, private and public sector and by gender) with data coming from the 1990 EPI. As they contemplate the possibility of a non-random allocation of workers into employment status (self-employed vs. wage earners) and sector (public vs. private), self-selection bias is controlled for by using a two-stage Heckman procedure in the estimation of the corresponding earnings equations. Oliver et al. (1998) estimate a simple Mincerian equation including both employees and self-employed in the sample. Sample selection bias is controlled for. Afterwards, employment probabilities derived from a profit model are used to weight forecasted earnings from the Mincerian equation. A cost-benefit analysis is applied to those earnings to obtain the internal rate of return.

Finally, Ullibarri (1996), García et al. (1997) and Lassibille (1998) all focus on public/private wage differentials. They estimate earnings functions for public and private sector employees. But, previously, they control for the probability of being employed in one of the two sectors. The idea behind is that there may be correlation between unobserved characteristics that determine the choice of sector and those that determine the wage. If that is the case, OLS estimators are inconsistent. So, at a previous stage, a sector choice model is used to generate a correcting factor to be included in the wage equations. Ullibarri (1996) follows this procedure, estimating separate equations by sector and gender. The results are the basis for an analysis of wage differentials decomposition. Lassibille (1998) carries out a similar analysis. García et al. (1997) address the differential public/private from a different perspective. Two complementary hypotheses are tested. Firstly, the so-called "hypothesis of public wage compression" which states that public/private wage differentials tend to decrease as job skill requirements increase. A second hypothesis would suggest that wage differentials vary along the wage distribution. With respect to the first point, the result shows that differentials of expected wages are lower the higher the reported appropriate level of education for the job. For the second hypothesis, quantile regressions were run. The results of quantile regressions indicate that, firstly, public/private differentials for women are higher than for men along different points of the distribution and, secondly, public/private differentials tend to get reduced as estimations refer to higher deciles.

3.2 Change over time

In San Segundo (1997) the ECPFs for 1985, 1986, 1987, 1989, 1994 and 1995 are used to extend the temporal comparison of returns to education and other forms of human capital for a sample of male wage earners (heads of household). Lassibille and Navarro (1998), and Vila and Mora (1998) compare wage earner regressions by using 1980/81 and 1990/91 EPF data. Vila and Mora include both male and female sub-samples while Lassibille and Navarro only consider males.

3.3 Gender wage discrimination

De la Rica and Ugidos (1995), drawing data from ECBC, estimate factors that contribute to the explanation of the gender wage gap, with the focus on differences in human capital. The method is to estimate the wage function for men by OLS whereas for women they apply Heckman's two-step method in order to control for sample selection bias. They also apply a variant of the Oaxaca decomposition method. Salabarría and Ullibarri (1997), with ECBC data too, analyse the "feminisation" effect (% of female employment in a type of job) on wages, considering feminisation as an endogenous variable. The authors estimate a multinomial logit model in order to control for the endogeneity of the feminisation variable, taking into account five groups of occupations depending on the female employment percentage (group 1 has less than 20% and group 5 with more than 80%). The probability for each individual to choose each one of the five groups according to his/her characteristics is calculated, and then, a certain level of feminisation is assigned to each individual. Estimation is carried out by OLS and by Heckman's method.

3.4 Other topics

Lassibille (1994), using EPF 1980/81, makes an empirical confrontation of human capital and signalling theories through the analysis of income generation for both employees and self-employed. The idea is to compare workers who need to be filtered by the educational system (employees) with those who do not (own employed). Some more work has been done recently about screening and ability. Corugedo (1998), with a sample of economists from the region of Madrid, obtains evidence of the mixed character of wage formation, explained both by the human capital and the signalling approach. Blanco and Pons (1998)[5] use an approach in which ability is introduced to test for the existence of signalling. They depart from the assumption that there should not be territorial differences in ability but also from the fact that there are territorial differences in average levels of education. So, those individuals with an education above their own regional average should reflect a higher innate abil-

[5] Blanco and Pons (1998) and Pons (1998) draw their data from ECBC.

ity. Pons (1998) used a different approach to measure ability. She uses the information provided by ECBC on the capacity of understanding the questions of the survey by controlling education. By running a regression which explains that capacity in terms of education level, Pons assumes that the residuals obtained in that regression approach a measure of ability for each individual.

Finally, according to the occupational mobility theory, Alba (1993), with ECVT data, explains the job match by comparing attained education and education job-requirements as reported by workers, to ascertain the effect of the job match on the return to education and determine the existence of over/undereducation for the Spanish case. The estimation method consists of, first, a multinomial logit model to classify workers; second, estimation of wage equations and calculation of the return to schooling of adequately educated, overeducated, and undereducated workers.

4 Estimation results

The main results that are reviewed below have problems that limit the scope of the following analysis. One difficulty arises because of different wage definitions. Normally, the dependent variable in the studies that use EPF or ECPF is net annual wages, but ECVT and EPI include net/gross monthly wages and only those studies that are based on ECBC can use hourly wages. On the other hand, only few of the reviewed studies include the actual number of years of education as an explanatory variable and most of them construct the variable applying the number of years attached to the completion of each degree. In those cases, comparability is not easy because legal changes in the Spanish educational system in the last twenty years generate a different aggregation for each basic level (primary, lower secondary, upper secondary and university studies). In fact, only ECVT and ECBC are the data sets where a question on the number of years of education is made. Also, other forms of human capital like experience are not measured exactly in the same way. Normally, in most studies work experience is measured as potential but those using ECBC and ECVT can approximate actual experience. These papers, along with Cañada's (1993), who uses an EPI sample, consider also tenure. Finally, other differences could arise from the inclusion of variables like those related to family situation and geographical environment.

4.1 Returns to education by years

Table 1 shows the results of the studies using years of education. Despite the differences of databases, estimation procedures, number of

Table 1. Returns to education (years): coefficients (multiplied by 100)

STUDY	DATA SET	WAGE DEF.	SECTOR	RETURN Female	Male	All
Alba (1993)	ECVT (1985)	Monthly net	Pub & Priv			4.2
Andrés & García (1991)[4]	ECVT (1985)	Monthly net	Pub & Priv	10.2	6.5	7.8
Cañada (1993)[2]	ECVT (1985)	Monthly net	Pub & Priv	5.4	4.0	
San Segundo (1996)	E.P.F. 1990/91	Annual net	Public	9.9	6.9	
			Private	10.1	8.5	
Vila & Mora (1998)[1]	E.P.F. 1990/91	Annual net	Pub & Priv	6.7	5.2	5.3
			Public	6.1	4.6	4.8
			Private	5.2	5.2	5.2
Lassibille (1998)[2]	E.P.F. 1990/91	Annual net	Public	7.0	4.5	
			Private	11.8	9.3	
Cañada (1993)	E.P.I. (1990)	Monthly gross	Pub & Priv			5.3
Alba & San Segundo (1995)[4]	E.P.I. (1990)	Monthly gross	Pub & Priv	9.8	7.3	8.1
			Public	7.5	6.1	6.6 (6.3)[2]
			Private	8.0	6.4	6.9
Pons (1998)	E.C.B.C (1991)	Hourly net	Pub & Priv			5.3
			Public			6.3 (4.1)[3]
			Private			4.3 (3.2)[3]
Blanco & Pons (1998)[2]	E.C.B.C. (1991)	Hourly net	Pub & Priv	4.2	5.5	4.9

Notes: [1] Only heads of households and partners.
[2] Controls for self-selection (two-step Heckman).
[3] Within brackets results when using a switching model.
[4] Only a simple Mincerian specification (no additional variables).

additional variables and wage definitions, the results seem to reflect some consistency and some regular patterns. Four facts can be highlighted. Firstly, the range of results for the complete samples is not wide, taken into account the above mentioned differences. That is, the range goes from a minimum value of 4.2% in 1985 for a monthly net wage to 8.1% in 1990 for a monthly gross. In spite of this apparent upward trend, most results, as can be seen from the table, fall within a very similar range, around 5–7%. Secondly, the range of results for women is wider than for men in most of cases, with some exceptions. For women, the lower rate is 4.2% (1991, hourly net wage) and the higher one is 10.2% (monthly net wage in 1985). On the other hand, the range for men goes from 4.0% (monthly net wage in 1985) to 7.3% (monthly gross in 1990). Thirdly, in all cases, except in one, the rates of return to education for women are higher than for men. Fourthly, in general the rates of return for the public sector are lower than for the private sector. Finally, when both sector and gender are taken into account the results show that the above patterns do not change.

4.2 Returns to education by levels

It is difficult to compare outputs from the different studies given that these differ in terms of the degree of aggregation used. Tables 2 and 3 show results from studies using different data sets. The criteria used when choosing these studies was to take from each data set that study which uses the most disaggregated scheme of levels. In general terms, it is possible to see that higher levels of education lead to higher returns. The only exception is the case of pre-university, which indicates a lower return than upper secondary in the public sector and for males. In most the cases, like in the case of years of education, female returns are higher than male retuns, and private returns are higher than public returns. An exception is Ullibarri (1996), where in most cases private returns are lower than public returns (the work of Ullibarri is the only one that uses hourly wages).

From Figures 1 to 5, which are from San Segundo (1996), it is possible also to see that, in general terms, we can keep as a first approximation the assumption of linearity. The most striking fact can be seen in Figures 3 and 4, where we compare males and females by sector. In the case of females, and contrary to males, there is a crossing in the profiles when attaining University long cycle level, showing that the public sector is clearly more rewarding than the private sector for higher educated women. This result can explain, at least in part, the strong growth of female higher education demand in Spain in the last twenty years.

Table 2. Returns to levels of education (% premium compared to compulsory level), 1990/91

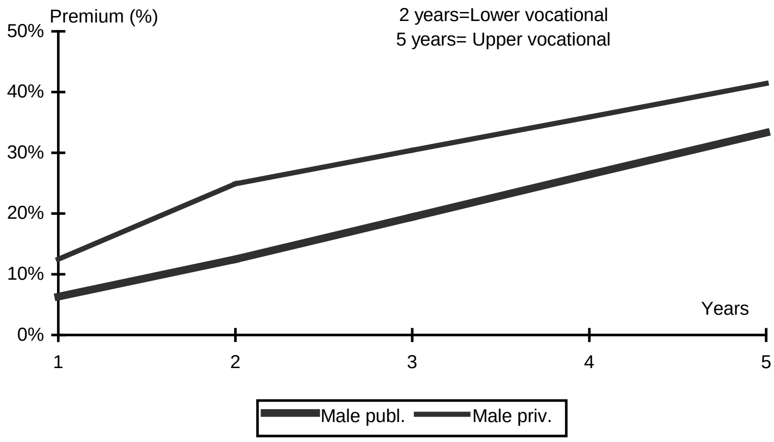
	Public		Private	
	Male	Female	Male	Female
San Segundo (1996), EPF 1990/91:				
Lower vocational	12.5	11.2	24.9	27.8
Upper secondary	27.1	28.8	31.8	35.8
Pre-University	26.3	35.3	34.5	46.1
Upper vocational	33.3	35.0	41.4	47.3
University (short cycle)	53.4	71.9	66.2	71.9
University (long cycle)	71.4	89.0	81.4	80.7
Ullibarri (1996), ECBC (1991):				
Vocational	21.41	30.18	10.68	16.43
Upper sec.+Pre-univ.	33.14	43.19	33.17	15.54
University (short cycle)	50.82	56.08	37.33	28.94
University (long cycle)	87.09	85.11	75.95	49.43

Table 3. Returns to levels of education (% premium compared to compulsory level)

	Male[1]	**Female**[1]	**Male+Female**[2]
Vocational	9.5	5.7	3.1
Upper secondary	11.5	18.7	38.3
Univ. (short. cycle)	27.3	38.9	51.1
Univ. (long cycle)	34.3	50.4	63.2

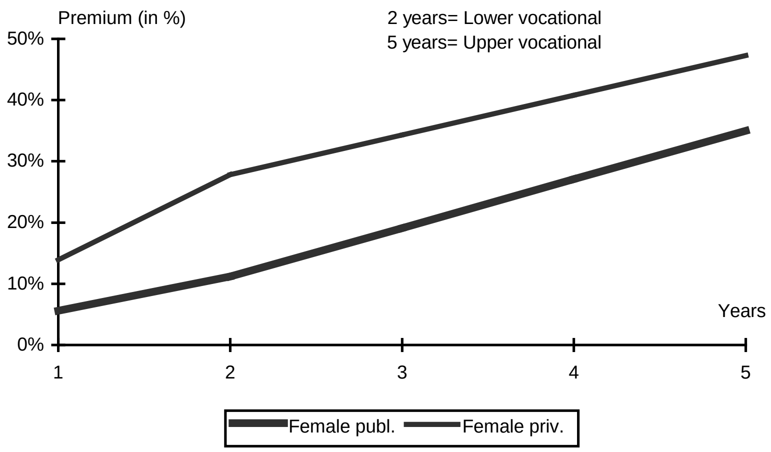
Notes: [1] Cañada (1993) (data ECVT, 1985). [2] Cañada (1993) (data EPI, 1990).

Figure 1. Returns to levels of education (% premium compared to compulsory level). Vocational path, males, 1990/91



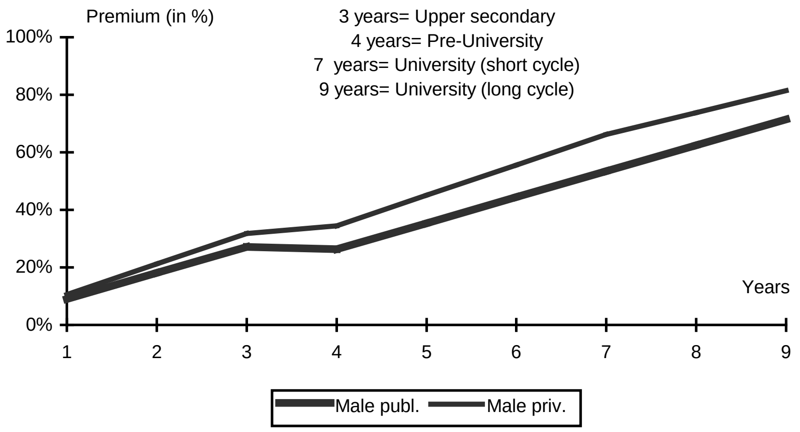
Source: San Segundo (1996), EPF 1990/91

Figure 2. Returns to levels of education (% premium compared to compulsory level). Vocational path, females, 1990/91



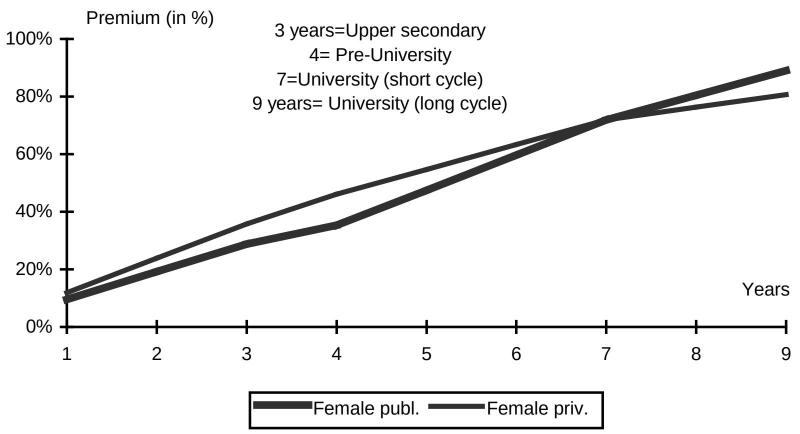
Source: San Segundo (1996), EPF 1990/91

Figure 3. Returns to levels of education (% premium compared to compulsory level). General path, males, 1990/91



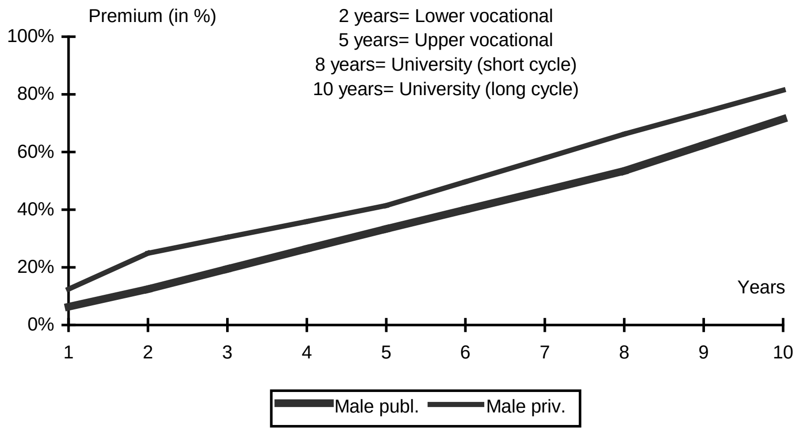
Source: San Segundo (1996), EPF 1990/91

Figure 4. Returns to levels of education (% premium compared to compulsory level). General path, females, 1990/91



Source: San Segundo (1996), EPF 1990/91

Figure 5. Returns to levels of education (% premium compared to compulsory level). Vocational and University, males, 1990/91



Source: San Segundo (1996), EPF 1990/91

All studies comparing 1981 with 1991 (San Segundo (1996, 1997), Vila and Mora (1998), see Tables 4 and 5 below) tend to remark an increase in the returns of upper vocational and short cycle university diplomas. Both are reflecting degrees with easier access to the labour market given that both tend to be designed with a professional profile. Nevertheless, Lassibille and Navarro (1998) find a decrease in returns, except for short cycle university degrees.

