ETLA ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY Sarja B 183 Series

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EDUCATION AND EARNINGS

Further Evidence from Europe

ETLA, The Research Institute of the Finnish Economy
Publisher: Taloustieto Oy

Helsinki 2001

Cover: Mainos MayDay, Vantaa 2001

ISBN 951-628-350-0
ISSN 0356-7443

Printed in: Tummavuoren Kirjapaino Oy,
Vantaa

ASPLUND, Rita, **EDUCATION AND EARNINGS. Further Evidence from Europe**. Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos. The Research Institute of the Finnish Economy 2001, 188 p. (B, ISSN 0356-7443, No. 183). ISBN 951-628-350-0.

ABSTRACT: This book offers further European evidence on the economic role of education at the individual level. A first topic concerns the potential impact of the differing risk of unemployment across differently educated people on the estimated return to education. Accounting for these differences along with the effects of the unemployment benefit system does influence the average return to education but the impact varies substantially across countries. A second topic focuses on what the return to education actually measures. Do investments in education really improve the productivity of individuals or are they merely devices used for signaling to employers about innate abilities? The evidence in support of the productivity-augmenting effect remains considerably stronger than the evidence in support of the signaling role. A third topic addresses the occurrence of general and firm-specific training and its relation to job mobility. Firms turn out to invest in both types of training, and there is no clear-cut evidence that those having received general training show a higher tendency of leaving the firm. A fourth and final topic explores the enrolment into higher education and the impact of public funding and current returns to education on these decisions. This supply-side aspect is further linked mainly to the demand for educated labour, but also to the institutional labour market framework, in an attempt to explain the observed variation in average returns to education across European countries. Public funding and admission rules are found to be important determinants of the supply of educated labour. The impact of the current rate of return to education is negligible. In itself, however, the return to education is highly dependent on the balance between supply and demand, much less so on the institutional labour market setting.

KEY WORDS: enrolment, higher education, human capital, job mobility, return to education, screening, training, unemployment

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TIIVISTELMÄ: Tässä kirjassa esitetään uutta Euroopan laajuista tutkimustietoa koulutuksen yksilöille tuottamasta taloudellisesta hyödystä. Ensimmäinen teema koskee eripituisen koulutuksen suorittaneiden työttömyysriskissä esiinty-

viä eroja ja niiden vaikutusta koulutusinvestoinneista syntyvään hyötyyn palkassa mitattuna. Näiden erojen, kuten myös työttömyysturvajärjestelmän vaikutusten huomioon ottaminen heijastuu koulutuksen keskimääräiseen tuottoasteeseen, mutta vaikutuksen suuruus vaihtelee merkittävästi Euroopan maiden välillä. Toinen aihe keskittyy kysymykseen, mitä koulutuksen tuottoaste loppujen lopuksi mittaa. Parantavatko koulutusinvestoinnit yksilöiden tuottavuutta vai rajoittuuko niiden rooli pelkiksi signaaleiksi työnantajille yksilöiden synnynnäisestä kyvykkyydestä? Tutkimustulokset ovat edelleen ristiriitaisia mutta antavat selvästi voimakkaampaa tukea tuottavuushypoteesille kuin signalointiargumentille. Kolmas teema pohtii yritysten halua investoida yleisluontoiseen verrattuna yrityskohtaiseen koulutukseen ja koulutusmuodon mahdollista yhteyttä työntekijän todennäköisyyteen vaihtaa työpaikkaa. Tulokset osoittavat, että yritykset investoivat molempiin ja että koulutusmuodolla ei ole selvää yhteyttä työ-paikan vaihtamisen todennäköisyyteen. Neljäs ja viimeinen aihepiiri tutkii korkea-asteen koulutukseen hakeutumista sekä julkisen rahoituksen ja koulutuksen tuottoasteen vaikutusta näihin päätöksiin. Lisäksi yritetään selittää Euroopan maiden välillä esiintyviä eroja koulutuksen tuottoasteessa täydentämällä tätä tarjontapuolen näkökulmaa ensisijaisesti kysyntäpuoleen, mutta myös työmarkkinoiden instituutioihin, liittyvillä näkökohdilla. Tuloksien mukaan julkinen rahoitus ja sisäänpääsyehdot vaikuttavat ratkaisevasti koulutetun työvoiman tarjontaan. Vastaavaa vaikutusta ei löydy koulutuksen nykyisen tuottoasteen osalta. Yksilöiden koulutusinvestoinneistaan saama taloudellinen hyöty vuorostaan riippuu tarjonnan ja kysynnän tasapainosta, vähemmän työmarkkinoiden instituutioista.

AVAINSANAT: inhimillinen pääoma, korkea-asteen koulutus, koulutukseen hakeutuminen, koulutuksen tuottoaste, signalointi, työpaikkakoulutus, työpaikan vaihto, työttömyys

Preface

The economic and societal role of education has occupied the minds of academics as well as policy-makers for decades. Nevertheless there continues to be an urgent demand for new basic knowledge on educational issues. Currently special interest is paid not least to the production of comparable cross-country results, which are of considerable importance for both national and EU level end-users. So far such comparative research is rather scarce, however. The recently completed project *Public funding and private returns to education – PURE* provides a unique contribution to fill some of this gap. The present volume is the third and last one published within the framework of the project. In addition to the three books, the project has produced a multitude of other reports as is evident from the its web-site http://www.etla.fi/PURE.

As the managing director of the co-ordinating partner, The Research Institute of the Finnish Economy ETLA, I would like to take this opportunity to thank the European Commission, DG Research, for having provided a major part of the financial means needed for undertaking the project. Special thanks go to the scientific contact persons of the project, Ms Maria Carvalho Dias and Ms Virginia Vitorino, and also to the economic contact person Mr Alan Wells. Their support during the project has been invaluable. The success of the project is exclusively due to an incredibly inspiring and hard working team of researchers from all the fourteen partner countries that have co-operated with us in this project. We owe them our deepest gratitude. On behalf of our partners we also wish to thank all national bodies that have contributed to the financing of the project. As representing the Finnish partner ETLA gratefully acknowledges the financial support received from the Academy of Finland.

Hopefully this path-breaking European-wide project will continue to inspire discussion and research on the topics covered.

Helsinki, September 2001

Pentti Vartia

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Chapter 1

INTRODUCTION

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The EU–TSER funded project *Public funding and private returns to education – PURE* (contract number SOE2-CT98-2044) has during its two-year duration, 1.11.1998–31.10.2000, produced a broad number of working papers, many of which have already been elaborated into book or journal articles. Moreover, this process has not yet been finalised, but is still in high progress, which the present volume is the most recent example of.

The overarching objective of the PURE project was to study the impact of different systems of public financial support for school attendance on observed outcomes in the labour market, particularly in terms of the levels and dispersion of private returns to education and education-related inequality in earnings. The project here intended to move into a territory not yet studied from the perspective of optimal investment in human capital, the role of student finance systems, school admission rules (free or selective entry) and school differentiation.

The project was originally divided into several distinct but closely related issues that were to be addressed in detail:

- Analysis and comparison of wage and human capital structures and private returns to education between countries and within countries over time in order to uncover distinct trends as well as similarities and dissimilarities across countries.
- Analysis of the impact on country-specific trends in educational returns of changes over time in underlying market forces (supply-side and demand-side factors).
- Analysis of the impact on country-specific trends in educational returns of carefully differentiated measures of returns by type and level of education in order to highlight and compare national systems of education.
- Analysis of the structure and evolution of the national systems of education, admission rules and systems of financial support for school attendance to be used as input in other parts of the project.
- Analysis of the effects of differing systems of public support for cost of education to individuals and admission rules on the private returns to education and on earnings inequality related to differences in educational attainment.

No less than 15 European countries have been involved in the project, that is, Austria, Denmark, France, Germany, Greece, Ireland, It-

aly, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK, and Finland as the co-ordinating partner. This has provided extraordinary opportunities to produce, on a comparable basis, cross-country evidence at a European level on a broad set of policy-relevant issues related to private returns to education.

Previous to the current volume, the PURE project has resulted in three books:

- *Returns to Human Capital in Europe – A Review of the Literature* (ETLA, Series B 156, Helsinki, 1999) edited by Rita Asplund and Pedro Telhado Pereira, a book that reviews country-by-country the current state-of-the-art of the research field covered by the PURE project.
- *Education and Earnings in Europe: A Cross Country Analysis of the Returns to Education* (Edward Elgar Publishing Ltd., 2001) edited by Colm Harmon, Ian Walker and Niels Westergaard–Nielsen. The book contains a comprehensive introductory chapter on returns to education written by the three editors, and 15 nation-specific chapters. In other words, the content covers both extensive PURE cross-country comparisons and national chapters giving more details on the various empirical results produced within each partner country.
- *Public funding and private returns to education – PURE. Final report. January 2001.* This final report is divided into three parts. The first part summarises a major part of all the research work done within the project. The second part presents a few of the large number of country-specific studies that have been undertaken in relation to the project. The third part, finally, highlights the considerable contribution to the project of each partner country. The final report will be published by the Commission. It is also available at the PURE web-site www.etla.fi/PURE.

The current book, finally, provides further evidence on two education-related dimensions to which the PURE project has paid considerable attention: the rate of return to education and enrolment into higher education. Chapter 2 undertakes in-depth analyses of the consequences for the magnitude of the traditionally estimated rate of return to education of considering the unequal distribution of unemployment across educational levels and the 'equalising' role of the unemployment benefit system. Chapters 3 and 4 address the complex question of what the estimated returns actually measure: Is education

a productivity-augmenting investment or merely a signaling device? Chapter 5 turns the focus from the rate of return to education *per se* to the intricate issue of firm-specific training and its uneven distribution across not least differently educated employees. Chapter 6 departs from the observed variation in levels and trends of average returns to education across Europe. An attempt is made to explain this variation by country-specific differences in supply and demand as well as in labour market institutions. Considerable efforts are thereby made to tackle the challenging task of examining the impact of public expenditure and returns to education on enrolment into higher education. This topic is further elaborated in Chapter 7.

Chapter 2

UNEMPLOYMENT AND RETURNS TO EDUCATION IN EUROPE*

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* We gratefully acknowledge the economic support of the European Commission (contract number SOE2-CT98-2044 'Public funding and private returns to education – PURE') and CICYT (grant SS 97-1333). We are indebted to PURE partners for providing the estimated wage equations and national information used in this study. Thanks are due to participants in the Lisbon PURE user-oriented seminar and especially to Lord Richard Layard for helpful comments and suggestions.
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2.1 Introduction

In most European countries, unemployment has been a dramatic problem in the last twenty years, not only due to the level reached but also because the burden of unemployment has been unequally distributed across different groups of the labour force. In fact, the data for the European countries analysed in this research clearly show that unemployment decreases with education. Distinguishing between low, medium and high educational levels, in all countries, the least educated individuals have higher unemployment rates than the more educated ones.[1] Therefore, increasing the educational level is profitable not only because this allows the more educated to obtain higher wages, but also because the more educated are less likely to become unemployed.

Even in a world with imperfect information and financial restrictions, the human capital model suggests that individuals should invest in those levels of education with higher rates of return. Simultaneously, the price of each level (or year) of education, reflected in the rates of return to schooling, is an indication to the public sector of the relative scarcity of qualifications in the labour force and, consequently, an indication of where public investment should be directed. Both for the individuals and the public sector, therefore, rates of return to schooling are a guide for investment. As is well known, however, the standard estimate of the rate of return to schooling is based on a comparison of observed earnings. Therefore, full employment is an implicit assumption in this procedure. The problem lies not only in the fact that many European countries are far from full employment, but also in the unemployment rate being inversely related to the educational level. In any case, the conclusion is that the standard estimate of the rate of return to schooling is distorted and a correction for unemployment becomes necessary.

The central idea behind the correction proposed in this study is to calculate the rate of return to schooling using the age-*expected* earnings profile instead of the age-*observed* earnings profile. This change is very important because the lower unemployment probability at higher educational levels is transformed into a widening of the gap between the relative *expected* gains that is not captured by the *observed* relative wages.

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[1] See the equivalence of these three educational levels for each country in Appendix 2.1.

Obviously, if unemployment benefits fully covered foregone earnings, the private rate of return would remain unchanged. However, this is not the case. Firstly, not all the unemployed individuals are eligible for unemployment benefits, that is, the coverage rate is not 100%.[2] Secondly, in most cases, the unemployment benefit consists of a fixed amount or it is a percentage of the previous earnings but, in any case, the unemployment benefit is lower than the foregone earnings, that is, the replacement rate is less than 100%. Additionally, it is important to note that these conditions vary considerably across countries. As a consequence, the returns to education must be computed taking both the unemployment probability and the unemployment benefit system into account.

Therefore, the aim of this study is to propose a new way to estimate the rates of return to schooling that will capture the influence of both the unemployment differentials by educational levels and the unemployment benefit. This methodology is applied to eleven European countries (Austria, Finland, France, Germany, Greece, Ireland, Italy, Portugal, Spain, Sweden and Switzerland).

As previously mentioned, the main idea in order to correct the rate of return is based on the adjustment of the age–earnings profiles by the probability of being employed. A procedure which allows us to introduce that probability thus modifying the age–earnings profile and, as a consequence, the rate of return, is the so-called 'elaborate method' (Psacharopoulos 1981). This implies the calculation of the rate of return that equals the opportunity costs and the expected life-cycle earnings.

Accordingly, in our research we consider that the distribution of expected earnings results from three factors: the distribution of wages, the probability distribution of being employed and the distribution of unemployment benefits. From this approach it is clear that the institutional factors of the labour market (the level and coverage of unemployment insurance) have a non-negligible impact on the rates of return to schooling and, as a result, on the household decision to invest in education. In addition, the introduction of these aspects affects both the level and the pattern of returns to the different levels of education.[3]

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2 The most common case refers to unemployed persons who are still looking for their first job and who, in some cases, are not eligible for unemployment benefits.

3 Guiso et al. (1998) have shown that the variability in expected earnings, if wages are non-flexible, depends on unemployment, while in the opposite case it depends on wages. Accordingly, we should expect a larger role for unemployment in European economies than in the American one.

The chapter is organised as follows. In section two a review is done so as to establish the work context of previous research in the field. The next section describes the pattern of unemployment by age and education level. Section four introduces the framework of our research, while in section five the main results are shown. From them, it is interesting to note that, as might be expected, both the level and relativities of rates of return within each country undergo a non-negligible change. A final section presents the conclusions.