Table 4. Returns to levels of education. % premium of University (long cycle) with respect to compulsory and University short cycle

	Univ. L.C. vs. compulsory	Univ. L.C. vs. Univ. S.C.
1981	57.00	20.20
1985	66.70	16.80
1986	60.80	21.30
1987	61.10	20.00
1989	87.40	44.10
1991	73.80	20.50
1994	66.10	16.80
1995	60.00	13.60

Source: San Segundo (1997), EPF 1980/81, EPF 1990/91 and ECPF (1985-1995)

Table 5. Returns to levels of education (% premium with respect to compulsory)

	Male 81	Female 81	Male 91	Female 91
Vocational	8.3		20.42	11.04
Upper Sec.	17.48	18.21	24.52	24.62
Univ.(short cycle)	31.04	24.7	47.33	49.35
Univ.(long cycle)	49.39	35.71	64.4	71.28

Source: Vila and Mora (1998), EPF 1980/81 and EPF 1990/91

4.3 Returns to experience

Table 6 shows those studies that run equations separately by sector and gender. The general pattern seems to reflect higher returns for men than for women and also higher returns in the private sector than in the public sector. Possibly, this pattern reflects the different pay schemes of the two sectors, with public sector wages which are regulated by rigid pay scales and seniority based promotion patterns.

Table 6. Returns to experience. Coefficients * 100 for the first year of experience

	Men		Women	
	Private	Public	Private	Public
Alba & San Segundo (1995), 1990	4.8	4.0	3.7	1.8
Garcia et al. (1997), 1991	2.3	4.9	2.4	3.7
Ullibarri (1996), 1991	2.2	2.5	1.8	0.6
Lassibille & Navarro				

(1998), 1990/91	5.5	2.8	6.2	4.0
San Segundo (1996), 1990/91	7.6	5.4	5.3	3.9

4.4 Others topics

With respect to signalling, the work done so far is not very conclusive, as happens in most cases. In general terms, we should accept that some degree of signalling exists (Pons, 1998; Blanco and Pons, 1998) and probably it takes place during the process of education, which acts as a first filter for employers. Afterwards, accumulation of human capital from experience and, maybe, continuous training, explains the returns of human capital. Thus, the weak hypothesis of screening seems to be confirmed by the Spanish evidence.

Alba (1993) addresses the problem of overeducation by using ECVT, where workers are asked about the required education for the job they hold. He finds a trade-off between education, experience and on-the-job training. Overeducated workers seem to have less experience, lower on-the-job training, and higher turnover than other comparable workers. Additionally, his evidence on occupational mobility shows a trend towards improved job match. That is, male, more educated as well as more experienced workers have a higher probability of becoming adequately educated in the new job but this has a non-linear effect with firm changes and experience. Thus, Alba concludes that overeducation is a short-term problem. However, other studies not using wage data (García and Malo, 1996) have found evidence of over/undereducation as a rather permanent phenomenon in the Spanish labour market in finding lower turnover among overeducated workers.

5 Conclusions

The literature on wage functions has basically focused on the analysis of returns within a framework of OLS regressions. No work has been done trying to instrument education and control for bias except for self-selection in the case of women and sector choice. Few studies have introduced ability or family background effects, partly because the limitations of the available data sets. No work has taken employer's characteristics into account.

From the reviewed literature the conclusions can be ordered into the following items: returns to education by years, returns to education by levels, other forms of human capital and, finally, other topics. Returns to education by years for the whole sample of wage earners seem to range around 5% to 7%, taken into account the disparity of data sets, samples, additional variables and wage definitions. In temporal terms, the results for the longest samples, with the same specification, show a scarce variability in the rate of return of education. The analysis by gender and sector tends to show a general pattern of higher returns for women than for men and also for the private sector as compared to the public sector.

The estimations using levels of education obtain results for the rate of return that tend to show linearity, keeping the same patterns by sector and gender. Nevertheless, it must be stressed that, in the case of women, a certain concavity appears at the highest levels of education in the private sector. When a temporal comparison is made most of the analysed work shows a pattern of widerning differentials between the compulsory and the highest level. Nonetheless, this widening is compatible with a reduction of differences between the lowest and also between the highest levels of education. That is, the premium between compulsory and upper secondary has tended to decrease, and so has also the difference between University short and long cycle.

With respect to experience the observed behaviour mirrors that of returns by sector and gender. A clear pattern appears with a higher return to experience in the male case and also in the private sector. This result must be interpreted with caution because experience is measured only in terms of potential experience which, in the case of women, may not be as good an approach as in the case of men.

Finally, the work done in signalling and sheepskin tends to show that the human capital approach can explain a large part of the variation of wages with education. Nevertheless, signalling cannot be rejected. In conclusion, the Spanish evidence suggests that both the human capital and the signalling approach must be taken into account when explaining wage determination. Nonetheless, we should keep in mind the intrinsic difficulties in this kind of testing.

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CHAPTER 14

Returns to Human Capital in Sweden

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1 Introduction[1]

The purpose of this chapter is to highlight the economic incentives for investments in human capital in Sweden. It reviews the current state of the literature concerning returns to education, work experience and seniority. Our interest in this topic is motivated by our belief in the importance of human capital for growth and employment. The role of human capital and the importance of maintaining high educational standards have received a great deal of attention in the public debate. The endogenous growth literature has stressed the importance of human capital for growth and the empirical research on the determinants of growth offers results indicating that economic growth is positively correlated with education across countries.[2]

Investment in human capital depends on many factors. Social background, for example, seems to have a substantial influence on an individual's choice of schooling.[3] This can be seen as evidence for individuals' educational levels being highly correlated with their parents' educational levels. Standard human capital theory[4] states that an individual's choice of education is determined mainly by the costs of and returns to education. From this perspective, the positive impact that social background has on educational attainment, can be interpreted as indicating that individuals with highly educated parents might have lower costs of education and, therefore, invest more in education.

When considering the economic incentives for investment in human capital, the main components highlighted in the literature are: direct returns to schooling in terms of higher future earnings, fringe benefits, more agreeable working conditions, decreased risk of unemployment, and financial costs associated with education, which include opportunity costs in terms of foregone wages.

If we examine earnings differentials associated with different educational levels, we find that Sweden is among the countries with the lowest returns to education. On the other hand, the direct financial costs associated with schooling are very low. It is easy in Sweden to

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1 We wish to thank Anders Björklund, Matthew Lindquist and Carl le Grand for helpful comments and discussions.

2 See Barro and Salai-Martin (1995), Krueger and Lindahl (1999).

3 Ericsson and Jonsson (1993, 1998).

4 See Becker (1962).

obtain substantial loans for financing higher studies and almost all studies are free from tuition. Returns to work experience and firm-specific human capital measured as seniority are also low in Sweden.

One must keep in mind that Sweden is characterised by small wage differentials along a number of other dimensions as well, such as the male-female wage gap and inter-industry wage differentials. A number of studies report results that wage differentials were compressed during the seventies along almost all dimensions in Sweden. Roughly speaking, the wage differentials with respect to schooling, work experience, firm seniority, gender and industry affiliation were reduced by one-half during the seventies. These changes can be attributed to egalitarian wage policies practised after the sixties. Wage differentials have increased somewhat since the mid-eighties.

An important question is to what extent these changes are compatible with changes in the supply of and the demand for education. One hypothesis is that the fall in the returns to higher education can be explained by an increased supply of individuals with higher education.[5] The decrease in returns is clearly pronounced for the period 1968–1974, while undergoing only minor changes after 1974. A corresponding change in the relative supply of labour with university education cannot be observed, though. The increase in the relative supply of individuals with higher education is smooth and reflects a general trend of increased education as in many other industrialised countries. It is not only the supply of labour with higher education that increased during this period, however. The demand for skilled labour also increased rapidly. The growth in the public sector was mainly dominated by growth in occupations which require post-high school education. Another major change in the Swedish labour market was the increased female labour supply promoted by an expansion in publicly provided child-care.

The sharp fall in wage dispersion during 1968–1974 is compatible with the view that the narrowing wage differentials in Sweden are primarily generated by the institutions of wage setting. The increased supply of education opportunities, resulting from expansion and decentralisation of the university system, in combination with generous subsidised loans to students during the sixties is another part of the overall institutional change in the Swedish society. The fall in returns

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5 Edin and Holmlund (1995) investigate this question.

to schooling in Sweden is possibly partly due to the lower quality of education in times of great expansion in the educational institutions. The recent development in Sweden in terms of a sharp increase in unemployment is accompanied with a pronounced increase in student enrolment and, consequently, a higher supply of individuals with higher education. Our impression is that more studies are needed to explain the pattern of changes in the returns to schooling in Sweden.

Here we report existing results on returns to human capital and also summarise the findings on the variation in these returns over time and across groups of workers and sectors of activity. Previous studies examine returns to human capital for different groups and sectors, as well as the sensitivity of these results with respect to measurement error in the education variable, omitted variable bias and heterogeneity in ability. Very little research is available on the variation in returns to schooling with respect to different types of education. Education of various types – technical, humanities, social sciences – as well as various types of training most probably have different impacts on economic activity and also systematically face different demands.

The remainder of the chapter is organised as follows. Section 2 presents the main data sources used in most of the studies reviewed here. Sections 3, 4 and 5 deal in turn with returns to education, work experience and seniority. Section 6 concludes.

2 Data sources

The two most widely used data sets in the studies reviewed here are the *Swedish Level of Living Surveys* (LNU) from 1968, 1974, 1981 and 1991, and the *Household Market and Non-market Activities Surveys* (HUS) from 1984, 1986, 1988, 1991, 1993 and 1996. The data consist mainly of information from interviews, but also of information from different registers that is matched with these samples. Both surveys have a panel design. The panel from LNU is not age-representative due to the long time period between the waves. Using two or more waves implies that the youngest and oldest cohorts are not covered. In addition, some other data sets have been used to examine various specific issues. A short description of the main micro-data sets used in previous studies is presented in the Appendix.

3 Returns to education

3.1 General results

The relationship between earnings and schooling can be measured in different ways. In the reviewed studies, this relation is measured as the wage premium of a specific education or educational level, and as the return to an additional year of schooling. A third measure of returns to schooling is the internal rate of return. The internal rate of return is the discount rate that equalises the present value of life-time earnings associated with two different educational levels.

We start with results from the studies that focus on the return to an additional year of schooling. Thereafter, we present the empirical findings of the wage premiums for various levels of schooling in Sweden. Results from previous studies are summarised in Table 1.

Björklund (1986) reports results from estimations of a wage equation including a gender dummy, years of schooling, years of work experience and work experience squared as well as age and age squared. The estimated returns to schooling fall from around 8 per cent in 1968 to around 4 per cent for the period after 1974. Running separate regressions for men and women, le Grand (1994) reports a decline in

Table 1. Return to schooling (log-%)

		TOTAL			PRIVATE			PUBLIC		
	Year	Total	Men	Women	Total	Men	Women	Total	Men	Women
Asplund et al. (1996)	1991		4.9	4.3		6.0	5.4		4.9	3.9
Björklund (1986)	1968	7.8								
	1974	4.3								
	1981	3.5								
	1984	3.9								
Blau & Kahn (1995)	1980		4.3	4.3						
Le Grand (1994)	1968		8.9	8.7	7.8			8.4		
	1974		5.3	5.5	5.1			5.5		
	1981		5.1	4.1	5.1			4.3		
	1991		5.0	4.0	5.5			4.2		

the return to schooling from 8.9 (8.7) per cent[6] for men (women) in 1968 to 5.0 (4.0) per cent in 1991, with the main fall in the early 1970s. This means that the decline in returns to education has been larger for women than for men, but the gender gap in returns to schooling is significant only for 1981 and 1991. Asplund et al. (1996) use post-compulsory schooling instead of total years of schooling and report somewhat lower figures for 1991 (4.9 and 4.3 per cent, respectively).[7] Blau and Kahn (1995) also present the estimated return to an additional year in post-compulsory schooling in 1980, but they do not find any gender differences. The return to an additional year is 4.3 per cent for both males and females.

The differences in the estimated returns to education over time and across gender may partly be due to differences in the return to schooling across sectors. The proportion of women (men) in the public sector has increased from 46 (22) per cent in 1968 to 61 (31) per cent in 1981.[8] Both le Grand (1994) and Asplund et al. (1996) report estimated returns to schooling by sector.[9] Whereas Asplund et al. present estimates by gender and sector, le Grand reports returns by sector with a dummy for gender. Le Grand (1994) finds that the returns to education in the private sector are significantly higher than in the public sector in 1981 (5.1 versus 4.3 per cent) and 1991 (5.5 versus 4.2 per cent). For the years 1968 and 1974, the returns to education are insignificantly higher in the public sector. Asplund et al. (1996) also show that the gender differential in returns to schooling in 1991 is larger in the public sector than in the private sector. The return to schooling in the public (private) sector is 3.9 (5.4) per cent for women and 4.9 (6.0) per cent for men.

The human capital variables explain better the variation in the logarithm of hourly wages in 1968 than in the following years. Furthermore, the human capital variables explain better the variation in log hourly wages in the public sector than in the private sector in 1968. The adjusted R-square is as large as 0.51 in the public sector compared to 0.39 in the private sector. The differences for the other years

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6 The returns are expressed in log percentages.
7 Asplund et al. (1996) show that the returns to schooling are more or less the same for Denmark and Norway, but much higher in Finland. The gender gap, however, is largest in Denmark.
8 See le Grand (1994).
9 See also Zetterberg (1988).

are much smaller, but still in the public sectors' favour. That the highest R-square is found for 1968 and for the public sector might reflect the decreasing importance of administrative criteria based on individual education, experience and seniority in the public sector after 1968.

Regarding the variation in returns to education across sectors, there are a couple of studies that investigate the variation in returns to schooling across employer size classes and industries. Albæk et al. (1998) report for Sweden that there are no significant differences in returns to education across different employer sizes, and allowing for different returns to education across various size groups leaves the size effects basically unchanged. Arai and Skalli (1996) estimate a standard Mincer equation where the schooling variable is interacted with industry dummies. Their results imply that the rate of return to education is systematically correlated with industry affiliation, and that the gender gap varies largely across industries. The lowest return to schooling is 3.4 per cent in the wood and wood product industry and the highest is 6.1 per cent in insurance followed by financial institutions with a rate of 5.5 per cent. These industry differentials in returns are similar to those observed for France, although the French estimates are somewhat higher. The gender wage gap varies significantly and largely across Swedish industries. It is as high as 30 per cent in the metal industry and as low as 8 per cent in real estate. These variations most likely reflect the occupational segregation and the fact that the female–male wage gap is to a large extent a result of between occupation differentials.[10]

These results are based on the relatively small sample of LNU, which sets limits for the flexibility of the estimated models. The cross-sector variations in returns to schooling nevertheless indicate some degree of heterogeneity in schooling. There might exist heterogeneity both with respect to type – technical, humanities, social sciences etc. (horizontal heterogeneity) – and/or returns to years of schooling at different educational levels (vertical heterogeneity). There is very little done with respect to horizontal heterogeneity. Wadensjö (1991) compares earnings for workers with technical, medical and social sciences background. He reports that annual earnings systematically vary

[10] For analysis of the gender wage-gap, see e.g. Jonung (1984), le Grand (1991), Edin (1992), Löfström (1992), Zetterberg (1994), Meyerson et al. (1996), Arai and Thoursie (1997), Persson and Wadensjö (1997), Edin and Richardsson (1997), Richardsson (1997) and Thoursie (1998).

across these groups as well as across universities where the education is attained.[11]

Considering vertical heterogeneity, there are a number of studies that allow for more flexible functional forms. The earnings function that relates the log of earnings to years of schooling, years of work experience and experience squared presumes that one additional year of schooling leads to the same returns at all levels of education. Non-linearities in the years of schooling have been the focus of several studies. Edin and Holmlund (1995) use a dummy variable for each year of schooling above nine years to capture shifts in the return to schooling. They report results indicating that those with 15 years of education in 1968 had 67 per cent higher wages compared to those with 9 years of education. In 1981 the difference had declined to 27 per cent, and increased to 35 per cent in 1991.

Palme and Wright (1998) show that the decline in the return to schooling between 1968 and 1981 is mainly concentrated to college education. The wage premium for high school relative to compulsory schooling reported by Palme and Wright is for men (women) 21 (22) per cent in 1968 and 13 (9) per cent in 1991. The premium for university education relative to compulsory schooling is about 150 (161) per cent for men (women) in 1968, whereas the premium in 1991 is 47 (44) per cent.[12] Björklund and Kjellström (1999) show that the standard Mincer equation predicts a fall in the internal rates of return for men from 8.6 in 1968 to 4.5 per cent in 1991 for all types of education. A more flexible functional form in schooling predicts a fall from 4.6 to 4.4 per cent for high school and from 13.8 to 5.5 per cent for college education.

3.2 Problems with interpreting returns to schooling

There is an extensive debate in the schooling literature about the failure to control for ability and measurement error in the schooling variable. The general opinion is that the schooling coefficient is biased

[11] See also Hemström (1995).

[12] These estimates are corrected for sample selection bias, which does not change the results substantially. Moreover, in contrast to Björklund and Kjellström who allow for a more flexible functional form in schooling, Palme and Wright also experiment with the functional form in experience. But estimating quadratic wage functions and splines gives approximately the same results as before.

upwards due to omitted variables (ability). But the situation is more complicated if schooling is measured with error. Then the coefficient on schooling would be biased towards zero. So the total effect of omitted variables and measurement error in schooling on earnings is uncertain. Kazamaki-Ottersten et al. (1996) find that the measurement error in the schooling variable leads to greater bias as compared to omitted ability. Accounting for measurement error results in an increase in the estimated return to schooling; from 3.7 to 4.1 per cent in 1984. Isacsson (1999) shows that the measurement-error-adjusted estimate of returns to education in a sample of MZ twins is slightly biased upwards, due to omitted variables on ability. He also demonstrates that the conclusion about a potential ability bias in conventional estimates of returns to education depends crucially on the magnitude of the reliability ratio. Isacsson presents an estimate of the reliability ratio of approximately 0.88 in his sample. At that reliability ratio, the ordinary least squares estimate is 4.6 per cent, whereas the within-pair estimate of returns to education is 4.2 per cent.

Two complications arise when interpreting results from twin data. First, we cannot be sure that the estimates correspond to effects representative for the global population. The empirical findings in Isacsson, however, show that the sample of twins seems to be representative, and he cannot reject the assumption of equal within-pair abilities. Second, variations in the twin data stem from different educational attainment within twins. This, however, begs the question, why "identical" individuals, as assumed in these studies, obtain different education. This leaves room for differences in preferences across twins. Allowing for heterogeneity in preferences complicates the estimation of returns to schooling. We usually do not have good measures for controlling this heterogeneity.

Another approach is to use direct indicators of ability. Kjellström (1999a) reports that the estimated wage premiums for schooling fall considerably when ability is controlled for. For example, including scores from three intelligence tests in the earnings function reduces the coefficient on imputed schooling from 0.049 to 0.043 for those born in 1948 and from 0.044 to 0.039 for those born in 1953. So the decline in the return to schooling is about 16 per cent for the 1948 cohort and 13 per cent for the 1953 cohort. He also shows that the magnitude of the ability bias becomes only somewhat lower when also accounting for measurement error in the schooling variable. The measurement-error-adjusted ability bias is only somewhat lower than previous research. The omitted ability bias is 13 and 10 per cent, respectively. Similar results are reported in Eriksson and Jonsson (1998), but they use grade point averages as an indicator of ability.

Palme and Meghir (1999) obtain basically similar results as those reported in Kjellström (1999a) when using the Swedish 1950-education reform (extension of the compulsory school from 7 to 9 years) as an instrument for educational choice. Their results imply that the point estimates increase when using explicit measures of ability as compared to using the school reform as an instrument.

Belzil and Hansen (1997), using another technique, report that controlling for ability and endogeneity bias leads to a higher rate of return. They estimate an optimal stopping model of the decision between continuing schooling and entering the labour market using a cross-section of Swedish labour force participants. Their model incorporates unobserved ability both at school and in the labour market. The estimates of returns to schooling for workers aged between 36 and 45 are around 4.9 per cent for males and 3.8 per cent for females. Corresponding ordinary least squares estimates are 3.5 per cent for males and 3.6 per cent for females.[13]

Björklund and Kjellström (1994) examine how sensitive the estimates on returns to education are for different measures of wages. In addition to hourly wages, they also use annual earnings before and after taxes, with and without self-employed individuals. The main finding is that returns to education depend strongly on which measure of earnings is being used. For instance, the estimate on returns to education for men in 1968 is 8.5 per cent when using hourly wages, whereas it amounts to 9.0 per cent and 7.2 per cent when using annual earnings before and after taxes, respectively. The estimate is somewhat higher when self-employed individuals are included.

Some studies investigate the internal rate of return. Björklund and Kjellström (1994), Edin et al. (1993), and Edin and Holmlund (1995) show that accounting for taxes and subsidised loans has a substantial effect on the calculations of the private internal rate of return to university education. For example, Edin and Holmlund (1995) find that the internal rate of return to university education is 7 per cent in the absence of taxes, stipends, and loans, and over 11 per cent when one

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[13] However, the unstable reported empirical findings suggest that the estimates are very sensitive to model specification.

accounts for this. The internal rates reported in Björklund and Kjellström are lower, but due to the design of the student aid system, the calculated internal rate of return to education is quite sensitive to different assumptions about inflation, wage growth and interest rates.

Another aspect, which is important in interpreting the evaluation of returns to human capital, is the existence of rents in the labour market. If education attainment is correlated with variables such as industry affiliation, profits and capital intensity, it is not easy to separate the effects of rents associated with employer characteristics and returns to schooling. Arai (1994a) reports that industry wage premiums are strongly correlated with the average level of education within industries. Arai and Skalli (1996) find that inter-industry differentials turn insignificant when controlling for variation in returns to education across industries.[14] They offer two explanations. One interpretation for this result is that it indicates heterogeneity of education and thus differentiated returns to various types of education. Another explanation is that industry wage premiums are not evenly distributed across workers and that workers with higher education capture a higher share of these premiums compared with those with lower education. Arai (1999) reports that wages are correlated with the firms' profit level and capital-labour ratio. The correlation with profit drops to a half but remains significant when controls for human capital are introduced. This indicates a high correlation of human capital variables and profits.

Moreover, working conditions, fringe benefits and job characteristics are important components of jobs associated with different types of education. Individuals with the same educational level might be assigned to jobs that vary both in pay and job characteristics, according to tastes and technology. This means that job characteristics might have different impacts on wages in different sectors of the economy.[15]

To sum up, previous studies indicate that the various sensitivity results do not modify the general picture obtained from the OLS esti-

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[14] For studies of inter-industry differentials see Edin and Zetterberg (1992) and Arai (1994a).

[15] Arai (1994b) reports results indicating that workers who are able to set their work pace and working time (autonomous) have significantly higher wages in the private sector while these workers earn significantly lower wages in the public sector.

mates. An important finding is that returns to education fell sharply during 1968–1974 to persist at this level afterwards.

3.3 Explaining the fall in returns to schooling

The fall in the returns to schooling has been interpreted as the result of the egalitarian wage policy. The overall wage differentials fell sharply from 1968 to 1974 and decreased slightly from 1974 to 1981 to increase slightly up to 1991. The changes in returns to schooling are similar to the changes in the overall wage structure.

Edin and Holmlund (1995) investigate whether this fall can be explained by an increase in the supply of skilled labour. They relate the estimated premium of university education based on seven cross-sections from 1968 to 1993 to the fraction of the labour force with university education during the period 1971–1993. They impute data for 1968 assuming the same development between 1968–1971 as in 1971–1974. They also use another data, i.e. university premiums for university education for white-collar men in manufacturing, mining and construction. This series displays a slightly different overall pattern. The fall in the beginning of the period is less sharp as compared with the corresponding change according to estimations from the LNU data. The rise in the university premium is steeper at the end of the period as compared to estimations based on the HUS data. The negative correlation between the university premium series and the fraction of university educated labour is interpreted as an indication that the fall in the wage premium during this period is compatible with an increased supply of labour with university education.

The major fall is during the period 1968–1974 and the changes after this period are not well pronounced. The corresponding change in the fraction of labour with university education is characterised by an increase in the entire period. The negative correlation reported by Edin and Holmlund (1995) seems to be critically dependent on the inclusion of the beginning of the period, i.e. 1968–1974. Another important aspect is that the increase in supply does imply a fall in university wage premiums only when the demand for labour with university education changes less. There are, however, indications that the demand for post-high school education has increased in the Swedish economy. The expansion of the public sector, schools, health care and public administration are examples of sectors that have recruited labour with university education.

Edin and Holmlund (1995) as well as Fredriksson (1997) examine the relation between the university wage premium and student enrolment. In both cases, student enrolment is related to the university wage premium for white-collar men in manufacturing, mining and construction. They report that the changes in student enrolment are in line with the changes in the wage premiums. Three basic questions arise when trying to interpret these results. First, student enrolment must be related to the expected university premium rather than the actual premium given the wage structure. Second, the estimates for the university premium are taken from a non-representative sample. The university premium used in these studies does not differ much from results based on representative micro-data in the beginning of the period 1968–1985. The sharp rise in the university premium for the period 1987–1991 for white-collar men in manufacturing, mining and construction is not compatible with results from micro-data, however. The university premium in 1991 had reached the same level as in 1971 in this restricted sample. Results from LNU imply that the university premium in 1991 was at the same level as in 1974, implying no significant increase in the university premium from 1974 to 1991. Third, student enrolment corresponds to education of all types, while the university premium from mining, manufacturing and construction mainly applies to studies in engineering and business administration.

The increased supply of education opportunities through expansion of universities and schools as well as generous subsidised loans to students during the sixties is another part of the overall institutional change in the Swedish society characterised by a growing public sector and expanding welfare state. During the 1960s the traditional universities soon reached their capacity limits, and in 1977 the government decided that admission to higher education should be based on high school grade-points averages and on work experience. So, more persons compete for every educational slot, which means that the demand for higher education is not necessarily affected by the return to schooling in the short run.

Further research is needed to explain the changes in the return to education in Sweden. The developments in the nineties characterised by high unemployment, sharp increase in student enrolment and, consequently, increased supply of skilled labour along with increased demand for this type of labour are important changes in demand and supply that influence the wage structure and the returns to education.

4 Returns to work experience

Returns to work experience can be divided into two components: returns to general human capital and returns to firm-specific human capital. This section deals with the returns to general human capital, and the next section with seniority. Le Grand (1994) reports results on changes in wage profiles by gender and sector of employment (see Table 2). The curvatures differ greatly over the years – to be the highest in 1968 and thereafter to be less pronounced; i.e., the coefficients on work experience for 1968 imply a much faster wage growth during the first years of work than the parameters for later years. These patterns are valid for both men and women.[16] For example, the return to five years of work experience for men is about 20 per cent in 1968 and about 10 per cent in 1991, with the main fall between 1968 and 1974. The return to 40 years of work experience is about 60 in 1968 and just under 50 per cent in 1991. Corresponding figures for women are lower.[17] Furthermore, the estimated parameters of work experience imply that in the years 1968, 1974, 1981 and 1991, wages peaked in the range 29–37 years of work experience for men and between 27–35 years for women. The peaks over time tend to occur at later stages in working life.

The estimates reported in Edin and Holmlund (1995) cover more years than the above-mentioned studies. By using information from both LNU and HUS they are able to estimate the earnings function for the following years; 1968, 1974, 1981, 1984, 1986, 1988 and 1991. The three first years refer to LNU and the other years to HUS. So they are able to examine more closely how the wage profiles devel-

Table 2. The return to work experience (log-%)

		Experi-	Total	Private	Public

[16] The coefficient on experience is significantly different across sexes only for the years 1981 and 1991. Experience squared is never significantly different across sexes.

[17] Björklund (1986) presents lower returns to experience due to the inclusion of age in the earnings function. Furthermore, his samples include both men and women, and a gender dummy captures any gender differences.

		ence	Total	Men	Women	Total	Men	Women	Total	Men	Women
Asplund et al. (1996)	1991	5	9.9	11.9	8.1		12.9	10.7		11.6	6.8
		40	35.6	42.0	27.2		46.0	29.6		44.8	26.8
Edin & Holmlund (1995)	1968	5	16.9								
		40	44.0								
	1974	5	12.8								
		40	36.8								
	1981	5	10.6								
		40	34.4								
	1984	5	10.3								
		40	43.2								
	1986	5	8.9								
		40	39.2								
	1988	5	8.8								
		40	34.4								
	1991	5	11.1								
		40	36.8								
Le Grand (1994)	1968	5		20.1	17.2	18.3			16.9		
		40		56.0	38.4	51.2			45.6		
	1974	5		15.2	14.2	15.1			12.4		
		40		45.6	37.6	42.4			36.0		
	1981	5		13.0	9.7	12.4			9.3		
		40		46.4	32.8	40.8			36.8		
	1991	5		12.1	8.4	11.6			8.4		
		40		48.0	30.4	42.4			35.2		

oped during the 1980s. They capture any gender differences by a dummy for gender in the earnings function. They find that the curvature became more pronounced in the late 80s, with the profiles for 1981 and 1991 being more or less identical. This contradicts previous results. One explanation is that they do not have explicit information on work experience for all years, but have to rely on potential work experience for some years. Furthermore, the samples of HUS data for some of the years are quite small.

Le Grand also shows that the return to work experience is significantly higher in the private sector than in the public sector for the years 1981 and 1991, but the gap is quite small. For example, the return to five years of work experience is 12 (12) per cent in the private sector for 1981 (1991) and 9 (8) per cent in the public sector for 1981 (1991). Moreover, wages reached their maximum later in the public sector than in the private sector; after 37 to 39 years in the public sector and after 32 to 35 years in the private sector. Furthermore, the wage profile in the public sector is somewhat flatter than in the private sector. Asplund et al. (1996) present similar estimates for 1991, but they also report the return to experience in the two sectors across gender. Regardless of the sector of employment, men have a somewhat higher return to work experience than women. They also show that the wage effect of experience is stronger in Sweden than in Denmark and Finland.

The work experience literature is not as sophisticated as the schooling literature. For example, little has been done to examine the consequences of measurement errors. Most likely, work experience is measured with errors, more sever ones than the errors in schooling. Moreover, the empirical specification of the earnings function, as proposed by Mincer (1974), implicitly assumes that all workers invest the same amount in on-the-job training. Because jobs are likely to differ in the amounts of on-the-job training, the effect of a change in work experience will not be the same for all individuals. According to the human capital theory, people who invest in human capital have lower initial earnings after school, but higher earnings growth than those who do not invest. Kjellström (1999b) estimates an earnings function, where the parameters are allowed to vary (stochastically) across individuals. The results show that ignoring this unobserved heterogeneity has minor consequences for traditional human capital variables, i.e. the coefficients on education and work experience. A natural question to ask is whether wage profiles vary systematically across occupations. Arai et al. (1998) show that the experience profile is steeper in high-wage occupations, and flatter in low-wage occupations. This result remains unchanged when controlling for selection into various occupations, indicating that heterogeneity in experience is closely related to occupational affiliation.