2.2 Previous work

A large literature has addressed education demand, drop-outs and incidence/duration of unemployment. Nevertheless, little research has been directed to investigate the impact of unemployment differentials between educational groups on rates of return. Even if there is clear agreement on the underestimation of values of internal rates, previous work trying to adjust them by unemployment is rather scarce.

However, some authors have worked on this issue and some research has been undertaken. For instance, Psacharopoulus and Hinchliffe (1973, p. 29) state: "Age–earnings profiles often need a downward adjustment because of the probability of unemployment". Also Weale (1993), pointing to the potential sources of downward bias in the value of rates of return, says: "Obviously, any assessment of the benefits of education which compares the remuneration of different types of employed labour, and neglects the differential probability of unemployment, will normally understate both private and social returns to education" (p. 732). Additionally, Trostel and Walker (2000, p. 3) indicate: "Our very preliminary examination of this issue suggests that it causes a non-trivial downward bias in the estimated rate of return to education". However, these topics have been addressed to a limited extent in the calculation of the rate-of-return literature, and do not seem to have been fully appreciated.

Among the first works estimating the effect of unemployment on the calculation of the rate of return, Nickell (1979) should be mentioned. He adjusts rates of return by introducing unemployment because, as he says: "…we shall be underestimating the private rate of return to the extent that the individual will only be in receipt of those earnings for some proportion of the time where the proportion is directly related to schooling" (p. S126). This author also found that after

correcting for unemployment, the pre-tax weekly income rises by 0.6% (from 8% to 8.6%), but when after-tax income and unemployment benefit are considered the impact is lower and very small (0.1% – 0.2%). More recently, Groot and Oosterbeek (1992), Asplund et al. (1996), Oliver et al. (1998) and Wolter and Weber (1999) have also estimated the effect of unemployment on the level of rates of return to schooling. The approach of Groot and Oosterbeek (1992) is based on non-parametric estimates and it is limited to 35–45 year-old men. Asplund et al. (1996) reformulate the earnings equation to allow for the introduction of unemployment by defining the *basic earnings* as the product of the wage rate and the *expected* number of hours worked. In all these cases, when unemployment differentials are taken into account, there is a general returns-to-education increase at all levels.

To sum up, it is quite surprising that, while the number of papers devoted to the calculation of rates of return to schooling is really impressive[4], the study of the impact of unemployment on it is so scarce. Our aim is to contribute to the discussion on the relationship between unemployment and education through this particular point, in line with the approaches of Nickell (1979), Groot and Oosterbeek (1992), Asplund et al. (1996), Oliver et al. (1998) and Wolter and Weber (1999).

2.3 Unemployment and education: empirical description

In what follows, a descriptive analysis is made of the relation between unemployment and education in the countries under study. Eleven European countries make up our sample (Austria, Finland, France, Germany, Greece, Ireland, Italy, Portugal, Spain, Sweden and Switzerland). The sample refers to full-time wage-earners only. In Table 2.1 the structure of unemployment, broken down by educational level, is summarised. In almost every country we observe the typical negative relationship between unemployment rates and level of schooling with two exceptions. In Greece and Portugal we find significantly higher unemployment rates at the medium level as compared to the low level.

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4 Blaug states that "Calculations of the rates of return to invest in formal schooling have proved to be the bread-and-butter of the human capital research program: literally hundreds of such studies have now been carried out around the world in both developed and developing countries (...)."(Blaug 1992, p. 6)

This fact may at least partly be explained by the relative importance of agriculture in these countries.

Table 2.1 Unemployment rates by educational level*

	Low	Medium	High	Total	Medium/ low	High/ medium
Austria	8.2	4.4	2.5	5.0	-46	-43
Finland	21.9	15.7	6.4	15.4	-28	-59
France	14.3	8.7	6.2	10.2	-39	-29
Germany	12.9	7.1	4.3	7.3	-45	-39
Greece	5.2	8.7	4.5	6.2	67	-48
Ireland	18.8	9.7	5.2	13.5	-48	-46
Italy	9.6	8.8	4.4	8.9	-8	-50
Portugal	5.3	6.3	3.0	5.3	19	-52
Spain	17.7	16.1	11.1	16.3	-9	-31
Sweden	12.3	10.7	4.9	9.8	-13	-54
Switzerland	6.4	3.1	2.6	3.5	-52	-16

* Percentage of labour force and percentage change between levels.
The period over which the average rates are calculated are the following: for Austria the average is from 1995 to 1998; for Finland, 1995 to 1999; for France, Italy, Portugal and Spain, 1992 to 1999; for Germany and Ireland, 1992 to 1997; for Greece, 1992 to 1998; for Sweden, 1992 to 1996; for Switzerland, 1996 to 1999.
For more details, see Table A1 of Appendix 2.3.

Source: Eurostat

In some countries the differences have the expected sign but are not statistically significant. In general, the relative difference in unemployment rates between high and medium levels of schooling is more important.

If the investigated countries are classified according to their structure of unemployment rates, the sample can be split into two groups. Thus, it is possible to identify one group with a significant negative relative unemployment difference between the high and medium levels, but a lower difference between the medium and low levels of education (Finland, Sweden, Spain and Italy) or even a positive difference (Portugal and Greece). A second group has significant unemployment differences at both levels of education (Austria, Ireland, Germany,

Table 2.2 Unemployment rates by age and educational level*

	Rates				Relative differentials	
	Low	Medium	High	Total	Medium/ low	High/ medium
Youth unemployment (< 30 years)						
Spain	29.4	26.9	24.5	26.9	-8.2	-9.2
Finland	43.3	23.2	11.6	26.0	-46.5	-49.8
Italy	20.5	21.3	24.2	22.0	3.8	13.8
France	25.6	14.8	11.5	17.3	-42.2	-22.7
Ireland	28.2	14.1	9.2	17.2	-49.9	-34.5
Greece	11.8	17.3	15.4	14.8	47.0	-11.2
Sweden	23.5	15.1	5.5	14.7	-36.0	-63.2
Portugal	8.4	10.8	8.2	9.1	29.0	-23.5
Germany	11.5	7.3	5.2	8.0	-36.7	-28.1
Austria	8.9	5.3	5.0	6.4	-41.2	-4.7
Switzerland	6.4	4.4	7.9	6.2	-31.4	78.7
Average	19.8	14.6	11.7	15.3	-19.3	-14.0
Adult unemployment (>29 years)						
Finland	16.0	12.5	5.6	11.4	-22.1	-54.9
Spain	13.5	8.6	5.6	9.3	-36.1	-35.3
Ireland	15.7	6.4	3.4	8.5	-59.0	-47.1
Germany	13.7	7.0	4.2	8.3	-49.0	-40.0
Sweden	10.1	9.0	4.8	8.0	-11.2	-46.4
France	11.2	6.4	4.6	7.4	-42.5	-28.2
Switzerland	6.4	6.4	1.9	4.9	0.0	-71.1
Austria	7.9	4.1	2.1	4.7	-48.5	-48.1
Italy	5.8	3.1	2.1	3.7	-46.0	-34.3
Greece	3.8	4.0	2.4	3.4	6.4	-38.8
Portugal	4.3	3.6	1.8	3.3	-15.3	-49.3
Average	9.9	6.5	3.5	6.6	-29.4	-44.9
Total average unemployment rates						
	12.1	9.0	5.0	9.2	-28.9	-28.0

* Average values of the available years for each country. Countries ranked by youth and adult unemployment rates. Changes and rates in per cent. For more details, see Tables A2 and A3 of Appendix 2.3.

Source: Eurostat

Switzerland and France). Certainly, there is no relationship between these unemployment rate differentials in educational levels and the absolute level of unemployment. In particular, on the one hand, Spain was the country with the highest average unemployment rate in the period considered, while the relative differential between the low and medium educational levels is one of the lowest among the countries studied. The other side of the coin covers Austria and Switzerland with a small total unemployment rate (5% and 3.5%) but a large dispersion in unemployment rates between both levels in Austria, and between low and medium in the Swiss case.

As we are looking at a decision-making process that is supposed to take place at a young age, youth labour market conditions should be taken into account as well. The extent of youth labour market tightness is going to condition the perception of opportunity costs of the educational decision. From the data in Table 2.2 (a breakdown by five-year age groups is displayed in Tables A2 and A3 of Appendix 2.3), two special features should be noted. Firstly, as was expected, youth unemployment rates are higher than the adult ones: the average total youth unemployment rate is 15.3% (compared with 6.6% for adults). Youth unemployment rates gradually decrease as we move up the educational ladder (19.8% for low to 14.6% for medium and to 11.7% for high), but not all countries show the same pattern. In Italy the opposite pattern appears while Portugal, Greece and Switzerland also show deviations from the common pattern. Secondly, the change between levels is larger in the adult than in the youth unemployment rates: while for young people the decreasing unemployment change is –19.3% between low and medium levels and –14.0% between medium and high levels, the corresponding values for the adult population go up to –29.4% and –44.9%.

2.4 Basic framework of the analysis

In a human capital framework, individuals face a decision in completing their compulsory education. They can stop studying and search for a job or they can continue in further education to increase their human capital (or also to consume education). This choice is made by maximising the present discounted value of expected future net benefits, other things being equal. A point to bear in mind is that an assumption is made that students form their earnings expectations from the current wages and employment rates in the labour market.

Depending on the institutional framework, the expected rate of return to schooling for those who decide to continue in the educational system, as opposed to the alternative of entering the labour market, would be more adequately approached by the rate of return with unemployment benefits. If access to unemployment benefits is not limited to those individuals with employment experience, the more adequate approximation to the expected rate of return would be the alternative that includes unemployment probability plus unemployment benefits. But in countries like Italy and Spain, in which eligibility for unemployment benefits depends on previous employment, the expected rate of return should be approximated through a weighted average of the rate of return to schooling with and without unemployment benefits. However, if the income expectation includes the whole life-cycle income, the worker expects to become employed after a certain period of job search, and to have access to the unemployment benefits if, in the future, he becomes unemployed.

In order to take the unemployment probability into account, the calculation of the return to schooling follows a three-step approach. In each step the expected life-cycle profile is modified by the introduction of different hypotheses. In the first step, the expected earnings profile is obtained from the classical Mincerian equation. The formula of the expected earnings flow has the traditional expression

$$\tilde{Y} = \exp\{\hat{Y} + \frac{1}{2}\hat{\sigma}^2\} \tag{2.1}$$

where $\hat{Y}$ is the predicted value of the log of earnings from the Mincerian equation and σ^2 is the regression residuals variance.[5] In the second step, this profile is modified to take into account the differences in employment probability according to each educational level and age. Logically, the introduction of this probability will in most cases reduce the expected earnings obtained directly from the Mincerian equation.

$$\tilde{Y} = (\exp\{\hat{Y} + \frac{1}{2}\hat{\sigma}^2\}) * p \tag{2.2}$$

where p is the employment probability. Finally, we shift these age–earnings profiles by the unemployment benefit

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[5] As is well known, under normality this correction should eliminate bias.

$$\tilde{\hat{Y}} = (\exp\{\hat{Y} + \frac{1}{2}\hat{\sigma}^2\}) * p + B * c * (1 - p) \tag{2.3}$$

where B is the unemployment benefit and c the coverage rate. In most countries, B has been estimated as a percentage of wages, assuming that the individual would be employed. For this reason, in general $B=\hat{Y} * f$, where f is the average replacement rate.

The three different life-cycle earnings flows are used to obtain three internal rates of return that equalise the expected earnings to the opportunity costs. Let Y be the earnings life-cycle flow and 1 and 2 two different educational levels, where 2 is higher than 1. Then r (the marginal internal rate of return to schooling of level 2) is obtained by solving the following equation in r

$$\sum_{t=h+1}^{n} (\tilde{Y}_2 - \tilde{Y}_1)_t (1+r)^{-t} = \sum_{t=1}^{h} (\tilde{Y}_1)_t (1+r)^t \tag{2.4}$$

where h is the total of years of foregone earnings of an individual who continues in level 2 and n is the number of years of active life.

In order to predict expected gross earnings, a traditional Mincerian equation such as (2.5) is used to obtain the expected life-cycle profile of earnings for each educational level.

$$\hat{Y} = a + b_2 * LEVEL_2 + b_3 * LEVEL_3 + c * EXPERIENCE + d * EXPERIENCE^2 + e \tag{2.5}$$

where $\hat{Y}$ is log annual gross earnings, $LEVEL$ are dummy variables for medium (2) and higher (3) ISCED-educational levels, the lower level being the reference group, $EXPERIENCE$ is defined, as usual, as age minus school-starting age minus the number of standard years for completing each educational level, and e is an error term. The introduction of annual earnings allows us to consider the impact of unemployment on the total earnings received, because, as Ashenfelter and Ham (1979) showed[6], the relationship between earnings and unem-

[6] They showed that the desired supply of hours is not correlated with the level of education but with the actual number of hours worked. The use of earnings as the dependent variable can also be found in Groot and Oosterbeek (1992).

ployment comes from the number of hours worked in each period, which is dependent on the educational level. The use of gross earnings (instead of post-tax income) is related both to the economic meaning of the rate of return (the productivity of the labour force) and the difficulties of homogenising tax treatment of unemployment benefits across countries.

The probability of being employed *(p)* was introduced in the following way. A specific tabulation was obtained from Eurostat with population shares broken down by five-year age groups and a common definition of employment status (employees, self-employed, unemployed, not active) for 1992 to 1999.[7] Additionally, to avoid the impact of a particular cyclical situation in unemployment we use an average unemployment rate for all the disposable years. Finally, it has to be underlined that in our approach we simplify the unemployment situation considering all of it as involuntary, in accordance with the Eurostat definition.[8]

Finally, defining a representative individual profile for each country allows the inclusion of unemployment benefits. In Table 2.3 the different considered values of coverage rates and replacement rates are summarised.

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7 See note to Table 2.1.

8 There is another way of generating the unemployment life-cycle profile. This alternative is based on the predicted values obtained from a probit model (1 if the individual is employed, 0 if he is unemployed) using educational levels, age and age squared as regressors. We carried out a comparative exercise between the two approaches (probit model and Eurostat data) using Spanish data. The wage equation was obtained using data from the 1995 *Wage Structure Survey*, while the probit model used data from the 1995 *Labour Force Survey*. The differences between the rates of return based on a probit model (10.85% for medium vs. low level and 11.12% for high vs. medium level) and those based on the unemployment Eurostat data set (10.32% and 11.93%, respectively) are negligible. This methodology based on a probit model for each country was rejected due to problems with homogeneity of information from the different national data sets.