5 Returns to seniority

By including both work experience and seniority in the earnings equation, it is possible to get an indication on the importance of general and firm-specific human capital for wage determination.

Asplund et al. (1996) report that seniority is more important in Finland (1987) than in Sweden (1991). For example, 10 years of seniority raises wages by 2.5 (6) per cent in Sweden (Finland), while 10 years of work experience raises wages by 17 (13) per cent. So, the returns to total experience is about 20 per cent in both countries. Furthermore, seniority seems to be more important in the public sector than in the private sector, and also more important for women than for men. Regnér (1997) also examines the relationships between seniority, experience, on-the-job training and wages. But in addition to seniority he includes seniority squared in the earnings equation. Again, the results indicate that seniority has a modest effect on hourly wages in Sweden. Cross-section wage equations predict that 10 years of seniority raises wages by 2.8 per cent, while 10 years of experience raises wages by almost 16 per cent. Fixed effects models predict significant effects of experience only, and the estimated wage effects are about the same as the cross-sectional estimates. He also presents results suggesting that a direct measure of on-the-job training has large and positive effects on the level of wages. Cross-sectional estimates suggest that workers who have participated in on-the-job training lasting more than 12 months earn significantly more (about 20 per cent) than workers who have participated in training lasting less than one month.

Björklund and Regnér (1996) report much higher returns to seniority, and lower returns to work experience. For example, the return to 10 years of seniority varies between 6 and 15 per cent depending on gender and sector of employment. This is due to their definition of experience. The experience variable in their study is the years of labour market experience before starting the current job.

Arai and Skalli (1996) analyse the cross-industry variation in returns to seniority in the firm, a variable usually interpreted as a measure of firm-specific human capital. Human capital theory predicts a positive seniority effect; stayers learn, increase productivity and are thus paid higher wages. This is not confirmed for all industries in Sweden, where the coefficient for seniority is negative for 10 out of 24 industries and negative and significant in the textile and services industries. The positive coefficients are significant in financial institutions, insurance and real estate industries. These results are unchanged when controlling for blue-collar status in the wage equation. No industry-specific seniority effect is rejected at conventional levels. While the mean seniority effect is 0.001, this estimate varies from -0.007 to 0.012, implying that the low overall returns to seniority in Sweden reflect the variation in the nature of this effect across industries. Negative effects of seniority on wages are theoretically compatible with a case where high-paid jobs are characterised by high turnover (lower mean seniority) compared with low-paid jobs. When selection and internal promotion are not important, the low-paid jobs are occupied by low productivity workers who stay in because of the lack of better opportunities, and high-paid jobs are only open to outside candidates who might leave for more productive jobs. In such cases there is a negative relation between seniority and wages. On the other hand, in industries where selection and internal promotion are important, higher ability workers are promoted and hence stay, and less productive workers have to leave or stay in low-wage positions. This means higher turnover in low-paid jobs compared with high-paid jobs and thus a positive seniority-wage relation.

Finally, the low overall effect of seniority on wages might reflect the strong employment protection legislation in Sweden. Employment protection leads to a situation where unskilled workers stay longer time at the firm compared with a situation without employment protection. Many years at the same job does not then mean increased productivity and increased wages. However, only further empirical examination can highlight the sources of these different seniority effects.

6 Conclusions

There are numerous studies investigating the returns to human capital in Sweden and there is a considerable amount of research on sensitivity analysis of estimating returns to schooling. The basic message of these results is that accounting for potential problems associated with OLS estimation of a standard Mincer equation only leads to minor modifications of the results. We also observe that while many studies examine returns to education, far less studies deal with on-the-job training. Moreover, very little research is done on returns to various types of education. Economic pecuniary incentives for education in different subjects – technical, humanities etc. – might vary in importance. Moreover, these incentives most likely have different implications for economic growth. Another neglected area is the importance of fringe benefits and whether there is reason to revise the results on returns to human capital on the basis of variations in fringe benefits.

Returns to human capital are low in Sweden. The major changes in returns to human capital took place during the late sixties and early seventies. During the same period, wages were compressed in almost all dimensions in Sweden. There has been a minor tendency towards increased returns to human capital after 1981. We know less about the impact on wage structures and returns to human capital of the recent developments in the Swedish labour market. During the nineties unemployment and student enrolment increased rapidly and a general impression is that education requirements for employment have increased.

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Appendix: Main data sources

The Level of Living Surveys (LNU)

LNU contains about 6,000 randomly sampled people between ages 16 and 75 (18–75 for 1991), where the primary sample from 1968 constitutes the base for these surveys: 1974, 1981 and 1991. The non-response rate has increased over time; from 9 per cent in 1968 to roughly 20 per cent in 1991.[18] Examples of the available variables in LNU are: years of schooling, highest educational level and programme, work experience, tenure, gross and net hourly wage (constructed from weekly, monthly or annual earnings), working conditions, sector of employment, occupational status, parental occupation and education.

LNU data from 1991 are also matched with data on firms' annual accounting data. The firm data contain information on profits, firm size, capital etc. on a yearly basis for the period 1987–1991. The sample includes private sector non-agricultural employees in 1991. Combining 1991 *Swedish Establishment Survey* (APU) and *Sweden Statistics (SCB) data*, yields information on plant size for the workers in 1991. County and municipal unemployment is from the *Swedish Labour Market Board* (AMS). The matched sample includes 726 individuals in 689 firms.

The Household Market and Non-market Activities Surveys (HUS)

HUS contains information on both the household and the individuals who make up the household. The 1984 survey was based on a stratified cluster sample of people aged 18–74, and of over 2,300 households to which these individuals belong. The data contain information on years of schooling, highest educational level completed, work experience, hourly wage, parental occupation and education, etc. This survey was followed by smaller surveys in 1986, 1988 (considerably smaller), 1991, 1993 and 1996. As a complement to those who were re-interviewed, a supplementary sample was added. This supplementary sample consists partly of those who become adult members of existing households, partly of a new random sample of households. For some of the years, only individuals in the new supplementary samples were asked questions on, for example, work experience and years of schooling. For the rest, we have to construct these variables by using information from previous years. The non-response rate is about 20 per cent.

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18 See Eriksson and Åberg (1987) and Fritzell and Lundberg (1994).

The Individual Statistics project (IS)

These data consist of two nationally representative samples (age cohorts) of pupils born in 1948 and 1953. The samples cover basically all individuals born on the 5th, 15th and 25th of each month during these years. The data sets include information on scores on achievement tests in Swedish, English and mathematics, school marks in Swedish, English and mathematics, scores from three intelligence tests representing the verbal, spatial and reasoning factors of intelligence. There is also information on the respondents' attitude to higher education, parents' attitude to higher education and parental education and occupation. Data were collected in 1961 and 1966 when the respondents were between 12 and 13 years of age.[19] Information on the highest educational level and yearly earnings are from SCB registers (*utbildningsregistret and ÅRSYS*) in 1993.

The Twin registry

This is a large sample of twins (monozygotic and dizygotic) born in Sweden between the years 1886 to 1967. This sample has been linked to the educational registry (1990 and 1993) and to ÅRSYS. Data on earnings are available for three years: 1987, 1990 and 1993.

Project on Class Structure and Class Consciousness (CSCC)

This data set includes information on before-tax income, educational status, age, working conditions, occupation and seniority for a number of countries. The Swedish survey of 1980 represents its employed population aged 18–65. A sample of households was selected. Thereafter, one respondent in each household was chosen to answer questions about their own work characteristics, those of their spouses, household composition, etc. The response rate was 76 per cent. The sample for Sweden includes information on income in previous years (different sources), kind of education obtained, but information on work experience and tenure is missing. The total sample size is 1,145.

Table A1

	Arai & Skalli (1996)	Asplund et al. (1996)	Björklund (1986)	Björklund & Regnér (1996)

19 See Svensson (1971) and Härnqvist and Svensson (1973).

Data (year)	LNU (91)	LNU (91)	LNU (68, 74, 81), HUS (84)	LNU (91)
Dependent variable	Log (gross hourly wage)	Log (gross hourly wage)	Log (gross hourly wage)	Log (gross hourly wage)
Age and age squared			X	
Years of education	X	X	X	X
Levels of education		X		
Experience	X	X	X	X
Experience squared	X	X	X	X
Experience of higher order				
Tenure	X	X		X
Tenure squared				X
Job qualification, occupation		X		
Public/private sector		X		
Firm/plant size	-/X			
Region	X			
Sector of activity	X			
Civil status	X			X
Sample size in hundreds	Private: 16	33	26(1968), 31(1974), 34(1981), 16(1984)	32
Estimation technique	OLS	OLS	OLS	OLS

Table A2

	Blau & Kahn (1995)	Edin & Holmlund (1995)	Le Grand (1994)	Regnér (1997)
Data (year)	CSCC (80)	LNU (68, 74, 81), HUS (84, 86, 88, 91)	LNU (68, 74, 81, 91)	LNU (81, 91)
Dependent variable	Log (annual earnings)	Log (gross hourly wage)	Log (gross hourly wage)	Log (gross hourly wage)
Age and age squared				
Years of education	X (calculated)	X	X	X
Levels of education				
Experience	X (potential)	X (potential for some years)	X	X
Experience squared	X (potential)	X (potential for some years)	X	X
Tenure				X
Tenure squared				X
Occupation	X			
Public/private sector			X	
Sector of activity	X			
Civil status				X
Sample size in hundreds	8	30 (1968), 30 (1974), 34 (1981), 16 (1984), 18 (1986), 15(1988), 13 (1991)	29(1968), 30 (1974), 33 (1981), 33 (1991)	Men: 10 (Panel 81-91), 16 (1991)
Estimation technique	OLS	OLS	OLS	OLS, Fixed effects and Random Growth

CHAPTER 15

Wages and Human Capital: Evidence from Switzerland

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1 Introduction[1]

The aim of the following study is to give an overview over the existing literature on research in the field of wages and human capital in Switzerland. As we are particularly interested in education related issues and private returns to education, we focus on the link between wages and human capital variables such as years or type of schooling and experience. Mainly we try to find out, if the results of different studies are similar, that is, if they are robust to different data sets, equation specifications and estimation procedures.

All reviewed studies report significant and positive rates of return to an additional year of schooling. The results are relatively robust across different specifications of earnings functions. The level of estimated returns, however, differ between men and women, ethnical groups and types of education. Estimations of returns to (potential) labour market experience are also quite robust across different studies. We find that returns are generally lower for women, i.e., that their age-earnings profiles are flatter. Tenure, which is an indicator of firm specific human capital, has a positive effect on wages.

The question of how to finance education in Switzerland has so far only rarely been adressed. Further research is certainly needed, in order to gain further insights about the link between the educational system as well as other institutional factors and the labour market.

The study is organised as follows. The second section outlines the aims of the reviewed literature. The third section gives a description of the data sets used. The fourth section explains the different estimation procedures that can be found in the literature. The main estimation results are summarised and compared in the fifth part. In section six we conclude, what we know and what we do not but should know about private returns to education in Switzerland.

2 Aims of the reviewed studies

In the context of wages and human capital most of the research in Switzerland so far has focused on wage discrimination. Wage differ-

[1] The authors would like to thank Aniela Wirz from the ETH-KOF in Zürich for helpful contributions.

entials by gender were for the first time analysed econometrically by Kugler (1988). His study consists of Mincer wage equations including the standard human capital variables *years of schooling* and *experience* as well as health. Kugler also corrects for sample selection bias due to unobserved wages of women not participating in the labour market. Diekmann and Engelhardt (D&E, 1995) have performed a similar estimation of female wage discrimination based on the first Swiss Labour Force Survey (SLFS) of 1991, also correcting for sample selection bias and additionally controlling for sector of employment. Bonjour (1997) has calculated a great variety of measures of wage discrimination using the SLFS of 1991 to 1993. In addition to the standard human capital variables, she controls for women's probability of *labour market participation*, for tenure, hierarchical level of the job and firm size. She also tests different estimation settings, for instance *endogenous experience*. The most recent estimations of wage differentials by gender have been carried out by Ferro-Luzzi and Silber (FL&S, 1998) and Henneberger and Souza-Poza (H&S, 1998a,b).

A second question which has been addressed by labour market economists in Switzerland is wage discrimination against foreign workers. (About 25% of the labour force in Switzerland are foreign workers.) Golder (1997) and De Coulon (1998a,b) have examined this question by estimating wage functions for different ethnical groups, controlling for human capital variables as well as individual and job related characteristics.

Curti (1998) in her study has tested, if *unemployment* causes wage losses after re-employment. In order to correct for selectivity biases, she controls for the risk of getting unemployment as well as the probability of being re-employed. Additionally, she includes several variables like tenure, nationality, region, sector of employment and plant size in her Mincer wage equations.

Ferro-Luzzi (1996) estimates earnings functions in order to quantify the impact of job related, personal and regional factors on gross wages of women and men in Switzerland.

Sheldon (1992) was the first to explicitly estimate private rates of return to *different types of education* in Switzerland. His econometric model consists of wage equations for people with different types and levels of education. To correct for the bias caused by *self-selection* into the (ex post) observed types of education, he simultaneously models the *process of educational choice*. He finds that the consideration of this selection process substantially alters the estimation results obtained by the standard Mincer approach.

The profitability of education has also been estimated by Wolter (1994), Weber (1998) and Wolter and Weber (1999). They have chosen the so called *Cost-Benefit Approach* to calculate *net present values of lifetime earnings* as well as *private rates of return to education* (Psacharopoulos, 1987). Taking into account income taxes, direct educational costs, the risk of dropping out of school and the unemployment probability, they calculate rates of return for men and women and different types of education. Finally they discuss whether the after-tax wage premium for education is high enough to justify further financial contribution to educational costs by students. As these studies are based on a different approach, the main results as well as the applied method will be presented in the appendix of this chapter.

3 Data sets

The data used in Kugler (1988) and Sheldon (1992) are drawn from two merged data sets: the first representative *health survey* (SOMIPOPS) and the *Income and Wealth Survey* (SEVS).[2] The sample of 4,250 observations is representative for the adult population, permanently resident in Switzerland in 1981/82. For the mentioned studies, variables on the labour market status, type of occupation, education, wages, household incomes, health and socio-demographic characteristics have been used. The two data sets are the first ones to give a representative picture of wages and human capital in Switzerland at a micro level.

Today the main data source for labour market related questions is the *Swiss Labour Force Survey* (SLFS), which is annually produced by the Swiss Federal Statistical Office (SFSO) since 1991. By far the major part of the reviewed studies is based on this data set. The SLFS is a rotating panel survey, that allows analyses of cross-sections and – in somewhat lesser detail – panels of a maximum of five years. One major advantage of the SFLS is its great variety of information on indi-

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[2] SOMIPOPS: *Soziomedizinisches Indikatorensystem der Population der Schweiz*, NFP 8, Projekt 4.350.079.08. SEVS: *Schweizerische Einkommens- und Vermögensstichprobe*, NFP-Projekt 1.455.0.81.

vidual, household-specific and work-related issues. Many variables (e.g. the labour market status) are defined according to international standards, which allow for international comparisons. The sample of 16,000–18,000 observations per year is representative for the adult population (>15 years). The data are collected by telephone interviews.

Table 1 gives an overview over the data sets and sample sizes used in the reviewed studies.

Table 1. Data sets and sample sizes (wage earners)

	Data set	Year	Total	Female	Male	Foreigners
Kugler (1988)	SOMIPOPS/ SEVS	1981 /82	1865	580	1285	540
Sheldon (1992)	SOMIPOPS/ SEVS	1981 /82	656	-	656	-
D&E (1995)	SLFS	1991	4510	1967	2543	-
Ferro-Luzzi (1996)	SLFS	1991	6563	2944	3563	x
Bonjour (1997)	SLFS	1993	6125	2597	3528	x
FL&S (1998)	SLFS	1991	4528	2037	2491	x
FL&S (1998)	SLFS	1995	10728	4907	5821	x
H&S (1998a)	SLFS	1995	8565	1804	6761	x
H&S (1998a)	SLFS	1997	4852	1299	3553	x
Golder (1997)	SLFS	1995	5856	-	5856	974
De Coulon (1998a,b)	SLFS	1995	5878	-	5878	860
Curti (1998)	SLFS	1993-97	17374	x	x	x

Note: x = included, number not indicated.

4 Estimation procedures

4.1 Functional form

Almost all the reviewed of the following form [3] studies are based on more or less extended types of Mincer wage equations

$$\ln(w) = \alpha_0 + \alpha_1 EDUC + \alpha_2 EXP + \alpha_3 EXP^2 + \alpha_4 X_1 + \alpha_5 X_2 + \ldots + \varepsilon \tag{1}$$

[3] Wolter (1994), Weber (1998) and Wolter and Weber (1999) use the so-called cost-benefit approach, which is described in the appendix of this chapter.

The wage variable *(w)* is defined as a gross hourly wage rate in Kugler (1988), Sheldon (1992), Ferro-Luzzi (1996), FL&S (1998), Bonjour (1997), De Coulon (1998a,b) and H&S (1998a,b). D&E (1995) use monthly gross earnings and Curti (1998) and Golder (1997) define their dependent variable as the log of annual gross earnings.

The human capital variable of education is defined as *years of schooling* except for Sheldon (1992), where rates of return are calculated for different types of education. None of the data sets, however, allows to observe years of schooling directly. The schooling variable was therefore estimated using the highest educational degree achieved as a proxy. Golder (1997) also includes a squared term of years of education in order to take into consideration decreasing respectively increasing returns to education.

The variable of *total actual experience* can neither be found in the original data sets. In most studies it is approximated by experience = age – years of schooling – 6.5 which is actually a measure of potential experience. Actual experience was approximated by a variable of experience without a break of 6 months in Bonjour (1997) and H&S (1998a,b). Contrary to potential experience, with this variable one risks to underestimate actual labour market experience, especially for women. D&E (1995) additionally use a corrected variable for women's experience by subtracting 3 years per child from potential experience. Curti (1998) and sometimes Bonjour (1997) have used the age variable instead of experience in their wage functions.

Ferro-Luzzi (1996), Bonjour (1997), Curti (1998) and H&S (1998a,b) further include *tenure* as a proxy for the accumulation of firm specific human capital. Kugler (1988) and Sheldon (1992), on the other hand, insert a human capital variable for *health* in their wage regression.

4.2 Additional control variables

Table 2 gives an overview of the control variables used in the different studies. Not all mentioned variables were included at the same time in one model. Some of them, especially those about household characteristics like the number of children, the household income and the martial status, were used to model the selection process of labour market participation and were typically not included in the wage equation itself.

Table 2. Wage functions: variables included

	Kugler (1988)	D&E (1995)	Bonjour (1997)	FL&S (1998)	H&S (1998a)	H&S (1998b)	De Coulon (1998a,b)	Golder (1997)	Curti (1998)	Ferro-Luzzi (1996)	Sheldon (1992)
Wage concept	hourly gross	monthly gross	hourly gross	hourly gross	hourly gross	hourly gross	hourly gross	annual gross	annual gross	hourly gross	hourly gross
Age			x		x	x			x		x
Age sq			x		x	x			x		
Experience[1]	x	x	x[2]	x	x[2]	x[2]	x	x		x	x
Experience sq[1]	x	x	x[2]	x	x[2]	x[2]	x	x		x	x
Years of schooling	x	x	x	x	x	x	x	x	x	x	
Years of schooling sq								x			
Type of education							x		x		x
Tenure			x	x	x	x			x	x	
Tenure sq										x	
Management function			x	x	x	x	x	x	x	x	
Log working hours		x			x						
Firm size			x	x			x	x	x	x	
Sector of activity		x						x	x		
Profession			x	x				x			
Region								x	x	x	x
Martial status	x	x	x		x	x	x		x		
Number of children	x	x	x		x	x	x				
Household income		x	x		x	x					
Selection bias correction[3]	x	x	x		x	x[4]	x		x[5]		
Other variables	assets, health		typical male/female professions			house owning	nationalities, years since immigration	nationalities, type of contract, training	training, experience with unemploym.	regional unemployment rates, working conditions	assets, health

Notes: [1] potential experience; [2] experience without a break of 6 months; [3] typically selection bias correction for labour market participation of women, sometimes for men; [4] additionally correcting for the selection bias due to non-response; [5] correcting for the risk of getting unemployed as well as the probability to find a job again.

4.3 Correction for selectivity biases

The estimations of Kugler (1988), D&E (1995), H&S (1998a) and Bonjour (1997) consist of two stages. In a first step the individual probability of labour market participation is estimated using a probit function.[4] The estimation results are used to compute the so-called inverse of Mills' ratio, a selection bias variable. This variable, in a second step, is included in the wage regression to correct for non-observed wages of people not participating in the labour market. This procedure is found to influence substantially the measures of female wage discrimination as well as the coefficients of the human capital variables for women (see estimation results). Golder (1997) and Sheldon (1992) focus on wages of men and therefore do not correct for the mentioned selection bias. De Coulon (1998a) estimates the wage equations simultaneously with the selection rule by maximum likelihood, in order to correct for the selectivity bias.

Curti (1998) uses a double selectivity approach to correct for the selection bias in her sub-sample of people affected by unemployment. In order to take into account the selection processes of job losses and reintegration into the labour market, she uses the same methodology as described above. Unlike the mentioned studies, however, she estimates *two* probit functions, one for the *risk of loosing a job* and one for the *probability of finding a job* after a certain period of unemployment. The selection bias variables derived by these models are both inserted in the wage regression.

H&S (1998b) also use a double selectivity approach. Additionally to non-participation in the labour market, they take into account the potential selection bias due to *non-response* in the wage question in the SLFS.

4.4 Different specifications

Bonjour (1997) in her work tests several model specifications. With the help of the so-called *Hausman test* she finds empirical ev-

4 As the rate of labour market participation of men is very high (>96% between 1991 and 1993), D&E (1995) and Bonjour (1997) carry out this step for women only.

idence indicating that in the case of women, experience is not independent of the wage. For that reason she treats experience as an endogenous variable that depends on the logarithm of the wage, the number of children, age and duration of marriage or number of years since an eventual divorce. The simultaneous wage and experience functions are then estimated by two- and three-stage least squares (2SLS, 3SLS). As a variation of this model, Bonjour uses an instrumental variable approach (IV) in order to account for endogenous experience. She uses the exogenous variables of the simultaneous model as instruments for experience and experience squared in the original wage function. Similar tests of different specifications can be found in H&S (1998a).

4.5 Rates of return to educational degrees

Unlike most other authors Sheldon (1992) does not estimate the rate of return of an additional year of schooling, but the rate of return to a *certain type of education*. The estimated rate of return is given by equation (2), where $(\alpha_0)_h$ and $(\alpha_0)_{h-1}$ correspond to the intercepts in two wage equations, for people having attained consecutive educational levels h and h–1, respectively. The variables S_h and S_{h-1} stand for the average years of schooling necessary to reach the respective educational level.[5]

$$E(r) = [(\alpha_0)_h - (\alpha_0)_{h-1}] / [S_h - S_{h-1}] \qquad (2)$$

Sheldon furthermore accounts for selection processes of the educational system. He models the allocation process to different types of education, in order to correct for the bias caused by self-selection into the (ex post) observed types of education. The direction of the selection bias shows whether the self-selection process is efficient, that is, if self-selection generates higher rates of return to education than a random selection process would.

5 Estimation results

[5] Sheldon (1992) uses extended forms of Mincer equations without years of education. Equation (2) therefore holds for individuals with zero value in all other control variables.

5.1 Rates of return to years of schooling

All reviewed studies on wage discrimination contain several estimations of Mincer wage equations. The coefficients associated with years of schooling, which are often interpreted as an average rate of return to an additional year of schooling, are summarised in Tables 3a-e. Wage equations without or with only a few additional control variables are called standard, whereas equations with more than three control variables are called extended.

Table 3a. Standard wage equations: education

		Coefficients for years of education		
	Year	Females	Males	All
Kugler (1988)	1981/82	0.091	0.055	-
D&E (1995)	1991	0.080	0.075	-
Bonjour (1997)	1991	0.075	0.083	-
Bonjour (1997)	1992	0.078	0.082	-
Bonjour (1997)	1993	0.079	0.078	-
Bonjour (1997)*	1991	0.070	0.070	-
Bonjour (1997)*	1992	0.074	0.068	-
Bonjour (1997)*	1993	0.078	0.066	-

Note: * using age and age^2 instead of exp and exp^2

Table 3b. Extended wage equations: education

		Coefficients for years of education		
	Year	Females	Males	All
Ferro-Luzzi (1996)	1991	0.074	0.075	0.075
Ferro-Luzzi (1996) +	1991	0.067	0.068	0.070
D&E (1995)	1991	0.074	0.075	-
Bonjour (1997)	1991	0.073	0.073	-
Bonjour (1997)	1992	0.075	0.071	-
Bonjour (1997)	1993	0.076	0.067	-
FL&S(1998)	1991	0.103	0.096	-
FL&S(1998)	1995	0.090	0.091	-
H&S (1998a)	1995	-	0.066	-
H&S (1998a)	1997	-	0.061	-
Curti (1998)*	1993-97	-	-	0.064
Curti (1998)*+	1993-97	-	-	0.058

Notes: * using age and age^2 instead of exp and exp^2
+ Estimation setting with more additional control variables.

Table 3c. Standard wage equations corrected for selection biases: education

	Year	Coefficients for years of education		
		Females	Males	All
Kugler (1988)	1981/82	0.072	0.060	-
D&E (1995)	1991	0.075	-	-
Bonjour (1997)*	1991	0.065		-
Bonjour (1997)*	1992	0.070		-
Bonjour (1997)*	1993	0.075		-

Note: * using age and age^2 instead of exp and exp^2

Table 3d. Extended wage equations corrected for selection biases: education

	Year	Coefficients for years of education		
		Females	Males	All
D&E (1995)	1991	0.070	-	-
De Coulon (1998a)	1995	-	0.086	-
H&S (1998a)	1995	0.065	-	-
H&S (1998a)	1997	0.061	-	-
Bonjour (1997)*	1991	0.065	-	-
Bonjour (1997)*	1992	0.068	-	-
Bonjour (1997)*	1993	0.072	-	-

Note: * using age and age^2 instead of exp and exp^2

Table 3e. Extended wage equations with endogenisation of experience: education

	Year	Coefficients for years of education		
		Females	Males	All
Bonjour (1997)**	1993	0.079	-	-
Bonjour (1997)***	1993	0.065	-	-
Bonjour (1997)****	1993	0.077	0.071	-
H&S (1998a)**	1995	0.079	-	-
H&S (1998a)**	1997	0.077	-	-

Notes: ** simultaneous model estimated by Two-Stage Least Squares (2SLS), using age, approximated exp and exp^2

*** simultaneous model estimated by Three-Stage Least Squares (3SLS), using age, approximated exp and exp^2

**** extended wage equation with instrumented experience and experience squared (IV), using approximated exp and exp^2

A comparison of the coefficients associated with education obtained from different estimation settings reveals that ...

(1) rates of return to education estimated by Mincer equations are fairly robust across different studies in Switzerland.[6]

(2) extensions of the standard wage equation by the addition of control variables lower the rates of return to education.

(3) inclusion of age instead of experience lowers the rates of return to education.

(4) correction for selectivity biases of labour market participation lowers the rates of return to education for women.

(5) endogenisation of experience does not alter the rates of return to education when compared to results without selectivity correction. Hence the returns are higher than those obtained from extended wage equations corrected for selection biases.

Comparison of rates of return to education for men and women over time reveals that ...

(1) rates of return to education for men rose during the eighties and slightly declined in the nineties.

(2) rates of return to education for women declined in the eighties, rose from 1991 to 1993 (Bonjour, 1997) and declined again between 1995 and 1997 (H&S, 1998).

(3) differences in rates of return to education between men and women have declined since the early eighties. Whereas women had remarkably higher rates of return than men in the early eighties returns were very similar or only slightly higher throughout the nineties.

Golder (1997) is the only author to add a term of years of schooling squared to the wage function. With the corresponding coefficients, *marginal rates of return to education* can be derived. The marginal rate of return to the 10th year of schooling – which is the first post compulsory year in Switzerland – amounts to 0.071 in the first estimation setting and to 0.077 in a setting with additional control variables for men. For the 18th year of schooling – for in-

6 It has to be mentioned, however, that with the exception of Kugler (1988), all studies are mainly based on the same data source (SLFS).

stance the last year at university – there results a marginal rate of return of 0.005 and 0.016 depending on the number of control variables included.

De Coulon (1998a,b) and Golder (1997) as well as Kugler (1988) find evidence, that rates of return to education remarkably differ between Swiss and foreign workers. All three authors find, that rates of return to schooling are lower for the foreign population than for natives. With a further analysis De Coulon can show that for all immigrants, education acquired in their home country is less rewarded than education obtained in Switzerland, which on the one hand could reflect differences in the quality of the education between countries or simply the fact that human capital is not a perfectly mobile asset.[7]

5.2 Rates of return to different educational degrees

Somewhat different measures of rates of return to education are given by Sheldon (1992). Unlike the above cited studies, he estimates the rate of return to a certain type of education compared to the next lower educational degree. Not correcting for selectivity biases he finds rates of return between –8.2 and 19.4%, depending on the type of training.[8]

Correcting for the bias caused by self-selection into the ex post observed types of education, Sheldon finds substantially higher rates of return compared to standard estimations. His corrected rates of return amount to 6.4 – 38.8%, depending on the type of education. The direction of the selection bias shows, that the self-selection process is efficient in all but one case, i.e., that self-selection leads to higher rates of return to education than a random selection process would.

Table 4. Private rates of return to different levels of education for men (in per cent)

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7 Rates of return to education abroad 0.040–0.076 vs. 0.052–0.118 for education in Switzerland, depending on the region of origin.

8 The results for higher vocational colleges, university and university entrance certificates are based on a weak database (between 23 and 51 observations). This might partly explain the rather extreme results.

Year	Sheldon (1992)	
	1981/82	1981/82*
Apprenticeship (3-4 years after compulsory schooling)	11.7	14.8
Higher vocational college (2 years after apprenticeship)	-8.2	38.8
Higher business or technical college (3 years after apprenticeship)[a]	12.8	35.7
University entrance certificate (4 years after compulsory schooling)	19.4	6.4
University (5 years after university entrance certificate)	1.5[b]	23.4

Notes: * corrected for self-selection bias
[a] Since 1998 Universities of Applied Science.
[b] Corrected result by replication.

The rates of return in Table 4 reveal, that returns to different types of education are very heterogeneous. This heterogeneity of returns is overlooked when measuring human capital by years of schooling only, because the same amount of schooling might lead to completely different returns depending on the type of schooling.

5.3 Returns to experience

The coefficients associated with experience can approximately be interpreted as the return to on-the-job training. The disposable estimates for Switzerland, with the exception of some small subpopulations, show the commonly found pattern of decreasing returns to experience, i.e., the coefficient of EXP is significantly positive, that of EXP^2 significant and negative. Tables 5a–e give an overview of the coefficients associated with years of potential and approximated labour market experience. Again wage equations without or with only a few additional control variables are called 'standard', whereas equations with more than three additional control variables are called 'extended'.