Table 2.3 Average unemployment benefit, % of earnings

	Coverage rate A	Average replacement rate B	Average benefit C=A*B
Austria	100.0	26.0	26.0
Finland	75.0	69.1	51.8
France	56.0	66.5	37.2
Germany	100.0	62.0	62.0
Greece			
Ireland			28.0
Italy			19.0
Portugal			
Spain	68.0	65.0	44.2
Sweden	66.9	75.0	50.2
Switzerland	60.0	75.0	45.0

2.5 Results

2.5.1 Internal rates of return to schooling by levels and countries

Table 2.4 shows a summary of the main results. IRR1 is the non-adjusted internal rate of return calculated using the original expected life-cycle earnings profile (equation (2.1)). IRR2 (the partially adjusted) is the internal rate when this profile is conditioned on the employment probability (equation (2.2)), while IRR3 (fully adjusted) also includes the expected unemployment benefit (equation (2.3)). From the table it is clear that the introduction of the probability of being employed and the consideration of the unemployment benefit leads to an important change in the fully adjusted rates. In particular, some stylised facts arise from these changes.

First of all, and considering the change between the unadjusted and fully adjusted marginal internal rates (IRR1 vs. IRR3), in all situations and countries the expected pattern of increasing rates appears, with only few exceptions (Finland and Switzerland in adjusting the marginal return to high level). For marginal rates of return to medium level, Ireland, France and Finland show particularly important increases.

Table 2.4 Marginal returns to education (IRR) with average unemployment rates and unemployment benefits*

	IRR1 a	IRR2 b	IRR3 c	Change in IRR b/a*100	Change in IRR c/a*100	Change in IRR c/b*100	Unemployment rates Low	Unemployment rates Medium	Unemp. different.
Marginal returns to medium level									
Ireland	9.2	19.5	15.9	112.0	72.8	-18.5	18.8	9.7	-48.4
France	6.4	13.4	10.3	109.4	60.9	-23.1	14.3	8.7	-39.2
Finland	4.0	11.3	6.2	182.5	55.0	-45.1	21.9	15.7	-28.3
Sweden	4.6	7.6	5.8	65.2	26.1	-23.7	12.3	10.7	-13.0
Italy	5.7	7.2	6.9	26.3	21.1	-4.2	9.6	8.8	-8.3
Austria	12.9	15.7	15.0	21.7	16.3	-4.5	8.2	4.4	-46.3
Spain	8.1	11.0	9.3	35.8	14.8	-15.5	17.7	16.1	-9.0
Germany	12.7	17.3	14.4	36.2	13.4	-16.8	12.9	7.1	-45.0
Switzerland	8.9	9.7	9.3	9.0	4.5	-4.1	6.4	3.1	-51.6
Greece	5.0	5.1	-	2.0	-	-	5.2	8.7	+67.3
Portugal	8.6	8.7	-	1.2	-	-	5.4	6.3	+16.7

	IRR1 a	IRR2 b	IRR3 c	Change in IRR b/a*100	Change in IRR c/a*100	Change in IRR c/b*100	Unemployment rates Medium	Unemployment rates High	Unemp. different.
Marginal returns to high level									
Italy	4.3	7.3	6.4	69.8	48.8	-12.3	8.8	4.4	-50.0
Sweden	5.1	7.9	6.3	54.9	23.5	-20.3	10.7	4.9	-54.2
Ireland	9.4	12.5	11.5	33.0	22.3	-8.0	9.7	5.2	-46.4
Greece	8.3	9.9	-	19.3	19.3	0.0	8.7	4.5	-48.3
Spain	7.5	10.0	8.6	33.3	14.7	-14.0	16.1	11.1	-31.1
France	7.2	8.6	8.0	19.4	11.1	-7.0	8.7	6.2	-28.7
Germany	5.7	6.9	6.1	21.1	7.0	-11.6	7.1	4.3	-39.4
Austria	5.4	5.8	5.7	7.4	5.6	-1.7	4.4	2.5	-43.2
Portugal	20.6	22.5	-	9.2	0.0	-8.4	6.3	3.0	-52.4
Finland	7.7	10.2	7.6	32.5	-1.3	-25.5	15.7	6.4	-59.2
Switzerland	9.1	8.8	8.9	-3.3	-2.2	1.1	3.1	2.6	-16.1

* Per cent. Ranked by decreasing change in IRR3/IRR1.

A second point is that the influence of institutional factors has to be considered. This effect is clearly shown by the change between IRR2 (the partially adjusted rates, without including benefits) and IRR3 (the

fully adjusted ones, including unemployment benefits), which reflects the impact of the inclusion of benefits in the expected earnings on the rates of return. Therefore we should expect a reduction from IRR2 to IRR3. Differences in this fall appear across countries.

Thirdly, also the modification in the *relative position* of each rate within a country should be stressed. As important as the relative, or the absolute, change in the rate due to the adjustment is the effect it has on the relativities among returns within countries, given that this is an indication of the market relative scarcity of labour force skills. Then, if our definition of internal rates alters the pattern of 'relative prices', the consequences for both public and private decisions on investment in education should not be negligible. This seems to be the case, as shown in Table 2.5. For example, medium and high rates of return in Italy and Finland are very similar when the adjustment is taken into account. Ireland, Switzerland and France show extreme cases in that the ranking of returns is reversed after adjustment.

Table 2.5 Change in relative returns differentials, %

	IRR1			IRR3		
	Medium	High	Medium/high	Medium	High	Medium/high
Greece	5.0	8.3	60.2	5.1	9.9	94.1
Finland	4.0	7.7	92.5	6.2	7.6	22.6
Italy	5.7	4.3	-24.6	6.9	6.4	-7.2
Sweden	4.6	5.1	10.9	5.8	6.3	8.6
Spain	8.1	7.5	-7.4	9.3	8.6	-7.5
Germany	12.7	5.7	-55.1	14.4	6.1	-57.6
Portugal	8.6	20.6	139.5	8.7	22.5	158.6
Austria	12.9	5.4	-58.1	15.0	5.7	-62.0
Ireland	9.2	9.4	2.2	15.9	11.5	-27.7
Switzerland	8.9	9.1	2.2	9.3	8.9	-4.3
France	6.4	7.2	12.5	10.3	8.0	-22.3

2.5.2 What explains returns to schooling? Some simulation results

As explained in the previous section, the changes in the internal rates across countries and educational levels are very different. Some countries with a high level of unemployment, and also a non-negligible differential between educational levels, show important modifications in the levels and differentials of rates of return, while others in a similar situation experience smaller changes. In addition, the sign of this change is different across countries. Overall, these results suggest that the effect of the average employment probability on returns is very different across countries and educational levels, and the same could be said for the unemployment benefit. In order to disentangle the effects of the different factors affecting the adjusted returns, we carried out a simulation exercise.

The private IRR of educational investment depends in a complex way on a list of conditioning variables: wage differentials between educational levels, employment probabilities for the different educational levels, and the replacement and coverage ratios. These characteristics are specific for each country. So, when analysing the determinants of the educational investment the answer must be country specific.

On the other hand, in the sample countries, the private decision to invest in human capital is centred on passing from secondary to tertiary level, because most of the secondary educational level is compulsory. So, hereafter, we will concentrate on analysing the response of the private return in passing from the secondary level to the tertiary educational level. In doing these calculations, and in order to eliminate some possible transitory factors, we have considered the average values of the variables in the last eight years.

The simulation has been carried out in the following way. Firstly, we established a set of values of different explanatory variables (employment probabilities by educational level and age, and unemployment benefit conditions) around the actual average value. Secondly, for each value of explanatory variable *j* its respective IRR was calculated, keeping constant the other explanatory variables on their average actual values. Once a data set was generated, we estimated the following equation

$$IRR_{i,j} = \alpha_{i,j} + \beta_{i,j} * X_{i,j} + e_{i,j} \qquad (2.6)$$

where *i* indicates country, and *j* indicates the following variables in turn: youth employment probability with medium level, youth employment probability with high level, adult employment probability with medium level, adult employment probability with high level, coverage rate and replacement rate. β_{ij} should be interpreted as the response of IRR country *i* to a change in explanatory variable *j*. Table 2.6 shows a summary of the estimated β's, and Table A4 in Appendix 2.3 shows the used estimation equations.[9]

Table 2.6 IRR response to changes in the explanatory variables (β's)*

	Adult employment		Youth employment			
	Medium	High	Medium	High	Coverage rate	Replacement rate
Austria	-7.2	11.3	-6.9	3.4	-0.10	-0.38
Finland	-5.3	8.0	-5.2	2.5	-1.75	-1.90
France	-6.5	10.2	-7.7	4.3	-0.92	-0.78
Germany	-12.2	14.4	-3.3	2.0	-0.71	-1.14
Greece	-18.0	27.5	-17.5	11.1	-0.41	-0.25
Ireland	-17.9	25.3	-15.4	10.5	-0.80	-2.84
Italy	-21.5	33.0	-8.0	4.8	-0.16	-0.82
Portugal	-5.3	11.1	-31.6	22.7	-1.85	1.12
Spain	-9.1	12.4	-10.7	7.4	-1.97	-2.06
Sweden	-9.7	12.6	-8.1	5.3	-2.00	-1.79
Switzerland	-9.1	13.3	-11.9	8.4	0.25	0.20

* The table shows the change (multiplied by 100) in IRR of the considered countries induced by a change of one point in each one of the explanatory variables. The range of variation for measuring the dependent variable (IRR) as well as the explanatory variables (employment rates, coverage rates and replacement rates) is between 0 and 1.
Adult employment probability: Reflects the employment rate in relation to the labour force for people older than 30 years. The considered educational levels are 'medium' and 'high'.
Youth employment probability: As in the previous case, reflects the employment rate in relation to the labour force for people younger than 30 years and the two educational levels.
Coverage rate: Represents the proportion of the unemployed population that receives unemployment benefit.
Replacement ratio: Is the proportion between the estimated wage and the unemployment benefit in the event of unemployment.

[9] Another possibility is based on the direct difference between the two IRR in the average real value of the explanatory variables. These results are shown in Table A5 in Appendix 2.3 and, as can be seen, they are very similar.

For each row, the table shows how a change of one point in, respectively, adult employment probabilities, youth employment probabilities, coverage rates and replacement rates entails a change in the corresponding internal rate of return. In order to make the interpretation easier IRR is multiplied by 100. So, the changes in IRR must be interpreted as changes in percentage points.[10]

From a theoretical point of view, when the employment probability for medium level increases, *ceteris paribus,* the foregone earnings should also increase and, consequently, IRR decreases. On the other hand, when the employment probability for high level increases, the reverse is true. This fact explains the negative response associated to changes in the employment probability for medium levels, and the positive response in the case of high levels (see Table 2.6). In addition, an increase in the unemployment benefit also causes a decrease in the foregone earnings and, consequently, a reduction in IRR. As Table 2.6 shows, our results are in line with theory.

From these results, three points should be stressed:

- First of all, with the exception of Portugal, the variation of adult employment probabilities is a more important conditioning factor of IRR than variations of youth employment probabilities. At a first glance, this result may seem surprising. However, the reason lies in the fact that in order to compute IRR, the youth employment probabilities operate around eight years (from the age of 22 to the age of 30), whereas, *ceteris paribus*, the adult employment probabilities apply during thirty-five years (from 31 to 65 years).
- Secondly, the high response of IRR to adult employment probabilities for Greece, Ireland and Italy (approximately between 25 and 33 percentage points), and the high response of IRR to youth employment probabilities for Portugal (32 percentage points) must be remarked. The highly non-linear relation between IRR and expected wage differentials is behind these results.
- Thirdly, the response of IRR to the coverage rate and to the replacement rate is limited. Due to the mechanism through which those variables affect the determination of IRR, the values that the rate of return reaches are only marginally affected by both variables.

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[10] It must be borne in mind that, strictly speaking, each value of the explanatory variables is associated to a different response. So, it is not correct to extrapolate the values obtained to other economic conditions that clearly differ from the picture that emerges from the eight-year average considered in this estimation.

In any case, two caveats must be mentioned in relation to the interpretation of the results.

In the first place, a cross-section is used to evaluate a life-cycle income stream. In an 'ex post' evaluation of the private returns to education, this implicitly means that the present experience of individuals who nowadays are, for example, fifty years old, is relevant in order to forecast the income stream thirty years forward for individuals who nowadays are twenty years old. In our case, this experience must be informative, not only about wage differentials, but also in terms of employment probabilities. However, we must recognise that this limitation is common to all evaluations of returns to education starting from cross-section information. In any case, the analysis has been limited to the male population because this hypothesis cannot reliably be applied to women's behaviour in some countries. The reason is due to the structural change that female participation rates have undergone during the last decade in some of the countries of Southern Europe.

The second caveat is that if we interpret IRR, not as an 'ex post' return but as the private expected benefits derived from an educational investment, the expectations that economic agents form about the future must operate through an average of past realisations of employment probabilities. This interpretation also implies that private agents, after having reached a secondary educational level whereby they must decide whether to enter the labour market or to continue in the educational system, have information about the relevant wage equations.

In any case, the figures in Table 2.6 convey the following simple idea: returns to tertiary education are clearly affected by changes in unemployment rates. A reduction of the unemployment rate in the higher level and an increase of the unemployment rate in the secondary level provide an incentive to enrol in higher education. In fact, an increase of the unemployment rate of secondary education tends to reduce the opportunity cost of higher education, and at the same time a reduction of the unemployment rate of higher education increases the expected benefits derived from the educational investment. The recent experience of some countries, Spain among them, of a large increase in the enrolment rate into higher education, is difficult to understand unless the different employment probabilities linked to the educational levels are taken into account. For some countries, the increase in the enrolment rate into tertiary education and the increase in the unemployment rate of the less educated population have occurred in parallel. The chart that we are considering allows us to justify a causal relation be-

tween both variables through the effects of unemployment rates on returns to education.

2.6 Conclusions

Traditionally, the returns to education have been approximated through a Mincerian wage equation that relates wages to schooling. In a situation of full employment, or almost full employment, or in a situation in which the unemployment rates are similar between different educational levels, such an approach could be adequate. However, if the unemployment rate is relatively high and unevenly distributed a bias in the estimation could occur if unemployment is not taken into account. Our analysis strongly suggests that the adjusted marginal internal rates of return are different from the non-adjusted ones. The results show the following stylised facts.