Table 5a. Standard wage equations: coefficients for experience/age

	Year	Experience /age			Exp. / age sq. $\times 10^{-2}$		
		Females	Males	All	Females	Males	All
Kugler (1988)	1981/82	0.026	0.049	-	-0.017	-0.070	-
D&E (1995)	1991	0.039	0.054	-	-0.074	-0.090	-
Bonjour (1997)**	1991	0.024	0.025	-	-0.05	-0.03	-
Bonjour (1997)**	1992	0.026	0.030	-	-0.05	-0.04	-
Bonjour (1997)**	1993	0.023	0.031	-	-0.04	-0.05	-
Golder (1997)	1995	-	0.044	-	-	-0.066	-
Bonjour (1997)*	1991	0.047	0.051	-	-0.05	-0.05	-
Bonjour (1997)*	1992	0.041	0.059	-	-0.04	-0.06	-
Bonjour (1997)*	1993	0.041	0.061	-	-0.04	-0.06	-

Notes: * age and age^2 instead of exp and exp^2
** exp = approximated by experience without a break of 6 months

Table 5b. Extended wage equations: coefficients for experience/age

	Year	Experience /age			Exp. / age sq. $\times 10^{-2}$		
		Females	Males	All	Females	Males	All
Ferro-Luzzi (1996)	1991	0.035	0.044	0.039	-0.067	-0.074	-0.070
Ferro-Luzzi (1996)+	1991	0.032	0.042	0.037	-0.058	-0.070	-0.063
D&E (1995)	1991	0.038	0.054	-	-0.072	-0.089	-
Bonjour (1997)**	1991	0.018	0.020	-	-0.04	-0.03	-
Bonjour (1997)**	1992	0.021	0.024	-	-0.04	-0.04	-
Bonjour (1997)**	1993	0.018	0.025	-	-0.04	-0.04	-
FL&S (1998)	1991	0.032	0.036	-	-0.067	-0.060	-
FL&S (1998)	1995	0.026	0.037	-	-0.051	-0.062	-
Golder (1997)	1995	-	0.034	-	-	-0.051	-
H&S (1998a)**	1995	-	0.028	-	-	-0.043	-
H&S (1998a)**	1997	-	0.026	-	-	-0.040	-
Curti (1998)*	93-97	-	-	0.054	-	-	-0.055
Curti (1998)*+	93-97	-	-	0.044	-	-	-0.045

Notes: * age and age^2 instead of exp and exp^2
** exp = approximated by experience without a break of 6 months.
+ Estimation setting with more additional control variables.

Table 5c. Standard wage equations corrected for selection biases: coefficients for experience/age

	Year	Experience /age			Exp. / age sq. $\times 10^{-2}$		
		Females	Males	All	Females	Males	All
Kugler (1988)	1981/82	-0.012	0.057	-	0.060	-0.080	-
D&E (1995)	1991	0.037	-	-	-0.067	-	-
Bonjour (1997)*	1991	0.047	-	-	-0.05	-	-
Bonjour (1997)*	1992	0.039	-	-	-0.04	-	-
Bonjour (1997)*	1993	0.040	-	-	-0.04	-	-

Note: * age and age^2 instead of exp and exp^2

Table 5d. Extended wage equations corrected for selection biases: coefficients for experience/age

	Year	Experience /age			Exp. / age sq. ×10^{-2}		
		Females	Males	All	Females	Males	All
D&E (1995)	1991	0.036	-	-	-0.065	-	-
De Coulon (1998a)	1995	-	0.038	-	-	-0.06	-
H&S (1998a)	1995	0.020	-	-	-0.036	-	-
H&S (1998a)	1997	0.015	-	-	-0.025	-	-
Bonjour (1997)*	1991	0.042	-	-	-0.05	-	-
Bonjour (1997)*	1992	0.037	-	-	-0.04	-	-
Bonjour (1997)*	1993	0.039	-	-	-0.04	-	-

Note: * age and age^2 instead of exp and exp^2

Table 5e. Extended wage equations with endogenisation of experience: coefficients for experience/age

	Year	Experience /age			Exp. / age sq. ×10^{-2}		
		Females		Males	Females		Males
		exp	age	exp	exp sq	age sq	exp sq
Bonjour (1997)**	1993	0.025	0.032	-	-	-0.005	-
Bonjour (1997)***	1993	0.022	0.032	-	-	-0.005	-
Bonjour (1997)****	1993	0.048	-	0.039	-0.009	-	-0.006
H&S (1998a)**	1995	0.024	0.035	-	-	-0.001	-
H&S (1998a)**	1997	0.033	0.036	-	-	-0.001	-

Notes: ** simultaneous model estimated by Two Stage Least Squares (2SLS), using age, approximated exp and exp^2

*** simultaneous model estimated by Three Stage Least Squares (3SLS), using age, approximated exp and exp^2

**** extended wage equation with instrumented experience and experience squared (IV), using approximated exp and exp^2

Analysis and comparison of results reveal, that ...

(1) the returns on labour market experience are quite robust across different studies in Switzerland. With very few exceptions all authors find highly significant coefficients with the expected signs (i.e. positive coefficient for experience, negative for experience squared).

(2) returns to experience are generally lower for women than for men (i.e. age-earnings profiles are flatter for women than for men).

(3) women reach the maximum of their wage profile earlier in their career than men.

(4) returns to experience are lower for foreign workers. Experience acquired in their country of origin is less rewarded in the Swiss labour market than experience obtained in Switzerland.[9]

(5) correcting for the selection bias of women's labour market participation slightly lowers the returns to experience and shifts the maximum of female wage profiles to the right.

(6) the inclusion of additional control variables lowers the returns to experience slightly.

(7) returns to experience seem to have decreased for women and increased for men throughout the nineties.

(8) in the case of women's wage functions experience is an endogenous right-hand variable. In a simultaneous estimation of a Mincer wage function experience, age and age squared have a significant influence. As compared to a least squares estimation of the same specification the endogenisation of experience increases the rate of return to experience while the coefficients of age and age squared remain unchanged and quite high.

(9) instrumenting experience and experience squared in a Mincer wage equation more than doubles the returns to experience for women and increases them significantly for men. Additional job related variables, on the other hand, lose part (managerial position, size of the firm) or all (tenure) of their explanatory power.

5.4 Returns to tenure

Table 6 gives an overview of the estimated coefficients of tenure in different studies. Tenure can be taken as a proxy for firm specific human capital and is therefore of interest here. On average men in Switzerland have a tenure of 10 and women of around 7 years (Bonjour, 1997).

Table 6. Extended wage equations: coefficients for tenure

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[9] Coefficients of 0.0405–0.0052 for experience obtained before immigration and 0.0535–0.0115 for experience obtained in Switzerland, depending on the region of origin.

	Year	Tenure / Tenure sq.×10^{-2} (%)		
		Females	Males	All
Ferro-Luzzi (1996)	1991	0.019/-0.039	0.007/-0.016	0.013/-0.024
Ferro-Luzzi (1996)$^{+}$	1991	0.013/-0.026	0.005/-0.014	0.010/-0.019
Bonjour (1997)	1991	0.004	0.003	-
Bonjour (1997)	1992	0.007	0.004	-
Bonjour (1997)	1993	0.008	0.004	-
FL&S (1998)	1991	0.007	0.004	-
FL&S (1998)	1995	0.008	0.003	-
H&S (1998a)	1995	0.007	0.005	-
H&S (1998a)	1997	0.006	0.005	-

Note: $^{+}$ Estimation setting with more additional control variables.

All authors who include the variable in their setting, find significant and positive effects of tenure on wages. The estimations of Ferro-Luzzi (1996), moreover, reveal that the returns to tenure are decreasing. Curti (1998), using two dummy variables, also finds a significant positive effect of tenure on wages.

5.5 Returns to training

A dummy variable for people who had on-the-job or off-the-job training in the last 12 months is included in the estimation of Golder (1997). He finds that men with training earn about 6% more than others, indicating that human capital obtained by training is positively rewarded on the labour market in Switzerland. Curti (1998) finds that the probability for unemployed to reintegrate into the labour market positively depends on training.

6 Discussion of the disposable results

In Switzerland from 1991 onwards many estimations of rates of return to education have been carried out. Most research, however, has focused on wage discrimination of certain sub-populations (i.e. men/women, foreigners, unemployed). Nevertheless the studies contain interesting information also on rates of return to human capital.

All estimations confirm the standard human capital theory hypothesis, that an additional year of schooling causes significantly positive returns. Experience in almost all estimates leads to positive but decreasing returns, which confirms the hypothesis of concave age-earnings profiles. Furthermore, the following results seem to be quite stable across studies:

(1) Women have slightly higher returns to education than men, but clearly lower returns to potential labour market experience. Consequently the age-earnings profiles are much flatter for women than for men. This finding reflects differences in typical professional careers of men and women.

(2) Foreign workers have significantly lower returns to education as well as to experience. It can furthermore be shown, that education and experience obtained by foreigners in their country of origin are less rewarded in the Swiss labour market than education and experience obtained in Switzerland. Given the high percentage of foreigners in Switzerland (about 25% of the workforce), the distinction between foreigners and natives is of particular importance also in the context of returns to education.

(3) The inclusion of additional control variables reduces the estimated returns to schooling as well as to experience.

(4) Correction for selectivity biases of labour market participation lowers the rates of return to education for women, whereas the returns to experience are only marginally influenced.

(5) There is empirical evidence that in the case of women experience is an endogenous variable. As compared to a least squares estimation the endogenisation of experience increases the rate of return to experience while the coefficients of age and age squared still exert a significant and unchanged influence. Estimating wage functions by instrumenting experience and experience squared more than doubles the returns to experience for women and increases them significantly for men.

Even though we have learned quite a lot about rates of return to education in Switzerland, many questions remain open.

In general research that explicitly investigates returns to human capital is rather scarce in Switzerland. Most research so far has focused on wage discrimination. Questions relating to the financing of education have been only rarely addressed. One of the exceptions is Sheldon (1992) who has estimated returns to different educational degrees. Moreover, Wolter (1994), Weber (1998) and Wolter and Weber (1999) have estimated private rates of return to educational levels with the help of the so-called cost-benefit approach (for a description of the method and results, see appendix).

Unfortunately micro data for the labour market in Switzerland are available only since 1991. There is but one data set that covers 1981/82, which allows earnings functions to be estimated. Only few studies contain inter-temporally comparable results. Comparisons between different studies and years are very difficult, since the specification of the earnings function as well as the observed population vary remarkably. More research is therefore certainly needed in order to gain insight into the evolution of rates of return over time, at least in the nineties.

Concerning the inclusion of control variables we do know that they have an impact on the estimates of rates of return. More research, however, is needed to find out which types of variables have the strongest impact on returns to human capital.

None of the reviewed studies has taken into account income taxes. Wolter and Weber (1999) show that the progressive tax system in Switzerland is a non-negligible factor in the estimation of private rates of return.

The effects of an endogenisation of experience and educational decisions should be further analysed. There is evidence suggesting that endogeneity of right-hand variables like experience and schooling can alter returns substantially.

In order to learn more about private rates of return to human capital in Switzerland, it will be important to examine systematically the influence of different model specifications on private rates of return. Moreover, institutional factors as for instance the organisation and financing of the educational system as well as the nature of the tax system, have to be taken explicitly into account. Particular attention has to be given to different sub-groups like men and women or foreign workers.

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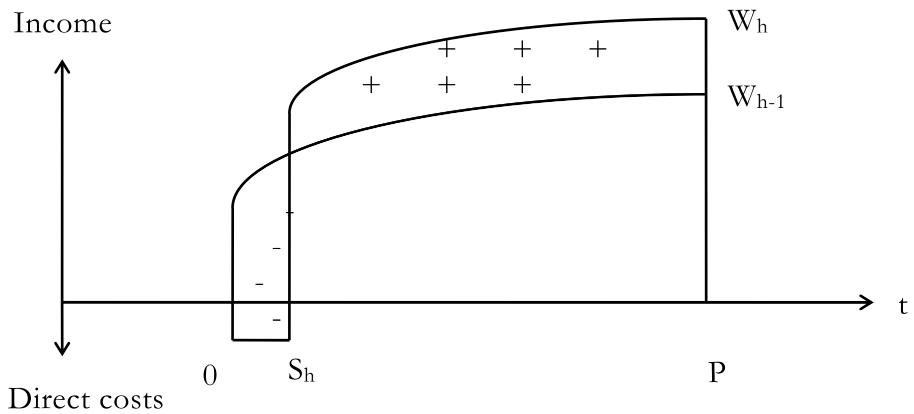
Appendix

The Cost-Benefit Approach

An alternative method to estimate private rates of return to education that can be found in the literature is the so-called *Cost-Benefit Approach,* described in Psacharopoulos (1987) and Alsalam and Conley (1995). Figure A1 shows a simple cost-benefit model for a type of education that leads to qualification level *h*. Training starts at point 0 and lasts S_h years. S_h is the point at which the individual begins professional activities in the labour market. In the educational period, there are direct costs (C_h) which include all expenditures that relate to education. There are, however, also indirect costs to be taken into account, in the form of lost earnings. In the literature these are usually assessed as the effective earnings by persons of the same age at the educational level just below (W_{h-1}). The actual wage difference between persons of different qualification levels $(W_h - W_{h-1})$ is regarded as a wage advantage determined by education. Wage advantages are obtained from the beginning of professional activities (S_h) and last to the age of retirement *(P)*.

Figure A1. The cost-benefit model



Source: Psacharopoulos (1987, p. 343)

There are a number of ways in which to evaluate information about the costs and benefits from education. *Rate of return analysis* is a way of determining the rate *r* at which discounted costs and discounted earnings cancel each other out. The corresponding equation is given in equation (A1) in discrete form. The so-called internal rate r corresponds to the average interest on capital invested in education. If the internal rate is higher than the rate of return of alternative investment projects, then the education may be considered as profitable.

$$\sum_{t=1}^{S_h}\left(C_h+W_{h-1}\right)_t\cdot\left(1+r\right)^{-t}=\sum_{t=S_h+1}^{P}\left(W_h-W_{h-1}\right)_t\cdot\left(1+r\right)^{-t} \tag{A1}$$

The *present value method* is based on comparisons between the discounted life-time incomes of individuals with different levels of educational attainment. The discount rate i enters the calculation as an exogenous measure of the alternative rate of return. Educational investments that increase the present value of the life-time income may be considered profitable. Equation (A2) shows how to calculate the *net present value* on an investment in education on level h.

$$NPV_h=\sum_{t=S_h+1}^{P}\left(W_h-W_{h-1}\right)_t\cdot\left(1+i\right)^{-t}-\sum_{t=1}^{S_h}\left(C_h+W_{h-1}\right)_t\cdot\left(1+i\right)^{-t} \tag{A2}$$

Estimations for Switzerland

Wolter (1994) has for the first time in Switzerland used a cost-benefit approach to calculate net present values of lifetime earnings for people with different educational attainments. Besides age-earnings profiles and direct education costs, he also takes explicitly into account *taxes* and a special *risk premium for the risk of dropping out of school*. His argument to include the latter is the following: as with any type of investment so with investments in one's own human capital, compensation should be allowed for the risk of failure, in the form of a risk premium. The method of calculating the risk premium proposed by Wolter assumes that the capital invested, in the form of direct and indirect costs, is lost when studies are interrupted. The loss probability is estimated in terms of drop-out quotas. An assumption is also made that dropping out of school occurs on average half way through the course of studies.

Wolter and Weber (1999) have used the same kind of analysis to calculate private rates of return to education (see equation A1). Taking into account income taxes, direct educational costs, the risk of dropping out of school and the unemployment probability, they calculate rates of return as well as net present values of lifetime earnings for men and women with different types of education.

The estimations of Weber (1998) and Wolter and Weber (1999) are based on a relatively new data source. The *Wage Structure Survey* (WSS) offers a very precise and detailed picture of the wage structure in Switzerland. From 1994 on 10,500 firms provide information on wages and individual characteristics of about 550,000 employees every two years. Wolter (1994) has used a pilot survey of the WSS, which was carried out in the canton of Geneva.

Table A1 summarises the estimates of private returns obtained by the cost-benefit approach. The figures indicate rates of return to a certain type of education, compared to the next lower educational degree.

Table A1. Private rates of return to different levels of education (in per cent)

	Wolter (1994)[a]	Weber (1998)		Wolter and Weber (1999)	
Year	1990	1994		1996	
	All	Men	Women	Men	Women
Apprenticeship (3-4 years after compulsory schooling)	10.7	8.4	11.9	8.6	11.7
Higher vocational college (2 years after apprenticeship)	11.1	8.8	8.5	7.7	7.5
Higher business or technical college (3 years after apprenticeship)[b]	6.8	10.3	8.1	10.0	7.8
University entrance certificate (4 years after compulsory schooling)	11.6	8.9	10.2	10.2	9.9
University (5 years after university entrance certificate)	5.5	5.7	4.6	3.6	4.5
Teacher training college (4-5 years after compulsory schooling)	-	5.8	9.0	5.0	10.0

Notes: [a] The results of Wolter (1994) have been transformed into rates of return by Sheldon (1996).
[b] Since 1998 Universities of Applied Science.

The estimations reveal that there are remarkable differences in rates of return between different types of education and gender.

The lowest rates of return are found at the university level.

Table A2 contains results on net present values of lifetime earnings for people who have attained different levels and types of education. It can be shown that initial wage differences beween people with different levels of education (a gross wage premium of 41–147% depending on the type of education) are substantially reduced when time preferences, taxes, direct educational costs and the risk of dropping out of the educational system are taken into account. The remaining differences in net lifetime incomes vary between 18% and 34%. These results suggest that education is profitable in Switzerland, from a purely individual and pecuniary point of view. No significant differences in net-life-incomes can, however, be observed between higher types of education.[10]

Table A2. Life-income differences, relative to people with compulsory schooling (in per cent)

	Wolter (1994)	Wolter and Weber (1999)	
Year	1990	1996	
	All	Men	Women
Apprenticeship (3-4 years after compulsory schooling)	18.5	9.2	17.1
Higher vocational college (2 years after apprenticeship)	33.8	14.5	22.2
Higher business or technical college (3 years after apprenticeship)[a]	25.0	24.7	26.0
University entrance certificate (4 years after compulsory schooling)	30.2	27.3	23.2
University (5 years after university entrance certificate)	33.8	21.3	20.9

Note: [a] Since 1998 Universities of Applied Science.

[10] Calculations with a discount rate of 5%.

CHAPTER 16

The Returns to Education in the UK

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1 Introduction[1]

This chapter outlines the main features of the UK education system and how that has changed over time; explains the way in which education is financed; briefly surveys the available literature on the returns to education; and presents some new estimates of the returns using a variety of specifications and data sets.

Section 2 outlines the main features of the UK system of education. Section 3 reviews some of the more relevant contributions to the UK applied literature. Section 4 presents new estimates.

2 The UK education system

The UK system is surveyed in more detail in DfEE (1999) and the higher education system is described in Dearing (1998). Below we highlight the essential points.

In Great Britain (GB) parents have a legal duty to ensure that their children obtain education between their 5th and 16th birthdays.[2] After the age of 16, when education is no longer compulsory, some 70 per cent stay in education, either at school (usually known as sixth-form education) or at further education (FE) colleges. Others go into work, with unemployed school-leavers guaranteed a place on the Government's training programmes for young people.

Many children under five attend state nursery schools or nursery classes attached to primary schools. Others may attend playgroups in the voluntary sector or in privately run nurseries. In England and Wales, many primary schools also operate an early admission policy where they admit children under five into reception classes. Nursery provision for three-year-olds in the state sector is funded

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[1] The data was supplied by the Economic and Social Research Council's Data Archive at the University of Essex and are used with permission of Controller of Her Majesty's Stationery Office.

[2] The minimum school leaving age was raised from 14 to 15 in 1947 and to 16 in 1974 (1975 in Scotland). In Northern Ireland (NI), compulsory schooling begins at age four.

at the discretion of Local Education Authorities (LEA) while places for children under three in voluntary or private pre-school settings are paid for largely by parents. Arrangements in Scotland are broadly similar. The government has recently implemented a free child-care programme for 4-year olds and intends to extend this to 3-year olds in the near future. Much of this free care is provided by schools which has effectively reduced the school starting age to 4.

93 per cent of pupils go to publicly funded schools, usually known as state schools. These make no charge to parents. In most areas children aged five to 10 attend primary schools, and move on to secondary schools at 11 for education up to the age of 16 or beyond. Almost all children in GB enter "comprehensive" schools at age 11 with a small proportion of areas maintaining a distinction between "grammar" schools which provide an academic education and "secondary modern" which traditionally provide a more vocational training. Entry to grammar schools is competitive on the basis of a test at age 11. However, the distinction is now less important because GB and NI have adopted a "national curriculum" which compels all (state-financed) schools to teach exactly the same topics. Independent schools are not funded by state and obtain most of their finances from fees paid by parents and income investments. Some of the larger independent schools are known as public schools. Most boarding schools are independent schools. Qualifications are as in the state sector.

In Scotland, 32 Scottish Local Authorities are responsible for the provision of education locally. School Boards, with elected parent and teacher members, play an important part in the running of Scottish State schools. There are three school categories: state schools, which are maintained and controlled by the LEA; grant-aided schools (including those for special educational needs); self-governing schools (equivalent to grant-maintained schools in England).

In Northern Ireland State schooling is administered centrally by the Department of Education and locally in controlled schools by five Education and Library Boards. There are several categories of school: controlled schools; voluntary maintained schools and voluntary grammar schools. Although all schools in Northern Ireland are open to pupils of all religions, most Roman Catholic pupils attend schools under Catholic management and most Protestant children attend controlled schools and non-denominational voluntary grammar schools.

In England, Wales and Northern Ireland GCSEs (General Certificate of Secondary Education) are normally taken at age 15–16. Pupils are tested by assessment of work during the course and examinations at the end of the course. GCSEs replaced the ordinary level (O level) and Certificate of Secondary Education (CSE) qualifications in 1988. GCE A level (General Certificate of Education Advanced level) and AS (Advanced Supplementary) examinations are usually taken after two years of further education (mostly aged 18). Passes are graded from A to G (A being the highest grade) primarily on final examinations and provide the main academic qualification for entry to higher education. GCE AS level examinations are at the same standard as GCE A levels, but each examination covers less content

In Scotland the Scottish Certificate of Education, Standard and Higher Grades, are equivalent to the GCSE and GCE A level. The Certificate of Sixth Year Studies (CSYS) builds on Higher Grade, encouraging independent study in preparation for higher education and the world of work. Assessment is by external exam and, in most cases, dissertation or project report.

Young people who decide to stay on in education at the age of 16 usually move into further education (FE). This is provided by a diverse range of institutions, including: sixth forms in secondary schools and sixth form colleges (in England and Wales only); general further education colleges; agricultural and horticultural colleges; art and design colleges; and specialist institutions such as the College of the Sea.

From April 1993, colleges of further education, tertiary colleges and sixth form colleges which previously received grants direct from the Government were given the autonomy to run their own affairs within the further education sector. Colleges are free to determine their own policies regarding tuition fees, except for 16 to 18 year-old home and EU students in full-time education, for whom tuition fees are not usually charged. The Further Education Funding Council (England) funds education and training in 446 institutions, and is responsible for ensuring universal availability of further education places.

A large proportion of young people (about one-third in England and Wales and almost half in Scotland) continues in education at a more advanced level beyond the age of 18. This higher education (HE) sector provides a variety of courses up to degree (usually 3 years) and postgraduate degree level. Over 50 per cent of students are now aged over 25 and many study part-time. Up to 1998 higher education institutions were funded by grant and fees paid by the Government on behalf of students. Tuition fees of £1,000 per year were introduced in 1998 – representing a quarter of the average cost of a course. Tuition remains free for students from lower income families. Loans will not be available for tuition fees. Students do, however, receive grants and subsidised loans to cover their living expenses.

There are 89 universities (one of which, the University of London, comprises over 40 institutions) and 19 colleges and institutes of higher education which have the power to award their own degrees. These include the former polytechnics or new universities, which gained degree awarding in the early 1990s. There are 34 other colleges of higher education, which do not have degree-awarding powers, but provide courses leading to degrees validated by universities. There are currently 1,194,500 full-time and 662,100 part-time students in higher education in the UK.

The Open College provides individuals and employers with open learning courses and support materials. It was initially funded by the Government but is now self-financing. The Open University has pioneered open and distance learning at university level in Britain and has grown to become the country's largest single teaching institution. No formal academic qualifications are required to enrol on undergraduate courses, but the standard of its degrees and other qualifications are as high as those of other universities. In 1995 more than 150,000 students were registered with the Open University, over 10,000 at post-graduate level.

General National Vocational Qualifications (GNVQs), (GSVQs in Scotland) combine general and vocational education. GNVQs provide a path into both education and employment. They are normally studied in school or college. National Vocational Qualifications (NVQs), (SVQs in Scotland) are occupation specific. Based on the competencies required in particular occupations, NVQs are made up of a number of units, which set out industry-defined standards of occupational competence. These describe the skills and knowledge people need to be able to perform effectively at work.

3 The previous literature

The aim of this literature review is to show the current state of knowledge in the applied research into the private returns to education in the United Kingdom. We endeavour to identify the robustness of results to the choice of data set, model specification and estimation procedure. The first section gives a brief overview of the literature in tabular form. Following on from this we present a more detailed description of the data sets used, the specification of the earnings equation, the estimation procedures and finally the main results

Table 1 outlines the period, data set and variables used in the selected studies. The dependent variable is the logarithm of earnings throughout. Harmon and Walker (1995) use pooled *Family Expenditure Survey* (FES) data for 1978 to 1986. Miles (1997) uses FES data for individual years. In the FES the sample size each year is around 5,000. Harmon and Walker (1999a) use pooled *General Household Survey* (GHS) data for 1974 to 1994. Each year contains approximately 20,000 observations, of which about half have employee/wage data. Bell (1996), Dearden (1998) and Harmon and Walker (1999b) uses the *National Child Development Survey* (NCDS) data, which is a continuing longitudinal survey of people who were born between 3 and 9 March 1958. There have been five waves, the last being in 1991. There were initially over 18,000 in the study, of which 5,000 have been lost due to attrition. Hildreth (1997) and Ermisch and Francesconi (1997) use *BHPS data* for the years 1991 and 1995. The BHPS is a panel survey of 5,500 households (over 10,000 individuals) interviewed annually. Brown and Sessions (1998) use pooled *British Social Attitudes* (BSA) survey data. Beginning in 1983 there are around 3,000 adults in each annual survey.

Bell (1996), Brown and Sessions (1998), Dearden (1998), Ermisch and Francesconi (1997), Hildreth (1997) and Harmon and Walker (1995, 1999a, 1999b) use the log real gross hourly wage using the Retail Price Index as the deflator where necessary. Miles (1997) uses the "normal" level of net weekly household earnings.

Table 1. Summary of previous specifications

	Bell (1996)	Brown & Sessions (1998)	Dearden (1998)	Ermisch & Francesconi (1997)	Harmon & Walker (1995)
Year	1991	1985-1994	1991	1991-1995	1978-86
Data Set	NCDS	BSA	NCDS	BHPS	FES
Data Type	Panel	X Section	Cohort	Panel	X Section
Education Yrs	✓	✓			✓
Qualifications		✓	✓	✓	
Age				✓	✓
Age^2				✓	✓
Experience		✓			
Experience^2		✓			
Region			✓		✓
Family			✓	✓	
School Type			✓		
Employer	✓		✓		
Trade Union	✓		✓		
Sex	✓	M only	✓	✓	M only
Year		✓			✓
Ability	✓		✓		
Occupation	✓				
IV/H2S			✓	✓	✓
Work Selection		✓*		✓	

Note: * Corrected for selectivity into employment and self-employment.

	Harmon & Walker (1999a)	Harmon & Walker (1999b)	Hildreth (1997)	Miles (1997)	Blundell, et al. (1997)
Year	1974-94	1991	1991, 1995	1983, 86, 90	1991
Data Set	GHS	NCDS	BHPS	FES	NCDS
Data Type	X-Section	Cohort	Panel	X-Section	Cohort
Education Yrs	✓	✓	✓	✓	
Qualifications			✓		✓
Age	✓		✓	✓	
Age^2	✓		✓	✓	
Experience			✓		
Experience^2			✓		
Region	✓	✓	✓	✓	✓
Family		✓			✓
School Type		✓	✓		✓
Employer			✓		✓
Trade Union			✓		✓
Sex	M only	M only	✓	✓	✓
Year	✓				
Occupation			✓	✓	
IV/H2S	✓	✓			✓
Work Selection			✓**		✓***

Notes: ** Also corrects for selectivity by union status.
*** Also corrects for selection of sample with A-levels.

Harmon and Walker (1995) and Harmon and Walker (1999a) use years of full-time schooling imputed from the reported school leaving age. Miles (1997) uses the actual school leaving age. Harmon and Walker (1999a) also introduce school leaving age dummies to allow for non-linearity. Harmon and Walker (1999b) uses years of post-16 schooling. Bell (1996), Dearden (1998), Brown and Sessions (1998) and Hildreth (1997) use both years of schooling and qualifications, again to allow for non-linearity in returns. Ermisch and Francesconi (1997) use O level, A level and "higher" dummies and interactions between these and age.

Hildreth (1997) uses both age and actual experience. Brown and Sessions (1998) use potential experience and potential experience squared. Ermisch and Francesconi (1997) use age and age squared, together with their interactions with qualifications. Due to the fact that experience is endogenous Harmon and Walker (1995) and Harmon and Walker (1999a) use age and age squared. Miles (1997) use age and age squared interacted with employment status to allow the life-cycle profile of earnings.

Dearden (1998) uses ordinary least squares (OLS) to obtain estimations of the standard Mincerian earnings function. She then uses the instrumental variable (IV) approach on years of schooling, and on the qualifications model uses a selection model where years of schooling is treated as an ordered probit to overcome the fact that schooling is not a continuous variable. This is a Heckman (1979) two-step procedure where a correction term (the inverse Mills' ratio) is obtained in the first-stage reduced form equation, and then included as a regressor in the earnings function. Separate estimates are obtained for males and females.

Harmon and Walker (1995) and Harmon and Walker (1999a) estimate using OLS, and then IV (and the Heckman two-step model to correct for the fact that schooling is not a continuous variable). Harmon and Walker (1999a) also use a dummy variables model to allow for non-linearity. Harmon and Walker (1999b) uses OLS and IV on the endogenous component of education. Ermisch and Francesconi (1997) follow a similar approach to Harmon and Walker (1999b) with corrections being included for participation and education selections. The reliance on only qualifications does allow for some non-linearity. Brown and Sessions (1998) again use two-steps, the first of which is a multinomial logit regression to provide a correction term for selection into unemployment, self-employment or general employment. The second step is again OLS with the relevant correction term included. They endeavour to distinguish between signals of ability and the actual increase in human capital, by utilising the fact that the self-employed give no weight to a signal. Hildreth (1997) provides OLS estimates after selection into unions has been corrected for and includes gender decompositions. This paper attempts to explain changes in the union wage differential. Miles (1997) uses standard OLS in trying to explain cross-sectional variations in household incomes. Bell (1996) obtains standard OLS estimates both with and without ability dummies.

Table 2. Rate of returns to years of schooling

	Males		Females	
	OLS	IV	OLS	IV
Dearden (1998)	4.8%	5.5%	8.3%	9.3%
Harmon and Walker (1995)	6.1%	15.2%		
Harmon and Walker (1999a)	4.1%	14.0%		
Hildreth (1997)*	5.0%		5.0%	
Miles (1997)	≈3%		≈3%	
Brown and Sessions (1998)	10.8%			
Bell (1996*)	4.6%		4.6%	
Harmon and Walker (1999b)	5.1%	9.9%		

Table 3. Total returns to qualifications

		Males		Females	
		OLS	IV	OLS	IV
Dearden (1998)	A level	37.6%	41.7%	37.2%	43.9%
	Degree	50.1%	56.2%	63.6%	73.8%
Hildreth (1997***)	A level	30.9%		30.9%	
	Degree	68.2%		68.2%	
Brown and Sessions (1998)	A level	34.3%			
	Degree	71.2%			
Ermisch and Francensconi	A level	0.6%	9.6%	43.5%	
(1997**)	Degree	26.4%	36.4%	71.3%	
Blundell et al. (1997) ****	Degree	20.8%	17.1%	39.1%	36.8%
Bell (1996)	A level	25.9%		25.9%	
	Degree	45.2%		45.2%	

Notes: * Males and females in the same equation.
** Education not found to be endogenous for females.
*** Qualification returns calculated as the sum of the returns to years of schooling and qualification dummies.
**** Omitted category is A-level.

Dearden (1998) obtains OLS estimates of 4.8% and 8.3% for males and females, respectively, for the returns to years of schooling, (5.5% and 9.3% using IV). Using OLS Harmon and Walker (1995) and Harmon and Walker (1999a) estimate the male returns to be 6.1% and 4.1%, respectively, which dramatically understates the IV estimates of 15.2% and 14.0%. This downward bias of OLS estimates is consistent with other international studies. Each year of extra schooling in the non-linear model of Harmon and Walker (1999a) provides returns of approximately 5% with OLS, which are roughly doubled when using IV. Harmon and Walker (1999b) who obtain an OLS estimate of 5.1% and an IV estimate of 9.9% support this. Dearden (1998) obtains OLS estimates, using qualifications, of around 15% and 9% per year for males, and 15% and 12% for females, for A-level and degree study respectively.