Firstly, unemployment inclusion notably changes the values of the non-adjusted internal rates (an increase of 24.6% in marginal medium level education and a further 12.4% in high level education). Therefore, unemployment (and the unemployment benefit) matters when the calculation of internal rates of return to schooling is our objective. Not taking both effects into account may lead, as could be expected, to underestimated returns. Theoretically the sign of the change is ambiguous, since both opportunity costs and expected incomes decrease, but in most cases the joint effect of employment probability and unemployment benefit is a return increase. Of course, this change is larger when returns are adjusted by employment probability only. When the unemployment benefit is included, a decreasing pattern appears, but not so important as to offset the employment probability effect.

Secondly, if the public sector takes the marginal rates of return as a proxy of the relative scarcity of those educational qualifications in the labour market, misguided decisions can be taken if the unemployment probabilities are not included in the calculation. The unadjusted internal rate could only be used in a situation of full employment. But in a situation, as in most European countries, where unemployment is unevenly distributed between educational levels, the unadjusted internal rate obtained from the most parsimonious Mincerian equation is not the proper one.

As a final point, it should be mentioned that the proposed methodology to correct the internal rates of return to schooling could supply

an input to those models that try to determine the optimal length of schooling and its relation to the cyclical economic evolution. Increasing enrolment in higher education is a rational response in countries with slack labour markets during long periods. If the unemployment rate of unskilled individuals is high, continuing in the educational system barely has a perceptible opportunity cost and, at the same time, the expected benefits of higher education increase to the extent that a higher educational level induces lower unemployment probabilities. Conversely, if there are plenty of good job opportunities for all educational levels, staying in the educational system has a clear opportunity cost that must be balanced with the extra benefits that the higher educational level is able to offer. Without this element affecting the households' decisions, in some countries, such as Spain, it is difficult to understand the recent evolution of the enrolment rate in the educational system.

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Appendix 2.1 Educational equivalence levels

Some countries have experienced problems in allocating national qualifications to the different levels of education as defined by Eurostat (ISCED). For this reason, data using ISCED is available only for three categories: *low* defined as the level equal to or lower than the first stage of secondary education; *medium* defined as second stage of secondary education; *high* defined as third level education. The very high rate of non-response for Germany is due to the fact that the these questions are not compulsory. The number of persons who have completed medium level education is underestimated for Ireland due to the nature of the Irish questionnaire, which does not provide information on specific vocational training.

ISCED variable (3 categories) in the LFS 1992–1997 series

Columns 86 (Highest level of general education attained) and 87 (Highest level of post-school or vocational training attained) of the LFS (cf. Methods and Definitions – 1992 Series) do not have direct equivalents in the international terminology used in the ISCED (International Standard Classification of Education). Therefore, it appeared necessary to create a new variable based on the two headings concerned in order to achieve a closer alignment with the concepts used in the ISCED. Eurostat thus created an indicator for "Level of education and training" based on a combination of columns 86 and 87, which is calculated as follows. Each individual is allocated to one of the following four levels (in the order set out below):

ISCED variable	Columns 86 and 87 (LFS 1992-97)
Level of higher education (ISCED 5-7) – *High*	col. 87 = 5-7 or col. 86 = 4
Level of upper secondary education (ISCED 3) – *Medium*	col. 87 = 2,4 or col. 86 = 3
Level of education below upper secondary level (ISCED 0-2) – *Low*	col. 86 = 1,2,5 or col. 86 = blank and col. 87 = 1,3,8
Undefined	if col. 86 = blank and col. 87 = blank

Danmark
Sajle 86: 1 = Folkeskole op til 8. Klasse; 2 = Afsluttet folkeskole 9. eller 10. Klassetrin; 3 = Afsluttet gymnasie eller Hoejere Forberedelseseksamen uddannelse; 4 = Sajle 87 = 5/6/7; 5 = Andet.
Sajle 87: 1 = Ingen erhvervsuddannelse; 2 = Erhuerusfaglig Grunduddannelse, basisår; 3 = -; 4 = Afsluttet lærlinge- og elevuddannelse, efteruddannelse af faglærte og

tillærte; 5 = Kortere og mellemlange videregående uddannelser af mindre end 3 års varighed; 6 = -; 7 = Mellemlange og længerevarende uddannelser af 3 års varighed eller derover; 8 = Anden erhvervsuddannelse.

Deutschland
Spalte 86: 1 = Kein Hauptschulabschluß oder Realschulabschluß; 2 = Hauptschulabschluß / Realschulabschluß; 3 = Fachhochschulreife / Hochschulreife; 4 = Spalte 87 = 5/6/7; 5 = Andere.
Spalte 87: 1 = Keine berufliche Ausbildung oder berufliche Schulung; 2 = Mittlere Reife / Hochschulreife an einer beruflichen Schule; 3 = Berufliches Praktikum; 4 = Abschluß einer beruflichen Ausbildung im dualen System (Lehre), Berufsfachschulabschluß; 5 = Meister- / Technikerabschluß; 6 = -; 7 = Fachhochschulabschluß / Hochschulabschluß; 8 = Sonstiger beruflicher Bildungsabschluß.

Ellada
Column 86: 1 = Illiterate, Primary school or less, Dimotiko or lower; 2 = Gymnasio; 3 = General lykeio; 4 = Column 87 = 5/6/7; 5 = Other.
Column 87: 1 = None; 2 = TCL from vocational/technical lykeio or from specialised branch of polytechnical lykeio or equivalent qualification from other institute; 3 = Vocational training (minimum one year) in working environment; 4 = TES; certificate of technical-vocational training (third-level vocational and ecclesiastic education); Technical-vocational schools (for graduates of three-year of High School); 5 = Graduates with certificate of Third-level technical Education (KATEE/TEI); Graduates with certificate of SELETE/ASETEM; Graduates with certificate of Charokopios School of Home Economics; 6 = Graduates with certificate (Higher education); 7 = Graduates with doctorate or diploma of post-doctorate studies; 8 = Other vocational qualification.

España
Columna 86: 1 = Analfabetos, sin estudios, estudios primarios, ensenanza general basica (EGB), ciclos inicial y medio o primera etapa y equivalente; 2 = Ensenanza general: segundo grado, primer ciclo. Bachiller elemental, ensenanza general basica (EGB), ciclo superior o segunda etapa y educacion secundaria obligatoria (nuevo sistema); 3 = Bachillerato superior, bachiller unificado polivalente (BUP) y bachillerato; 4 = Columna 87 = 5/6/7; 5 = Otra.
Columna 87: 1 = Ninguna formación post-secundaria o profesional; 2 = Formación profesional de grado medio o equivalente; 3 = Formación profesional dentro de la empresa; 4 = Formación profesional mixta (en una empresa y en un centro escolar); 5 = Formación profesional de grado superior o equivalente, estudios superiores no equivalentes a diplomado universitario; 6 = Carreras universitarias de ciclo corto; diplomados universitarios o equivalentes; tres cursos aprobados (o primer ciclo), sin derecho a titulacion, de una carrera de ciclo largo; 7 = Carreras universitarias de ciclo largo; Licenciados, Ingenieros, Doctores o equivalentes; 8 = Otra formación.

France
Rubrique 86: 1 = Études primaires ou inférieures; 6ème, 5ème, 4ème de l'enseignement secondaire; études professionnelles sans diplôme; 2 = 3ème, 2ème, 1ère de l'enseignement secondaire (les personnes ayant suivi un enseignement professionnel de niveau supérieur ou égal à la dernière année du Brevet d'Études Professionnelles sont supposées être passées par la classe de 3ème de l'enseignement général); 3 = Terminale de l'enseignement secondaire général ou technologique, y compris préparation au brevet de technicien – Baccalauréat; 4 = Rubrique 87 = 5/6/7; 5 = Autres.

Rubrique 87: 1 = Aucun diplôme supérieur ni professionnel; 2 = Formation professionnelle de niveau secondaire sanctionée par un diplôme (Certificat d'Éducation Professionnelle, Certificat d'Aptitude Professionnelle, Brevet d'Études Professionnelles, baccalauréat professionnel, brevet professionnel, etc.) hors apprentissage; 3 = -; 4 = Certificat d'Aptitude Professionnelle ou Brevet d'Études Professionnelles obtenu par apprentissage; 5 = Brevet de Technicien Supérieur, Diplôme Universitaire de Technologie, diplômes des professions de la santé (hors celle de médecin) et autres de niveau technicien supérieur; 6 = Licence; 7 = Maîtrise, diplômes universitaires du 3ème cycle (Diplôme d'Études Supérieures, Diplôme d'Études Approfondies, doctorat), Certificat d'Aptitude Professionnelle de l'Enseignement Supérieur, Certificat d'Aptitude Professionnelle de l'Enseignement Technique, agrégation; diplôme d'une grande école; 8 = Diplôme d'Études Universitaires Générales ou équivalent (1er cycle universitaire).

Ireland
Column 86: 1 = Primary or lower; 2 = Junior cycle; Intermediate/Group/Junior Certificate; 3 = Senior cycle; Leaving Certificate; 4 = Column 87 = 5/6/7; 5 = Other.
Column 87: 1 = No professional/vocational qualifications; 2 = -; 3 = At the workplace only; 4 = Partly within the workplace and partly at school, including apprenticeship; 5 = Diploma from Regional Technical College, College of Technology or equivalent; 6 = Bachelor degree; 7 = Masters or higher degree; 8 = Other vocational qualification.

Italia
Colonna 86: 1 = Nessun titolo di studio; Licenza elementare; scuola media inferiore non completata; 2 = Licenza di scuola media inferiore; Licenza di avviamento professionale; qualifica professionale o altro diploma di scuola media superiore che non permettete l'accesso all'universita; 3 = Diploma di scuola media superiore; 4 = Colonna 87 = 5/6/7; 5 = Altro.
Colonna 87: 1 = Nessuna formazione post-scolastica o professionale; 2 = Diploma di scuola media superiore che non permette l'accesso all'università; 3 = Unicamente in ambiente di lavoro; 4 = Apprendistato; 5 = Diploma universitario - Laurea breve; 6 = Laurea; 7 = Specializzazione post-laurea; Dottorato di ricerca; 8 = Altra formazione post-scolastica.

Nederland
Kolom 86; 1 = Al dan niet voltooid kleuter- en basisonderwijs; niet voltooid Middelbaar Algemeen Vormend Onderwijs; klas 3 Hoger Algemeen Vormend Onderwijs of Voorbereidend Wetenschappelijk Onderwijs niet met succes doorlopen (ISCED 0-1); 2 = Voltooid Middelbaar Algemeen Vormend Onderwijs; klas 3 Hoger Algemeen Vormend Onderwijs of Voorbereidend Wetenschappelijk Onderwijs met succes doorlopen (ISCED 2); 3 = Voltooid Hoger Algemeen Vormend Onderwijs of Voorbereidend Wetenschappelijk Onderwijs (ISCED 3); 4 = Kolom 87 = 5/6/7; 5 = Overig.
Kolom 87: 1 = Geen beroepsonderwijs of beroepsopleiding; 2 = Voltooid Lager Beroepsonderwijs en Middelbaar Beroepsonderwijs (ISCED 2 or 3); 3 = -; 4 = -; 5 = Voltooid Hoger Beroepsonderwijs (ISCED 5); 6 = Voltooide universitaire opleiding (ISCED 6-7); 7 = -; 8 = Universitair kandidaatsexamen.

Portugal
Coluna 86: 1 = Não sabe ler nem escrever; sabe ler e escrever, sem possuir o 1º ciclo do básico (antiga 4ª classe); tem 6 anos de escolaridade; 2 = Completou o 2º ciclo do básico (7°, 8° e 9° anos de escolaridade); 3 = Completou o 3º ciclo do básico (10º, 11° e 12° anos de escolaridade); 4 = Coluna 87 = 5/6/7; 5 = Outro tipo de educação geral.

Coluna 87: 1 = Sem qualquer outro tipo de educação (apenas ensino geral ou nenhum) ou formação profissional; 2 = Completou um curso (mínimo de um ano) numa escola ou instituto, vocacionado para uma actividade específica; 3 = Completou formação específica (mínimo de um ano) num ambiente de trabalho (sem formação complementar numa escola ou instituto); 4 = Completou formação específica através de um sistema com experiência de trabalho e ao mesmo tempo formação complementar noutro local (qualquer tipo de sistema "desdobrado", incluindo aprendizagem); 5 = Recebeu uma qualificação de terceiro nivel que não é grau universitário; 6 = Recebeu um grau universitário (grau de início - licenciatura ou equivalente); 7 = Recebeu um grau universitário não inicial ou uma qualificação de pós-graduação (mestrado, doutoramento); 8 = Recebeu uma qualquer qualificação profissional não especificada acima.

United Kingdom
Column 86: 1 = Left full-time education before 15 years of age; 2 = Remained in full-time education to at least 15 years of age, with or without obtaining qualifications necessary for progress to next level (e.g. 'O' level or equivalent); 3 = Remained in full-time education to at least 17 years of age, with or without obtaining qualifications necessary for progress to next level (e.g. 'A' level or equivalent); 4 = Column 87 = 5/6/7; 5 = Other.
Column 87: 1 = No professional/vocational qualifications; 2 = Ordinary or General BTEC; RSA; City and Guilds (CGLI) or equivalent; 3 = -; 4 = Ordinary or General BTEC/SCOTBTEC, BEC/SCOTBEC, TEC/SCOTEC, SCOTVEC; ONC; OND; YTS/YT/ET; 5 = Higher BTEC/SCOTBTEC, BEC/SCOTBEC, TEC/SCOTEC, SCOTVEC; HNC; HND; teaching and nursing qualifications without degree; 6 = First degree; other degree level of qualification; graduate membership of professional institute, 7 = Higher degree; 8 = Other professional/vocational qualification.

Sweden
Kolumn 86: 1 = Förgymnasial utbildning kortare än 9 år; 2 = Förgymnasial utbildning 9(10) år; enhetsskola, grundskola; 3 = Gymnasial utbildning upp till 3 år; 4 = Kolumn 87 = 5/6/7; 5 = Utbildning saknas samt ej hänförbar till specifik grupp; 9 = Ej aktuell.
Kolumn 87: 1 = Ingen vidare yrkesutbildning; 2 = -; 3 = -; 4 = -; 5 = Eftergymnasial utbildning kortare än 3 år (20-119 poäng); 6 = Eftergymnasial utbildning 3 år eller längre (120 poäng); 7 = Forskarutbildning; 8 = -; 9 = Ej aktuell.

Suomi Finland
Column 86: 1 = Less than primary school – Primary school or part of lower secondary or comprehensive school; 2 = Comprehensive school or lower secondary school; 3 = Matriculation examination or upper secondary school; 4 = Column 87 = 5/6/7; 5 = Another general education programme.
Column 87: 1 = No vocational, professional or higher education qualification; 2 = Vocational or professional education in a school (minimum duration one year); 3 = -; 4 = -; 5 = Vocational or professional education in a college; 6 = Polytechnical vocational or professional education; lower-level university degree (bachelor degree); 7 = Higher-level university degree (incl. licentiate in medicine) or postgraduate (doctorate level) degree.; 8 = -.

Österreich
Column 86: 1 = Kein Pflichtschulabschluß; 2 = Pflichtschulabschluß; 3 = Lehrabschluß, Abschluß einer BMS, Matura an einer Höheren Schule, Kolleg; 4 = Colum 87 = 5/6/7; 5 = -.
Column 87: 1 = Keine berufliche Ausbildung oder berufliche Schulbildung; 2 = Berufsbildende mittlere Schule; 3 = Berufspratikum; 4 = Abschluß einer beruflichen Ausbildung im dualen System (Lehre); 5 = Berufsbildende höhere Schule; 6,7 = Universitäts-,

Hochschulabschluß, hochschulverwandte Lehranstalt; 8 = Sonstiger beruflicher Bildungsabschluß.

Appendix 2.2 Labour force concepts

The labour force comprises persons in employment and unemployed persons.

a) *Employment*. Persons in employment are those who during the reference week did any work for pay or profit, or were not working but had jobs from which they were temporarily absent. Family workers are included but not persons on lay-off. For operational purposes, the notion of "some work" may be interpreted as work for at least one hour.

b) *Unemployment*. The "unemployed" comprise all persons above a specified age who, during the reference period, were: (1) "without work", i.e. were not in paid employment or self-employment, as defined in paragraph 9; (2) "currently available for work", i.e. were available for paid employment or self-employment during the reference period; (3) "seeking work", i.e. had taken specific steps in a specified recent period to seek paid employment or self-employment. Persons who had a job to start later are also categorised as unemployed.

Unemployed persons can be classified by reason for unemployment into four major groups: (1) job-losers are persons whose employment ended involuntarily and who immediately began looking for work; (2) job-leavers are persons who quit or otherwise terminated their employment voluntarily and immediately began looking for work; (3) re-entrants are persons who previously worked, but were inactive or on compulsory military service before beginning to look for work; (4) first job-seekers are persons who have never worked in a regular job.

c) *Unemployment rates*. Unemployment rates represent unemployed persons as a percentage of the labour force.

d) *Employees*. Employees are defined as persons who work for a public or private employer and who receive compensation in the form of wages, salaries, fees, gratuities, payment by results or payment in kind; non-conscript members of the armed forces are also included.

f) *Full-time / part-time distinction*. The distinction between full-time and part-time work should be made on the basis of a spontaneous answer given by the respondent. It is impossible to establish a more exact distinction between part-time and full-time work, due to variations in working hours between Member States and also between branches of

industry. By checking the answer with the number of hours usually worked, it should be possible to detect and even to correct improbable answers, since part-time work will hardly ever exceed 35 hours, while full-time work will usually start at about 30 hours.

Appendix 2.3 Tables

Table A1. Male unemployment rates by educational level and year, percentage of the labour force

	Lower	Medium	High	Total	Lower	Medium	High	Total	Lower	Medium	High	Total
	Austria				Danmark				Finland			
1992	n.a.	n.a.	n.a.	n.a.	9.6	9.2	4.5	8.5	n.a.	n.a.	n.a.	n.a.
1993	n.a.	n.a.	n.a.	n.a.	11.0	12.0	6.2	10.6	n.a.	n.a.	n.a.	n.a.
1994	n.a.	n.a.	n.a.	n.a.	10.0	7.4	4.5	7.3	n.a.	n.a.	n.a.	n.a.
1995	6.1	3.5	2.2	4.0	8.1	5.2	4.7	5.7	25.1	18.1	7.8	18
1996	8.5	4.8	3.1	5.4	8.2	5.4	3.4	5.6	22.5	15.5	6.9	15.7
1997	8.0	4.7	2.3	5.1	6.9	4.1	3.1	4.6	21.4	15.2	5.7	14.9
1998	10.1	4.6	2.3	5.4	5.4	3.6	3.1	3.9	18.4	14.0	5.2	13.0
1999	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	France				Germany				Greece			
1992	9.8	6.6	4.0	8.2	8.8	4.7	3.2	4.9	3.9	7.9	4.2	5.0
1993	13.3	8.3	6.2	9.7	11.3	6.2	3.7	6.5	4.9	8.2	4.6	5.8
1994	15.4	9.6	7.2	11.2	14.0	7.3	4.6	7.6	5.2	8.9	4.5	6.2
1995	14.2	8.4	7.1	10.1	12.9	6.7	4.3	7.1	5.5	8.8	4.6	6.4
1996	14.9	9.4	6.3	10.7	14.3	8.1	4.9	8.3	5.2	8.5	4.7	6.2
1997	15.9	9.5	6.9	11.1	15.8	9.5	5.2	9.4	5.4	9.0	4.6	6.4
1998	15.2	8.8	6.3	10.5	n.a.	n.a.	n.a.	n.a.	6.5	9.5	4.3	7.2
1999	16.1	8.7	5.9	10.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Ireland				Italy				Netherlands			
1992	20.8	10.4	5.5	15.3	7.0	7.6	3.6	6.9	8.8	3.3	2.3	4.1
1993	21.4	11.7	6.7	15.9	8.2	8.4	2.9	7.8	10.7	4.4	3.8	5.4
1994	20.0	11.3	5.9	14.8	9.8	8.6	4.1	9.0	12.9	5.5	4.8	6.6
1995	17.1	9.1	4.8	12.3	10.1	9.0	4.3	9.3	10.9	5.4	4.5	6.2
1996	17.7	8.5	4.5	11.9	10.5	9.6	4.7	9.7	8.2	3.8	3.8	5.3
1997	15.6	7.4	3.7	10.5	10.9	9.4	5.3	9.8	6.8	3.3	3.1	4.4
1998	n.a.	n.a.	n.a.	n.a.	10.3	9.3	5.2	9.6	n.a.	n.a.	n.a.	n.a.
1999	n.a.	n.a.	n.a.	n.a.	9.7	8.7	5.1	9	n.a.	n.a.	n.a.	n.a.
	Portugal				Spain				Sweden			
1992	3.8	3.2	1.0	3.5	14.8	13.3	8.1	13.7	n.a.	n.a.	n.a.	n.a.
1993	4.8	6.0	2.0	4.7	20.4	17.9	11.8	18.7	n.a.	n.a.	n.a.	n.a.
1994	6.3	6.8	3.0	6.1	21.7	20.8	13.1	20.2	n.a.	n.a.	n.a.	n.a.
1995	6.8	8.5	4.8	6.8	19.6	18.4	12.6	18.2	10.8	10.6	3.8	8.9
1996	6.6	9.0	4.3	6.7	19.5	17.5	12.4	17.8	12.4	12.0	5.3	10.6
1997	6.3	7.7	3.1	6.2	17.9	16.0	12.0	16.4	14.3	11.9	5.4	11.2
1998	4.2	4.5	2.2	4.0	15.3	13.9	10.1	14	12.5	10.7	5.4	10.0
1999	4.5	4.8	3.7	4.4	12	11.2	8.3	11	11.6	8.5	4.8	8.4
	Switzerland				United Kingdom							
1992	n.a.	n.a.	n.a.	n.a.	15.5	10.6	4.9	11.7				
1993	n.a.	n.a.	n.a.	n.a.	16.6	11.5	5.7	12.5				
1994	n.a.	n.a.	n.a.	n.a.	15.9	10.4	5.3	11.5				
1995	n.a.	n.a.	n.a.	n.a.	13.9	9.4	5.0	10.2				
1996	6.6	2.8	3	3.5	13.7	8.4	5.0	9.8				
1997	8.6	3.5	4	4.5	11.7	7.4	3.7	8.2				
1998	4.7	3.3	2.2	3.3	n.a.	n.a.	n.a.	n.a.				
1999	5.7	2.6	1.3	2.8	n.a.	n.a.	n.a.	n.a.				

Source: Own calculations and Eurostat

Table A2. Male unemployment in low and medium education by age. Averages of disposable periods for each country, percentage of labour force

	Austria	Switzerland	Germany	Denmark	Spain	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Sweden	United Kingdom
Low														
15-19	7.2	7.0	7.3	7.5	40.8	55.3	27.5	15.1	34.5	30.6	15.1	10.0	21.1	21.5
20-24	12.0	6.4	17.4	10.0	27.7	46.2	28.7	12.1	32.7	21.7	14.7	9.4	26.8	24.2
25-29	9.8	3.1	17.7	10.8	21.9	18.4	17.5	6.8	26.6	11.3	13.3	5.2	23.1	17.9
30-34	8.0	6.3	16.8	9.0	17.8	22.4	12.7	4.4	23.1	7.2	12.1	5.4	16.0	16.4
35-39	10.1	7.6	15.1	5.8	14.7	15.4	11.0	3.7	21.4	5.6	10.6	3.4	10.3	15.3
40-44	8.4	8.4	13.7	5.8	12.6	15.3	9.1	3.3	19.1	4.1	6.9	3.5	11.0	12.2
45-49	6.1	3.3	12.8	5.3	11.2	16.1	8.8	3.3	16.8	3.6	7.1	2.8	8.7	9.9
50-54	8.7	5.9	13.3	5.9	12.1	12.4	9.2	3.5	14.5	3.6	8.8	3.6	7.7	12.4
55-59	7.5	6.9	20.0	5.4	13.6	21.8	9.1	3.1	11.5	4.0	6.3	4.6	8.0	13.7
60-64	2.3	7.1	11.9	4.3	8.3	6.1	3.3	2.2	7.5	2.4	2.1	3.2	13.7	13.7
Total	8.2	6.4	14.3	8.4	16.9	21.9	12.8	4.7	20.7	8.3	10.8	5.0	12.3	16.0
Medium														
15-19	5.2	7.4	11.0	18.7	42.4	41.4	27.7	34.5	25.8	35.4	9.7	20.0	47.1	18.8
20-24	6.5	5.4	9.7	6.3	30.1	28.2	18.5	22.9	17.0	27.5	8.5	15.1	18.4	16.5
25-29	4.5	3.3	7.1	4.3	18.6	17.1	9.9	9.3	11.6	11.6	5.0	5.2	11.3	11.7
30-34	3.6	3.3	6.7	3.0	11.0	12.1	7.1	4.8	7.7	4.8	4.0	2.8	10.7	9.3
35-39	3.8	2.3	7.0	2.8	8.9	11.4	5.7	3.2	7.6	2.2	3.5	3.7	9.4	9.0
40-44	3.6	2.3	7.2	3.9	6.7	11.4	5.1	2.8	7.5	1.7	2.7	1.0	8.8	7.7
45-49	4.1	3.1	7.4	5.2	7.0	13.3	5.6	3.3	6.3	1.5	2.6	1.3	8.0	7.9
50-54	4.6	2.3	7.8	4.7	6.9	14.9	5.7	3.3	6.2	1.7	2.7	2.2	8.2	9.6
55-59	6.2	2.1	13.7	6.3	10.2	19.9	7.2	4.0	5.8	1.6	2.2	5.7	8.7	10.7
60-64	3.0	2.9	7.8	4.7	10.2	0.0	1.7	3.1	6.5	0.9	2.3	1.6	7.6	11.8
Total	4.4	3.1	8.1	6.7	15.4	15.7	8.2	8.3	11.1	8.2	4.4	5.3	10.7	10.8
Change (in %)														
15-19	-27.8	5.7	50.7	149.3	3.9	-25.1	0.7	128.5	-25.2	15.7	-35.8	100.0	123.2	-12.6
20-24	-45.8	-15.6	-44.3	-37.0	8.7	-39.0	-35.5	89.3	-48.0	26.7	-42.2	60.6	-31.3	-31.8
25-29	-54.1	6.5	-59.9	-60.2	-15.1	-7.1	-43.4	36.8	-56.4	2.7	-62.4	0.0	-51.1	-34.6
30-34	-55.0	-47.6	-60.1	-66.7	-38.2	-46.0	-44.1	9.1	-66.7	-33.3	-66.9	-48.1	-33.1	-43.3
35-39	-62.4	-69.7	-53.6	-51.7	-39.5	-26.0	-48.2	-13.5	-64.5	-60.7	-67.0	8.8	-8.7	-41.2
40-44	-57.1	-72.6	-47.4	-32.8	-46.8	-25.5	-44.0	-15.2	-60.7	-58.5	-60.9	-71.4	-20.0	-36.9
45-49	-32.8	-6.1	-42.2	-1.9	-37.5	-17.4	-36.4	0.0	-62.5	-58.3	-63.4	-53.6	-8.0	-20.2
50-54	-47.1	-61.0	-41.4	-20.3	-43.0	20.2	-38.0	-5.7	-57.2	-52.8	-69.3	-38.9	6.5	-22.6
55-59	-17.3	-69.6	-31.5	16.7	-25.0	-8.7	-20.9	29.0	-49.6	-60.0	-65.1	23.9	8.7	-21.9
60-64	30.4	-59.2	-34.5	9.3	22.9	-100.0	-48.5	40.9	-13.3	-62.5	9.5	-50.0	-44.5	-13.9
Total	-46.3	-51.6	-43.4	20.2	-8.9	-28.3	-35.9	76.6	-46.4	-1.2	-59.3	6.0	-13.0	-32.5

Source: Own calculations and Eurostat

Table A3. Male unemployment in medium and high education by age. Averages of disposable periods for each country, percentage of labour force