Hildreth (1997) estimates 5% returns per year with additional estimates for qualifications obtained and place of study. This result is for pooled 1991 and 1995 data with males and females both included. Brown and Sessions (1998) also obtain estimates of the returns to an additional year of schooling of 10.8% for males. Miles (1997) acknowledges the potential downward bias of his estimated returns of 3% due to the holding constant of occupation whilst changing education. Ermisch and Francesconi (1997) estimate returns of approximately 2.5% and 10% per year for males, and 16% and 20% for females, for A-level and degree study respectively, when taking the average of nine slightly different model specifications. Bell (1996) obtains OLS results (not including ability dummies) consistent with other studies. Blundell et al. (1997) using a group with at least one A level as a reference group, obtain estimates for the returns to higher education. Those who obtain a degree have an OLS estimated return of 20.8% for men and 39.1% for women (17.1% and 36.8% having controlled for selection into employment as well as into further education and instrumented for ability).

4 New estimates of the returns to education

This section presents preliminary descriptions of the stylised facts and some estimates of the returns to education for a variety of simple models using several of the available data sets from the UK.

Figure 1. Education and wages - GB men and women in FES

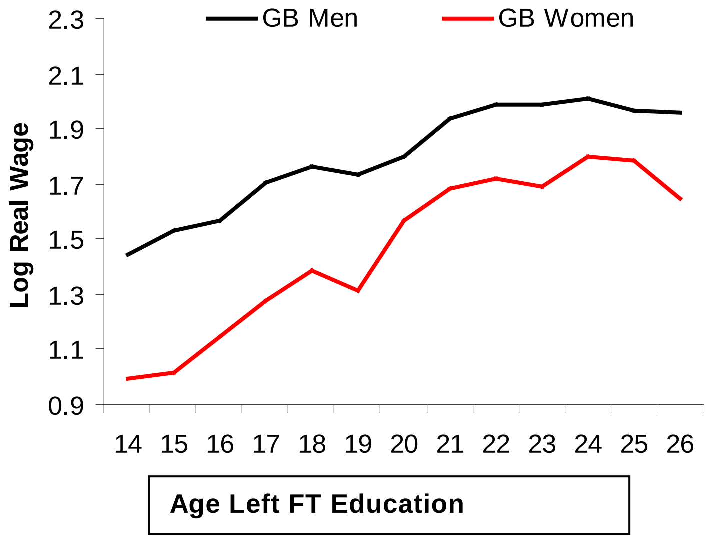


Figure 2. Education and wages - GB men and women in FRS

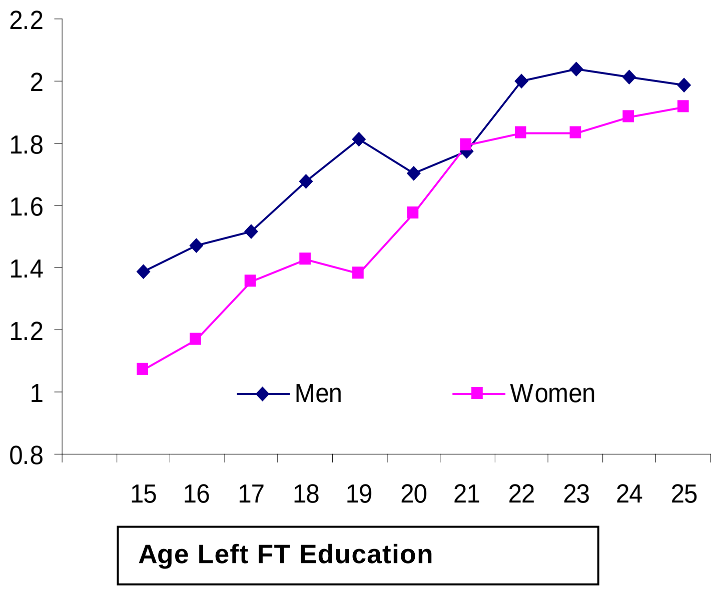


Figure 3. Age and wages by age left school - GB men in FES

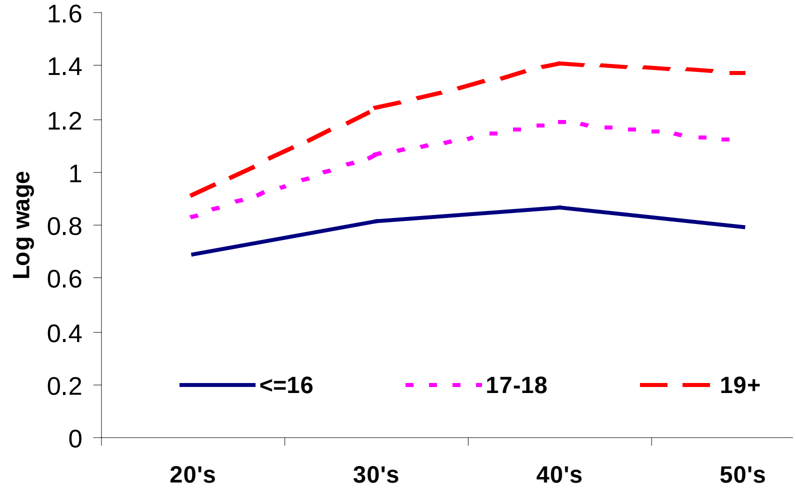
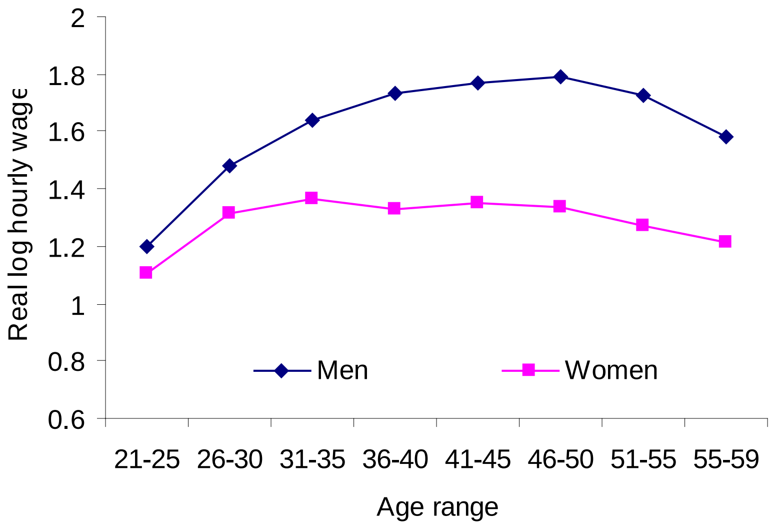


Figure 4. Age and wages - GB men and women in FRS

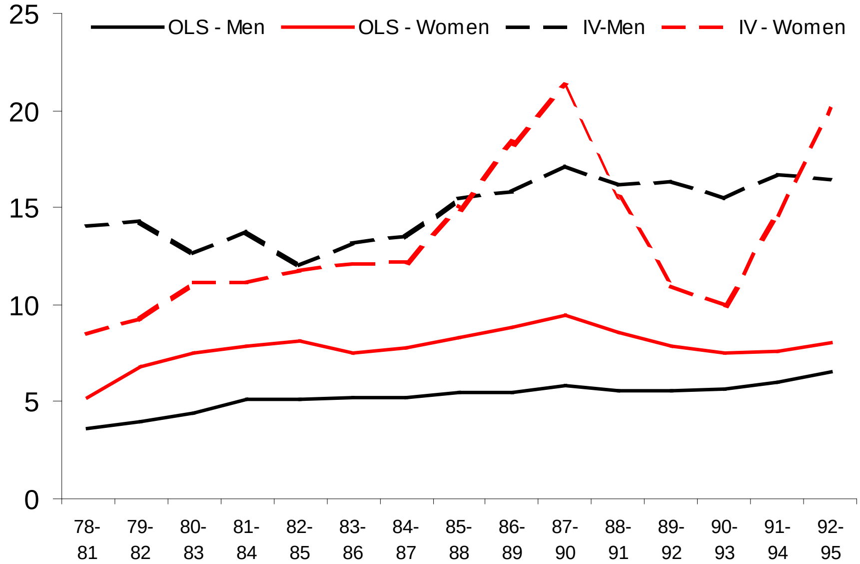


The FES is a random sample of approximately 7,000 households each year and years of education is available for every year from 1978. Figure 1 shows the approximately linear relationship between full-time school leaving age and the log real hourly wage (there are few observations above 24 and below 15 or in the 19/20 "dip") for men and women aged 21–59 in Great Britain (i.e UK excluding Northern Ireland). Note that the relationship for men is distinctly flatter than for women.

The FRS data is a random sample of approximately 25,000 households conducted every year from 1993/4 and Figure 2 shows the same relationship between wages and education in that data.

Figure 3 shows the relationship between log wages and age for individuals with different levels of schooling (for GB men aged 21–59) in FES. Figure 4 shows the average relationships for men and women in FRS pooled for the three years 93/4–96/7. Note the characteristically flatter shape for those with lower levels of education and for women.

Figure 5. Estimated returns to education: UK FES 1978-95



Note: Each estimate is obtained from pooling four consecutive years. Estimates control for quadratic in age, region and year dummies. Instruments are minimum school leaving age dummies and smoking dummy. Total sample is 16,780 women and 25,200 men.

The availability of FES over a long period of time alows us to test for stability of returns over time. In Figure 5 we present estimates of the rate of return estimated from pooling successive four years of FES data using OLS and IV where we instrument education by minimum school leaving age dummies (see Harmon and Walker, 1995) and a smoking dummy (see Evans and Montgomery, 1994). The estimates are highly significant and the differences between men and women and between IV and OLS are statistically significant. The IV estimates are reasonably robust to changes in the instrument set used (see Harmon and Walker, 1999a). Tests of the stability of the estimates over time show significant rises in returns for both IV and OLS up to the early 1990s but not thereafter.

The finding that the returns have been rising, and certainly not falling, is surprising in the light of the dramatic increases in the higher education participation rate that took place over this period. It suggests that the large increase in the supply of graduates failed to keep pace with the demand for them.

In Table 4 we use the pooled FRS data to show that the estimated returns to education vary with respect to the definition of experience. Using a quadratic in age tends to produce the lowest returns of approximately 8% for men and 11% for women, while using potential experience (age minus education leaving age) or actual expe-

Table 4. Estimated OLS rates of return: FRS GB employees aged 21-59

	Age	Actual experience	Potential experience	Sample size
All - no gender dummy	0.0943 (0.0009)	0.1183 (0.0009)	0.1085 (0.0010)	59045
All - with gender dummy	0.0925 (0.0009)	0.1085 (0.0009)	0.1068 (0.0009)	59045
Men	0.0793 (0.0012)	0.0986 (0.0012)	0.0987 (0.0013)	29685
Women	0.1066 (0.0012)	0.1200 (0.0012)	0.1161 (0.0013)	29360

Note: All specifications include union membership, region dummies, unemployment by region and month, and a monthly trend variable.

rience (recorded in the data as the sum of the number of years of part-time and full-time work since leaving full-time education) indicates a return to education of approximately 10% for men and 12% for women. The sample sizes are large and the estimates are very precise so even these small differences are statistically significant.

Table 5. OLS rates of return and PT work: FRS GB employees aged 21-59

	All	Men	Women
No hours control	0.0975 (0.009)	0.0842 (0.0012)	0.1121 (0.0013)
PT dummy included	0.0948 (0.0009)	0.0850 (0.0012)	0.1061 (0.0012)
PT instrumented	0.0983 (0.0011)	0.0857 (0.0015)	0.1019 (0.0016)

Note: Estimates control for age, age squared, union status, trend, marital status and gender. Instrument set includes unearned income.

Figure 6. Returns to education by region: men and women in FES/NIFES

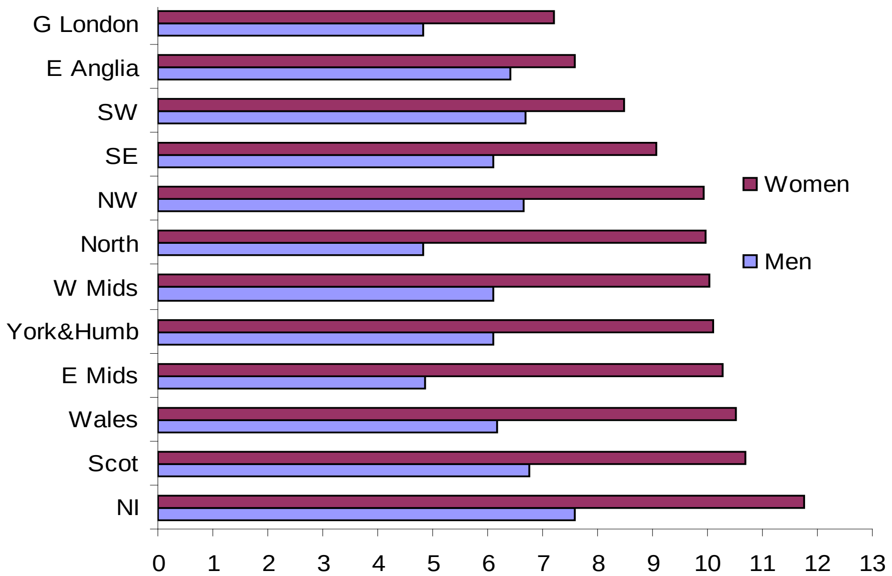


Table 5 shows how the estimated return to education varies according to whether individuals are full- or part-time workers. We instrument part-time status with unearned income although this has no effect on the estimated education return which remains at around 8% for men and 11% for women.

In Figure 6 we use the GB FES and the NIFES pooled together and investigate the extent to which returns to education differ across region. The returns in Northern Ireland are significantly higher than in GB but within GB the differences are not significant.

Finally we use the British Household Panel Survey to investigate the robustness of the return to education to the use of other con-

Table 6. Estimated OLS rates of return: BHPS GB employees aged 21-59, Wave 4

	All	Men	Women
Basic specification	0.071 (0.003)	0.0588 (0.004)	0.0838 (0.004)
with plant size dummies	0.686 (0.003)	0.0564 (0.004)	0.0815 (0.004)
with quadratic in tenure and plant size dummies	0.0695 (0.003)	0.057 (0.004)	0.0818 (0.004)
Sample size	3384	1597	1787

Note: Estimates control for age, age squared, union status, region, marital status and gender.

Table 7. OLS rates of return: BHPS GB employees aged 21-59, Waves 1-6

Wave	All	Men	Women
1991	7.62 (0.38)	6.95 (0.43)	9.43 (0.65)
1992	7.18 (0.30)	6.16 (0.40)	8.16 (0.44)
1993	7.13 (0.31)	5.57 (0.41)	8.64 (0.44)
1994	7.10 (0.31)	6.94 (0.40)	8.38 (0.44)
1995	6.76 (0.32)	5.86 (0.44)	7.32 (0.46)
1996	7.20 (0.32)	6.58 (0.45)	7.41 (0.46)

Note: Estimates control for age, age squared, union status, region, foreign-born, marital status and gender.

trol variables: tenure in the current job and plant size. The results are summarised in Tables 6 and 7. In Table 6 we use just Wave 4 (September 1994) of the BHPS and show that the estimated OLS returns are higher for women than for men but stable with respect to the inclusion of plant size and length of tenure controls. In Table 7 we show that the returns vary little across waves, relative to the precision of the estimates, using the basic specification.

5 Conclusion

The results suggest that the rate of return is stable in the face of specification changes, but that education is endogenous and that estimates which instrument education find substantially higher returns. The returns for men are lower than for women. There is some suggestion that the returns have risen over the 1980s but have remained static since. A reasonable summary of the results suggests that the returns to education estimated by OLS for GB are, in recent years, approximately 7–10% for men and 8–12% for women. However, estimates obtained using a variety of instruments suggest that these OLS estimates are biased downwards quite considerably and that the true returns are in the order of 15%.

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