Medium														
15-19	5.2	7.4	11.0	18.7	42.4	41.4	27.7	34.5	25.8	35.4	9.7	20.0	47.1	18.8
20-24	6.5	5.4	9.7	6.3	30.1	28.2	18.5	22.9	17.0	27.5	8.5	15.1	18.4	16.5
25-29	4.5	3.3	7.1	4.3	18.6	17.1	9.9	9.3	11.6	11.6	5.0	5.2	11.3	11.7
30-34	3.6	3.3	6.7	3.0	11.0	12.1	7.1	4.8	7.7	4.8	4.0	2.8	10.7	9.3
35-39	3.8	2.3	7.0	2.8	8.9	11.4	5.7	3.2	7.6	2.2	3.5	3.7	9.4	9.0
40-44	3.6	2.3	7.2	3.9	6.7	11.4	5.1	2.8	7.5	1.7	2.7	1.0	8.8	7.7
45-49	4.1	3.1	7.4	5.2	7.0	13.3	5.6	3.3	6.3	1.5	2.6	1.3	8.0	7.9
50-54	4.6	2.3	7.8	4.7	6.9	14.9	5.7	3.3	6.2	1.7	2.7	2.2	8.2	9.6
55-59	6.2	2.1	13.7	6.3	10.2	19.9	7.2	4.0	5.8	1.6	2.2	5.7	8.7	10.7
60-64	3.0	2.9	7.8	4.7	10.2	0.0	1.7	3.1	6.5	0.9	2.3	1.6	7.6	11.8
Total	4.4	3.1	8.1	6.7	15.4	15.7	8.2	8.3	11.1	8.2	4.4	5.3	10.7	10.8
High														
15-19	0.0	0.0	13.9	0.0	33.1	0.0	0.0	17.6	19.8	0.0	0.0	0.0	0.0	17.2
20-24	8.3	8.3	8.5	5.2	30.9	22.4	16.5	22.5	18.3	17.0	11.7	10.7	8.5	12.9
25-29	4.9	7.9	5.3	5.9	21.1	10.0	8.9	12.8	6.4	21.5	7.4	3.6	4.6	4.8
30-34	3.0	2.7	4.2	3.5	10.4	7.4	5.0	4.6	4.5	4.8	3.4	2.1	4.9	4.3
35-39	1.9	1.7	3.5	2.5	4.9	4.4	4.5	1.9	3.3	1.0	3.6	1.2	5.7	3.1
40-44	2.4	1.2	3.9	2.4	4.1	4.5	3.7	1.8	2.8	0.8	2.4	2.1	5.7	3.5
45-49	1.4	0.6	3.6	3.4	3.4	6.1	3.8	1.4	3.2	0.5	2.3	0.2	4.3	3.8
50-54	0.9	1.9	4.3	2.7	4.2	4.8	4.5	1.5	4.3	0.5	2.3	0.6	3.5	6.7
55-59	2.1	2.0	9.4	5.2	6.4	8.2	5.7	2.0	4.1	0.4	1.3	3.0	5.5	8.1
60-64	3.2	4.1	5.3	5.0	3.9	1.3	3.0	1.4	2.9	0.3	0.7	1.7	4.1	7.4
Total	2.5	2.6	4.8	4.2	11.1	6.4	5.8	4.4	6.0	3.5	3.6	2.0	4.9	5.3
Change (in %)														
15-19	-100.0	-100.0	26.4	-100.0	-21.9	-100.0	-100.0	-49.0	-23.3	-100.0	-100.0	-100.0	-100.0	-8.5
20-24	27.7	53.7	-12.4	-17.5	2.7	-20.6	-10.8	-1.7	7.6	-38.2	37.6	-29.1	-53.8	-21.8
25-29	8.9	139.4	-25.4	37.2	13.4	-41.5	-10.1	37.6	-44.8	85.3	48.0	-30.8	-59.3	-59.0
30-34	-16.7	-18.2	-37.3	16.7	-5.5	-38.8	-29.6	-4.2	-41.6	0.0	-15.0	-25.0	-54.2	-53.8
35-39	-50.0	-26.1	-50.0	-10.7	-44.9	-61.4	-21.1	-40.6	-56.6	-54.5	2.9	-67.6	-39.4	-65.6
40-44	-33.3	-47.8	-45.8	-38.5	-38.8	-60.5	-27.5	-35.7	-62.7	-52.9	-11.1	110.0	-35.2	-54.5
45-49	-65.9	-80.6	-51.4	-34.6	-51.4	-54.1	-32.1	-57.6	-49.2	-66.7	-11.5	-84.6	-46.3	-51.9
50-54	-80.4	-17.4	-44.9	-42.6	-39.1	-67.8	-21.1	-54.5	-30.6	-70.6	-14.8	-72.7	-57.3	-30.2
55-59	-66.1	-4.8	-31.4	-17.5	-37.3	-58.8	-20.8	-50.0	-29.3	-75.0	-40.9	-47.4	-36.8	-24.3
60-64	6.7	41.4	-32.1	6.4	-61.8	13-1	76.5	-54.8	-55.4	-66.7	-69.6	6.3	-46.1	-37.3
Total	-43.2	-16.1	-40.7	-37.3	-27.9	-59.2	-29.3	-47.0	-45.9	-57.3	-18.2	-62.3	-54.2	-50.9

Source: Own calculations and Eurostat

Table A4. Estimated equations. Dependent variable: IRR

	Adult-medium		Adult-high		Youth-medium		Youth-high		Coverage rate		Replacement rate	
	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.
Austria												
Constant	0.1231	1064.0	-0.0558	-193.3	0.1198	844.2	0.0218	910.5	0.0554	2232873.7	0.0554	514819.0
Beta	-0.0717	-574.6	0.1128	365.4	-0.0692	-446.7	0.0342	1322.7	-0.0010	-35913.0	-0.0038	-9365.3
R^2	0.9996		0.9992		0.9993		0.9999		1.0000		1.0000	
Standard error	0.00005		0.00010		0.00007		0.00001		0.00000		0.00000	
Number of obs.	132		110		138		138		199		199	
Finland												
Constant	0.1349	4271.1	0.0122	129.0	0.1284	1689.7	0.0658	5075.3	0.1010	15068.7	0.1010	13876.4
Beta	-0.0532	-1406.2	0.0797	761.3	-0.0521	-534.0	0.0246	1695.0	-0.0175	-1958.2	-0.0190	-1804.0
R^2	1.0000		0.9998		0.9993		0.9999		0.9999		0.9999	
Standard error	0.00001		0.00003		0.00008		0.00001		0.00001		0.00001	
Number of obs.	99		105		197		178		199		199	
France												
Constant	0.1380	1777.6	-0.0214	-96.1	0.1410	843.3	0.0376	1096.3	0.0815	36896.0	0.0815	43872.2
Beta	-0.0654	-757.4	0.1024	422.6	-0.0767	-386.6	0.0426	1116.5	-0.0092	-2351.1	-0.0078	-2792.1
R^2	0.9998		0.9993		0.9987		0.9999		1.0000		1.0000	
Standard error	0.00003		0.00010		0.00016		0.00002		0.00000		0.00000	
Number of obs.	109		122		196		168		199		199	
Germany												
Constant	0.1706	670.3	-0.0804	-210.3	0.0878	1874.6	0.0378	2465.8	0.0644	134224.0	0.0644	76067.4
Beta	-0.1224	-437.0	0.1442	348.4	-0.0330	-638.9	0.0205	1235.2	-0.0071	-13285.3	-0.0114	-8349.8
R^2	0.9992		0.9989		0.9996		0.9999		1.0000		1.0000	
Standard error	0.00016		0.00018		0.00003		0.00001		0.00000		0.00000	
Number of obs.	157		132		160		137		199		199	
Greece												
Constant	0.2626	497.9	-0.1782	-135.6	0.2354	277.4	-0.0074	-26.0	0.0904	900642.6	0.0904	1548664.8
Beta	-0.1799	-315.5	0.2753	195.6	-0.1747	-170.2	0.1110	341.5	-0.0041	-6086.1	-0.0025	-9999.0
R^2	0.9988		0.9972		0.9936		0.9984		1.0000		1.0000	
Standard error	0.00023		0.00048		0.00078		0.00024		0.00000		0.00000	
Number of obs.	124		111		190		184		199		199	

Ireland												
Constant	0.2727	518.3	-0.1418	-125.5	0.2384	374.1	0.0053	23.0	0.1119	98009.9	0.1119	24634.4
Beta	-0.1794	-309.8	0.2531	208.9	-0.1539	-210.6	0.1046	418.3	-0.0080	-6331.8	-0.0284	-1783.3
R^2	0.9987		0.9973		0.9956		0.9992		1.0000		0.9999	
Standard error	0.00025		0.00045		0.00059		0.00013		0.00000		0.00001	
Number of obs.	129		118		197		146		199		199	
Italy												
Constant	0.2447	383.4	-0.2860	-146.8	0.0990	384.4	-0.0020	-25.7	0.0367	353079.5	0.0367	58692.2
Beta	-0.2150	-311.4	0.3296	157.6	-0.0805	-247.6	0.0479	480.1	-0.0016	-13531.6	-0.0082	-2586.5
R^2	0.9990		0.9964		0.9968		0.9992		1.0000		1.0000	
Standard error	0.00020		0.00055		0.00026		0.00008		0.00000		0.00000	
Number of obs.	100		92		196		196		199		199	
Portugal												
Constant	0.2753	5561.8	0.1156	537.8	0.5072	501.0	0.0112	51.6	0.2237	8972.7	0.2165	323.0
Beta	-0.0535	-996.1	0.1106	483.4	-0.3163	-273.3	0.2272	950.6	-0.0185	-425.5	0.0112	9.5
R^2	0.9999		0.9995		0.9979		0.9998		0.9989		0.3161	
Standard error	0.00002		0.00008		0.00066		0.00012		0.00018		0.00474	
Number of obs.	124		109		156		144		199		199	
Spain												
Constant	0.1705	926.9	-0.0272	-86.9	0.1649	633.4	0.0323	306.0	0.1029	10921.4	0.1029	10435.8
Beta	-0.0915	-436.0	0.1241	358.1	-0.1067	-289.6	0.0742	544.6	-0.0197	-1427.0	-0.0206	-1363.9
R^2	0.9991		0.9991		0.9977		0.9993		0.9999		0.9999	
Standard error	0.00014		0.00013		0.00030		0.00011		0.00001		0.00001	
Number of obs.	172		120		197		196		199		199	
Sweden												
Constant	0.1499	625.0	-0.0585	-149.0	0.1298	697.8	0.0107	183.0	0.0748	11840.5	0.0748	13262.9
Beta	-0.0971	-365.6	0.1258	296.2	-0.0806	-367.8	0.0530	841.7	-0.0200	-2130.0	-0.0179	-2384.5
R^2	0.9987		0.9984		0.9986		0.9998		1.0000		1.0000	
Standard error	0.00017		0.00020		0.00018		0.00003		0.00001		0.00001	
Number of obs.	172		139		197		137		199		199	
Switzerland												
Constant	0.1885	1323.3	-0.0298	-98.8	0.2135	737.4	0.0219	174.4	0.0982	2999452.5	0.0982	3750778.8
Beta	-0.0911	-600.0	0.1326	410.2	-0.1189	-380.1	0.0841	605.6	0.0025	45583.5	0.0020	56927.0
R^2	0.9997		0.9994		0.9991		0.9996		1.0000		1.0000	
Standard error	0.00006		0.00010		0.00014		0.00008		0.00000		0.00000	
Number of obs.	122		106		133		151		199		199	

Table A5. Response to changes in the explanatory variables (direct difference)

	Adult employment		Youth employment		Coverage rate	Replacement rate
	Medium	High	Medium	High		
Austria	-7.4	10.4	-6.6	3.5	-0.10	-0.38
Finland	-5.5	7.6	-5.2	2.5	-1.75	-1.90
France	-6.8	9.6	-7.6	4.3	-0.92	-0.78
Germany	-12.6	13.5	-3.2	2.1	-0.70	1.14
Greece	-19.5	23.6	-17.0	11.2	-0.40	-0.25
Ireland	-19.3	22.2	-15.2	10.8	-0.80	-2.84
Italy	-24.3	27.1	-8.0	4.8	-0.16	-0.82
Portugal	-5.5	10.4	-30.1	23.1	-1.85	-1.85
Spain	-9.3	11.5	-10.6	7.4	-1.97	-2.06
Sweden	-9.9	11.8	-8.0	5.4	-2.00	-1.79
Switzerland	9.5	12.2	-11.2	8.6	0.25	0.20

Table A6. Earnings equations by country*

Dependent variable:	Yearly gross		Hourly gross		Yearly net		Hourly net	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Austria (95)								
Constant					**9.1716**	**661.8**	4.1158	293.5
Edcat2					**0.1928**	**23.4**	0.1885	22.6
Edcat3					**0.5855**	**39.7**	0.5438	36.4
Experience					**0.0298**	**25.2**	0.0288	24.0
Experience^2					**-0.0005**	**-17.9**	-0.0004	-17.1
R^2 adjusted					**0.26**		0.24	
N					**7481**		7481	
S.E. of regression					**0.2754**		0.2787	
Finland (93)								
Constant	**10.7290**	**161.8**	3.5733	86.5	10.4940	148.1	3.3381	84.7
Edcat2	**0.1548**	**5.5**	0.1290	5.9	0.1212	4.1	0.0953	4.6
Edcat3	**0.6182**	**15.8**	0.5225	16.5	0.5215	13.6	0.4258	14.6
Experience	**0.0699**	**11.3**	0.0381	10.0	0.0699	10.4	0.0381	10.5
Experience^2	**-0.0012**	**-8.9**	-0.0006	-6.8	-0.0013	-8.8	-0.0007	-8.2
R^2 adjusted	**0.34**		0.32		0.27		0.27	
N	**1156**		1156		1156		1156	
S.E. of regression	**0.4281**		0.3199		0.4497		0.3003	
France (95)								
Constant			**3.4005**	**476.4**				
Edcat2			**0.1318**	**32.6**				
Edcat3			**0.5492**	**97.9**				
Experience			**0.0334**	**52.5**				
Experience^2			**-0.0005**	**-35.7**				
R^2 adjusted			**0.31**					
N			**28236**					
S.E. of regression			**0.2991**					
Germany (95)								
Constant	**8.2624**	**96.8**	1.2972	15.2				
Edcat2	**0.2140**	**7.3**	0.1979	9.2				
Edcat3	**0.4337**	**13.3**	0.4003	14.6				
Experience	**0.1326**	**23.2**	0.1006	18.6				
Experience^2	**-0.0017**	**-19.5**	-0.0013	-16.3				
R^2 adjusted	**0.41**		0.43					
N	**2107**		2182					
S.E. of regression	**0.49007**		0.35448					
Greece (95)								
Constant					**13.5014**	**290.3**	5.7748	123.0
Edcat2					**0.2977**	**10.2**	0.3101	10.5
Edcat3					**0.5867**	**17.5**	0.6023	17.8
Experience					**0.0707**	**19.2**	0.0726	19.5
Experience^2					**-0.1041**	**-14.5**	-0.1056	-14.6
R^2 adjusted					**0.26**		0.27	
N					**2093**		2096	
S.E. of regression					**0.54052**		0.5456	

Table A6. (cont.)

Dependent variable:	Yearly gross		Hourly gross		Yearly net		Hourly net	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Ireland (94)								
Constant	**8.0788**	**180.1**	0.1994	3.7	8.0393	214.8	0.1809	3.8
Edcat2	**0.2140**	**8.0**	0.2707	8.4	0.1498	6.7	0.1854	6.5
Edcat3	**0.4485**	**13.0**	0.6449	18.6	0.3415	11.9	0.4962	16.2
Experience	**0.0854**	**23.9**	0.0946	22.2	0.0661	22.2	0.0741	19.6
Experience^2	**-0.0012**	**-18.3**	-0.0013	-16.3	-0.0009	-16.6	-0.0010	-14.2
R^2 adjusted	**0.39**		0.36		0.37		0.32	
N	**1614**		1972		1614		1972	
S.E. of regression	**0.4390**		0.5765		0.3661		0.3186	
Italy (95)								
Constant					**9.0496**	**347.1**	1.7177	80.9
Edcat2					**0.2996**	**19.6**	0.3058	24.5
Edcat3					**0.4677**	**17.7**	0.6647	30.9
Experience					**0.0624**	**28.6**	0.0468	26.3
Experience^2					**-0.0010**	**-22.1**	-0.0007	-19.2
R^2 adjusted					**0.30**		0.37	
N					**3538**		3538	
S.E. of regression					**0.4074**		0.3320	
Portugal (95)								
Constant			**5.6310**	**458.4**				
Edcat2			**0.5488**	**50.7**				
Edcat3			**1.3049**	**80.0**				
Experience			**0.0476**	**47.9**				
Experience^2			**-0.0006**	**-35.9**				
R^2 adjusted			**0.29**					
N			**24196**					
S.E. of regression			**0.4815**					
Spain (95)								
Constant	**14.1259**	**2528.2**	6.6269	1159.6	13.8313	2355.7	6.3324	1056.1
Edcat2	**0.3951**	**121.1**	0.4078	122.2	0.4117	120.1	0.4244	121.2
Edcat3	**0.7066**	**223.9**	0.7245	224.5	0.7405	223.3	0.7583	223.9
Experience	**0.0478**	**114.3**	0.0488	114.0	0.0502	114.1	0.0511	113.9
Experience^2	**-0.0006**	**-79.3**	-0.0006	-79.1	-0.0006	-79.9	-0.0006	-79.7
R^2 adjusted	**0.34**		0.34		0.34		0.34	
N	**118027**		118027		118027		118027	
S.E. of regression	**0.3849**		0.3937		0.40446		0.4131	
Sweden (96)								
Constant	**11.7387**	**244.3**	4.1778	92.1				
Edcat2	**0.1640**	**6.4**	0.1276	5.2				
Edcat3	**0.3849**	**12.8**	0.3078	10.9				
Experience	**0.0236**	**6.5**	0.0247	7.2				
Experience^2	**-0.0003**	**-4.7**	-0.0004	-5.4				
R^2 adjusted	**0.249**		0.2212					
N	**722**		722					
S.E. of regression	**0.2569**		0.2424					
Switzerland (95)								
Constant	**10.3813**	**547.7**	2.7390	136.5	10.1884	588.8	2.5462	137.9
Edcat2	**0.2833**	**19.8**	0.3071	20.3	0.2418	18.5	0.2656	19.1
Edcat3	**0.5908**	**38.4**	0.6250	38.3	0.5057	36.0	0.5399	36.0
Experience	**0.0411**	**30.1**	0.0421	28.9	0.0384	30.6	0.0391	29.1
Experience^2	**-0.0668**	**-22.1**	-0.0664	-20.8	-0.0006	-23.4	-0.0006	-21.8
R^2 adjusted	**0.34**		0.34		0.32		0.32	
N	**6334**		6334		6334		6334	
S.E. of regression	**0.30555**		0.3235		0.2789		0.2976	

* Year of reference within brackets. The equation used for IRR estimation in bold.

Chapter 3

THE ROLE OF SCHOOLING: SCREENING VERSUS HUMAN CAPITAL*

*Ali Skalli***

* I am grateful to the EU–TSER programme for financial support for the PURE project (SOE2-98-2044) and to LASMAS-IDL for supplying the French data. I thank PURE partners for providing results based on their national data. Valuable comments by PURE partners and by participants to the first user-oriented seminar of the PURE project are also acknowledged. The usual disclaimer applies.

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3.1 Introduction

Since Becker (1964), economists agreed upon the idea that the more individuals invest in education, the more they acquire skills that increase their productivity and, hence, their earnings. In the early 1970s, however, Arrow (1973) and Spence (1973, 1974) developed signaling models where the positive effect of education on earnings is not due to greater productivity, but rather to the information about innate capabilities it provides employers with. This is the so-called screening hypothesis.

Because these two views have different policy implications, it is important to discriminate between them. If education merely serves as a signaling device, then there is no reason why education should be publicly funded. In contrast, if education plays a productivity augmenting role, then social benefits from it might be substantial enough to justify public funding. In the intermediate case where education would have both human capital and signaling effects, measuring the relative importance of each of these effects is necessary to properly evaluate the social returns to education.

A natural testing strategy to discriminate between the screening hypothesis and human capital theory might consist in examining the impact of education on individuals' productivity. Unfortunately, no measure of the latter is available. As a consequence, most of the empirical tests reported in the literature rely on earnings functions where wages are assumed to proxy productivity. As clearly discussed by Layard and Psacharopoulos (1974), this is what makes the exercise difficult since both the screening hypothesis and human capital theory predict a positive effect of education on earnings. Obviously, empirical analyses attempting to discriminate between the two views do not primarily aim at examining the extent to which education increases earnings. Rather, they mainly address the question of whether the observed education–earnings relationship is compatible with specific predictions of the screening hypothesis.

Another problem that the earnings equation approach raises is that it is not clear how sensitive the results are to the privileged prediction one considers and, hence, to the testing methodology. Not only does the literature report different conclusions for different countries, but they are also sometimes mixed for the same country. For instance, while Ziderman (1992), Brown and Sessions (1999) and Cohn et al. (1987) find evidence of screening in Israel, Italy and Spain, respectively, Lambropolous (1992), Groot and Oosterbeek (1994) and Albrecht

(1974) do not for Greece, the Netherlands and Sweden. More-over, Layard and Psacharopoulos (1974) find no evidence for the screening hypothesis in the USA, whereas Riley (1979) does.

In this study, instead of relying on a single test, I consider three alternative testing strategies and use data from several European countries. This way, the sensitivity of the results to testing approaches as well as to institutional characteristics can be judged.

One of the tests performed relies on the idea that, according to the screening hypothesis, the returns to education should be lower for self-employed workers than for privately employed ones. The idea is that, compared to the latter group, the former is unscreened since the self-employed do have perfect information about their own innate ability (e.g. Wolpin 1977).[1]

Another prediction of the screening hypothesis that I examine is that the speed at which an individual attains a given qualification is also an indicator of his innate ability and should, therefore, influence the returns to education that he earns. For instance, Groot and Oosterbeek (1994) compare the returns to effective, drop-out, skipped, repeated and inefficient routing years of schooling in the Netherlands. Their approach has recently been replicated for France by Guille and Skalli (2001). In both cases, the evidence does not strongly support the screening hypothesis. Here, I adopt Jarousse and Mingat's (1986) testing strategy which consists in comparing the returns to the actual number of years of schooling to those that these individuals would have got had they completed their qualifications in the same number of years as a reference group of individuals in their cohort.

I also address the question of whether certification has an extra effect on the returns to education. To the extent that the number of years spent at school is a reasonable proxy of the accumulated amount of human capital, individuals with the same number of years of schooling should have the same returns irrespective of whether they

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[1] There are also other approaches in the literature that rely on the distinction between screened and unscreened groups of workers. Albrecht (1974) distinguishes between individuals that are outsiders to the firm and those hired from within. Taubman and Wales (1973) as well as Riley (1979) distinguish between occupational categories, some of which being treated as unscreened ones. The so-called P-test (Psacharopoulos 1979, Brown and Sessions 1999) consists in comparing the returns across the public and the private sector. The idea here is that wages are closer to the marginal product of labour in competitive sectors than in non-competitive ones where wages are bureaucratically set and, hence, where screening is more likely.

completed a given qualification or dropped out. The screening hypothesis on the other hand would predict that obtaining a diploma should yield higher returns since success in certification signals personal attributes such as the determination to finish tasks or to jump hurdles.

The chapter is organized as follows. Section 2 compares the returns to education of self-employed and privately employed individuals. Section 3 addresses the question of whether the speed of completion influences the returns, while section 4 focuses on sheepskin effects. Section 5 concludes.

3.2 Do screened workers earn more?

In this section, I compare the returns to education of screened and unscreened groups of workers. The unscreened group consists of self-employed individuals whereas the screened one includes employees. The idea underlying such a testing strategy is that screening is likely to occur only when potential employers miss information about individuals' productive capabilities. To the extent that self-employed individuals do not face any hidden information problem, their returns to education should only reflect the productivity augmenting role of education. Therefore, estimation of employment status specific earnings functions should indicate whether the returns to education are lower for the self-employed and, hence, whether education has a positive signaling value.

The test is based on data from nine European countries; namely, the pooled 1991, 1993 and 1995 waves of the *Mikrozensus* for Austria, the pooled 1969, 1976, 1984 and 1992 waves of the *Training and Professional Qualifications survey (FQP)* for France, the pooled 1984–97 waves of the *German Socio-Economic Panel (GSOEP)*, the 1994 *Household Budget Survey (HBS)* for Greece, the *Indagine Sui Bilanci delle Famiglie* conducted by the Bank of Italy in 1995, the 1994 wave of the *European Community Household Panel (ECHP)* for Spain, the 1995 wave of the *ECHP* for Portugal, the 1995 *Swiss Labour Force Survey*, and the pooled 1991–96 waves of the *British Household Panel Survey* as well as the pooled 1994–96 waves of the *Family Resources Survey* for the United Kingdom. The results based on pooled cross-section data are obtained from specifications including year dummies and earnings measured in constant currency units.

To make the country-specific results as comparable as possible, only parcimonious Mincer-type equations are estimated. The only regressors they include are the actual number of years of schooling and a quadrat-

ic function of age or of potential labour market experience.[2] Clearly, because of differences in the national tax systems, it would have been preferable to use net wages as the endogenous variable. Unfortunately, except for Spain, the data sets include gross wages only, so the resulting estimates are not purged from tax effects.[3] Note also that the endogenous variable is hourly wages, except for France where only annual earnings were available.[4]

To ensure sample homogeneity, separate estimations have been conducted for men and women, except for Italy and Spain where only results from male samples are available, and Portugal where the gender distinction has not been made. Note, however, that while male samples include only full-time employees, the regressions based on female samples include a part-time dummy as well.[5] Besides, a further sampling related remark is in order. For most countries, the sample of employees includes individuals from the private as well as the public sector. In Austria and France, however, it includes private sector employees only. The obvious motivation underlying such a sampling restriction is to provide estimates that are immune of noisy effects that might arise from the specific wage setting mechanisms at work in the public sector.

The results for the nine countries I consider are reported in Table 3.1. Columns 1, 2 and 3 provide indications about gender sampling, the measure of the endogenous variable and of labour market experience, respectively. Columns 4 and 5 (6 and 7) report the returns to education and the sample size for employees (for the self-employed). The last column measures the signaling value of education as the difference between the returns to education of employees and the self-employed. Robust standard deviation estimates are reported in parentheses below the corresponding coefficients.

In most of the countries under consideration, the signaling value is not statistically significant. Only in France, Greece, Portugal and Spain does there seem to be a signaling value of education. A quick conclu-

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2 Although the use of age systematically results in lower returns to education, signaling values, if any, are still comparable from one country to another.

3 In some countries where taxation is household based, e.g. France and Germany, calculation of net earnings is impossible.

4 Other French data sets where hourly wages are available have also been used. However, because the information on earnings of the self-employed was rather poor, the results are not reported.

5 In the Portuguese case, a part-time dummy was included for the whole sample of men and women.

Table 3.1 Returns to education of employees and self-employed in nine countries

	Specification		Employees		Self-Employed		Signaling Value
Gender	Gross Annual	Experience	Return	N	Return	N	
Austria (Mikrozensus 91, 93, 95)							
Men	Gross hourly	Potential	0.097 (0.002)	16,147	0.102 (0.012)	155	-0.005 (0.012)
Women	Gross hourly	Potential	0.089 (0.002)	11,417	0.073 (0.017)	97	0.016 (0.017)
France (FQP 69, 76, 84, 92)							
Men	Gross annual	Potential	0.085 (0.001)	33,089	0.061 (0.004)	798	**0.024** (0.004)
Women	Gross annual	Potential	0.073 (0.007)	14,448	0.061 (0.001)	154	**0.012** (0.007)
(West) **Germany** (GSOEP 84-97)							
Men	Gross hourly	Potential	0.079 (0.001)	21,492	0.086 (0.018)	207	-0.007 (0.018)
Women	Gross hourly	Potential	0.098 (0.001)	14,956	0.092 (0.024)	186	0.006 (0.024)
Greece (HBS 94)							
Men	Gross hourly	Potential	0.063 (0.003)	2,096	0.027 (0.046)	806	0.036 (0.046)
Women	Gross hourly	Potential	0.086 (0.006)	1,054	0.046 (0.015)	264	**0.040** (0.016)
Italy (Indagine Sui Bilanci delle Famiglie, 95)							
Men	Gross hourly	Age	0.046 (0.002)	3,431	0.055 (0.005)	1,147	-0.009 (0.005)
Portugal (ECHP 95)							
All	Gross hourly	Potential	0.099 (0.000)	2,418	0.117 (0.000)	639	**-0.018** (0.000)
Spain (ECHP 94)							
Men	Net hourly	Actual	0.069 (0.002)	2,193	0.032 (0.012)	428	**0.037** (0.012)
Switzerland (LFS 95)							
Men	Gross hourly	Potential	0.089 (0.002)	6,151	0.089 (0.010)	777	0.000 (0.010)
Women	Gross hourly	Potential	0.092 (0.003)	4,582	0.079 (0.017)	289	0.02 (0.017)
United Kingdom (FRS, 94-96)							
Men	Gross hourly	Age	0.079 (0.001)	24,951	0.068 (0.005)	5,250	**0.011** (0.007)
Women	Gross hourly	Age	0.108 (0.015)	24,424	0.083 (0.010)	1,854	0.025 (0.030)
United Kingdom (BHPS, 91-96)							
Men	Gross hourly	Age	0.064 (0.002)	10,001	0.051 (0.008)	1,717	0.013 (0.012)
Women	Gross hourly	Age	0.103 (0.002)	9,550	0.076 (0.015)	563	0.026 (0.019)
United Kingdom (BHPS, 91-96)							
Men	Gross hourly	Age	0.069 (0.003)	10,001	0.055 (0.022)	1,717	0.014 (0.025)
Women	Gross hourly	Age	0.103 (0.002)	9,550	0.078 (0.066)	563	0.025 (0.070)

sion would suggest that only in Southern Europe are signaling mechanisms at work. Note, however, that while in Portugal the returns to education of the self-employed are significantly higher than those of the rest of the labour force, in Greece only for women does the signaling value of education seem to be positive, while for Spain only male sample based estimates are available. Consequently, France is the only country where, for men as well as for women, the returns to schooling of employees are higher than those of self-employed individuals.

Some authors argue that the extent to which education is used as a screen depends critically on country-specific cultures and institutions.[6] While there are certainly some elements of truth in this argument, the results remain puzzling for those countries where different studies report contradictory results. For example, while Table 3.1 suggests that education has a signaling value in Greece, at least for women, the results reported by Lambropolous (1992) highlight no screening effects. Similarly, Table 3.1 suggests that education serves as a screening device in France as well as in Spain whereas Barceinas-Paredes et al. (Chapter 4 of this volume) conclude that evidence for screening is rather weak in these two countries. Last but not least, by suggesting that no screening is at work in the UK, the above results contradict those found by Shah (1985).

These examples show that the results are in fact very sensitive to the testing strategy and that attention should be paid to the various potential sources of bias. Obviously, the simple specification we estimate might suffer from various biases, the most important of which is possibly that related to self-selection.[7] Indeed, the observed individuals might have chosen self-employment because of comparative advantages and/or because they have expected their individual endowments to be best remunerated in self-employment and/or simply because they have expected higher earnings. The choice of employment status is therefore not random and so are the separately observed samples of employees and self-employed individuals. Consequently, self-selection is likely to be a major source of bias.

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6 For instance, Brown and Sessions (1999) list a series of examples of countries depending on whether evidence of screening has been found or not.

7 Specification, endogeneity, measurement errors and ability biases have been shown in the literature to be serious potential sources of bias. See for instance Card (1999), Ashenfelter and Rouse (1999) or Harmon et al. (2001). However, correcting for these biases would have required that further – e.g. appropriate instruments – and sometimes similar – e.g. ability indicators – information be available for each of the countries we investigate. Unfortunately, such a requirement could not be met.

To avoid this selectivity bias, the results reported for the UK in the last two rows of the table have been obtained by using a switching regression model with endogenous switching.[8] The specification from which the probability of self-employment has been predicted included information on whether one's parents were self-employed and on housing equity. The rationale for the latter instrument is that one can use housing equity as collateral to finance a business overdraft. As can be seen from Table 3.1, controlling for the endogeneity of self-employment does not result in statistically significant signaling values of education neither for men nor for women.

To sum up, our results do not strongly plead in favour of the screening hypothesis. Still, it is not clear whether the differences they suggest among countries are due to institutional differences or to weaknesses in the testing strategy based on the comparison of screened and unscreened groups of workers. Indeed, our results strongly depend on how accurate is the hypothesis that employees are screened while the self-employed are not. It is, therefore, important to examine to what extent these results are sensitive to other testing methodologies. Two different ones are proposed in the following two sections.

3.3 Does faster degree completion yield higher earnings?

In this section, an alternative testing approach is adopted. It relies on the idea that while human capital theory states that any year spent at school will have a non-negative effect on wages, the screening hypothesis predicts that some components of individuals' schooling careers will yield lower wages. Very often, individuals with the same qualification level show a large variation in the number of years it has taken them to attain that qualification. Such a variation might of course be due to illness episodes, national service, personal considerations, etc., but these seem to have a rather limited effect. In fact, most of the observed variation is due to skipped, repeated, drop-out and/or unusual detour years. The screening hypothesis implies that such aspects of a person's educational record are very informative for employers in the sense that more rapid completion of a degree signals greater ability and

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[8] See Maddala (1983) for a formal presentation. The results for the UK are from Chevalier and Walker (2001) where more details can be found.

should therefore lead to higher earnings, while years spent in education without obtaining a degree should not increase earnings.

The main component of a person's educational career is that of effective years of schooling (those typically required to attain a given qualification). In the human capital view, these years increase the person's human capital endowment and should therefore have a positive effect on wages. In the screening hypothesis, the higher the number of effective years, the higher is the value of the signal potential employers are provided with and the higher should wages be.

The effect of unusual routing years is more problematic. Indeed, only when these extra years lead to an accumulation of the relevant human capital does human capital theory expect them to have a positive effect on wages.[9] In the screening framework, these detour years provide no useful information on ability to employers.

Besides, any other component of an individual's schooling record has a different impact on wages according to human capital theory and the screening hypothesis. The former predicts, indeed, a positive effect on wages of drop-out years because these lead to an increase in individuals' human capital whereas the latter predicts that, compared to mere attendance for a number of years, graduation provides a stronger signal of ability and should therefore lead to higher earnings. Likewise, according to human capital theory, one would expect repeated years to have no effect on wages if they do not lead to an increase in human capital or a slight positive effect if they lead to a more thorough understanding of what is taught, while the screening hypothesis suggests that repeated years signal that the worker is of lesser ability than workers with the same effective schooling completed in standard time. On the other hand, human capital theory expects skipped years to have a negative effect on wages if they correspond to a lower accumulation of human capital and no effect if individuals are allowed to skip a year only when they could accumulate an amount of human capital equivalent to that accumulated by other individuals in standard time. In contrast, the screening hypothesis predicts that skipped years will have a positive effect on wages as they provide potential employers with a signal of higher ability.

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9 Assuming human capital is heterogeneous.

Thus, because this approach is based on the analysis of the objectively observed components of schooling it is certainly a good alternative (complement) to the one relying on the comparison of screened and unscreened workers. However, it requires that information on individuals' educational records is available, which is very seldom the case. Only Groot and Oosterbeek (1994) and Guille and Skalli (2001) have been able to make such a distinction between the components of schooling. Although based on the same idea, the testing approach I adopt in this section is less data demanding.

Consider a given qualification level q and the actual number S_q of years an individual has spent at school to attain it. In the absence of information on the various components of this number, one could think about distinguishing between the effective number of years of schooling E_q and a component D_q measuring drop-out, repeated, skipped and/or unusual routing years so that $S_q = E_q + D_q$. In the screening framework, individuals with $D_q < 0$ are endowed with a high innate ability level while those with $D_q > 0$ are of lower ability. Hence, a distinction between individuals with presumably different ability levels remains possible if E_q is known.

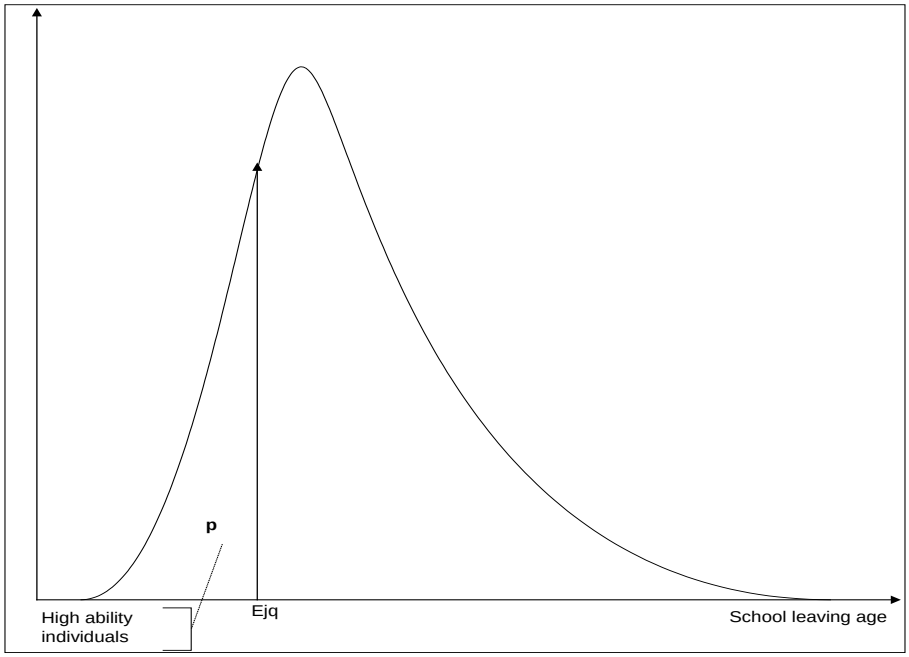
In general, however, E_q is not known. First, it might be changing over time so that it is not the same for individuals from different cohorts. Second, as underlined by Kroch and Sjoblom (1994), if education serves as a signaling device, then its value as a signal should be distilled in the distribution of educational attainments. Therefore, for a given qualification level q and a cohort j, the distribution of years of school leaving age is such that there is a number of years $E_{j,q}$ such that individuals with a higher number of years of schooling are of low ability whereas those with fewer years of schooling are of high ability. Consequently, the effective number of years $E_{j,q}$ could be identified if one knows the proportion p of individuals that potential employers are likely to consider as higher ability applicants (Figure 3.1).

Obviously, p is not known either. Yet, simulations could be made with different hypothetical values of p. This is the approach adopted by Jarousse and Mingat (1986), which I replicate to obtain the results in Table 3.2.

Using data from the 1995 *Labour Force Survey* for France, I distinguish between four 12-year-long cohorts j of individuals and 18 qualification levels q and then infer the value of the effective number of years of schooling $E_{j,q}$ from the corresponding distribution of years

of schooling for three alternative values of p. I finally estimate gender-specific Mincer-type equations to see how the returns to education change according to whether the education measure is S, the actual number of years of schooling, or $E_{j,q}(p)$, the effective number that is infered from specific values of p.[10]

Figure 3.1 Distribution of years of schooling for individuals with qualification level *q* and belonging to cohort *j*



Two results in Table 3.2 deserve particular attention. First, for men as well as for women, the inclusion of hypothetical effective years of schooling, instead of the actual ones, enhances the goodness of fit since the adjusted determination coefficients increase by at least 3 percentage points. This result suggests that the effect of education on earnings is better captured by effective than by actual schooling duration. Second, the returns to effective years of education are much higher than the returns to actual schooling; 1.5 times higher on aver-

[10] The male sample includes full-time employees only while the female sample includes part-time employees as well. A part-time dummy is then added as an extra regressor in the regressions based on the female sample.

age. One is tempted to conclude, like Jarousse and Mingat (1986), that these high returns are those that individuals would have earned had they all completed their education in a time equal to the effective number of years of schooling corresponding to their specific cohorts and qualification levels. This would mean then that the reason why the returns to actual years of schooling are much lower is that it takes the majority (1–*p*) of individuals more years to attain their qualification than the effective duration. Reasoning this way leads to the conclusion that the longer it takes individuals to attain their qualification level, the lower are the returns to education they earn. This is in line with the prediction of the screening hypothesis that slower completion provides potential employers with a signal of lower ability.

Table 3.2 Returns to actual and effective numbers of years of schooling

	Women				Men			
	Actual	p = 5	p = 15	p = 25	Actual	p = 5	p = 15	p = 25
Intercept	1.8426	1.5286	1.4345	1.4880	1.8427	1.6208	1.4385	1.5567
	(0.0313)	(0.0311)	(0.0302)	(0.0298)	(0.0301)	(0.0296)	(0.0293)	(0.0290)
S	0.0653	-	-	-	0.0561	-	-	-
	(0.0007)	-	-	-	(0.0006)	-	-	-
E	-	0.0967	0.0981	0.0979	-	0.0906	0.0907	0.0879
	-	(0.0009)	(0.0008)	(0.0008)	-	(0.0008)	(0.0008)	(0.0007)
Age	0.0520	0.0579	0.0570	0.0517	0.0597	0.0597	0.0643	0.0576
	(0.0015)	(0.0015)	(0.0014)	(0.0014)	(0.0015)	(0.0015)	(0.0014)	(0.0014)
Age sq./ 100	-0.0465 (0.0019)	-0.0497 (0.0018)	-0.0489 (0.0018)	-0.0431 (0.0018)	-0.0515 (0.0019)	-0.0482 (0.0018)	-0.0539 (0.0018)	-0.0468 (0.0018)
Part-time	-0.1079	-0.0954	-0.0906	-0.0901	-	-	-	-
	(0.0046)	(0.0045)	(0.0043)	(0.0043)	-	-	-	-
N	25,243	25,243	25,243	25,243	30,018	30,018	30,018	30,018
Adj. R^2	0.35	0.38	0.42	0.43	0.35	0.39	0.42	0.42

Source: Own calculations based on the 1995 French LFS. Endogenous variable is log of gross hourly wage.

On the other hand, the higher returns to effective years of schooling might simply reflect a statistical artefact, viz. that the variance of effective years of schooling is necessarily lower than the variance of actual years. To examine this issue, consider the two wage equations estimated so far:

$$\ln(w) = aS + X\beta + \varepsilon \tag{3.1}$$

and

$$\ln(w) = bE + X\beta + \varepsilon \tag{3.2}$$

where w denotes wages, S and E the actual and the effective number of years of schooling, respectively, X a vector of regressors excluding education and ε the random disturbance. Clearly, they are both restricted versions of the more general specification

$$\ln(w) = bE + cD + X\beta + \varepsilon \tag{3.3}$$

where $D = S - E$ and the imposed restrictions are $b = c$ $(= a)$ and $c = 0$, respectively. Hence, estimation of this more general specification is likely to shed some light on the accuracy of each of the restrictions. The results are reported in Table 3.3.

As can be seen from the table, a first interesting feature of the results is the higher goodness of fit observed for the lowest values of p. This indicates that the lower the effective numbers of years of schooling are, the more important it is to distinguish between these and the actual ones. The results also highlight high significance levels of the difference between actual and effective years. Note also that although slightly lower, the returns to effective years remain in the same range as those obtained from the restricted version reported in Table 3.2. Moreover, while the restriction imposed in the standard equation including actual years of schooling ($b = c$; see the columns labeled Actual in Table 3.2.) is systematically rejected (see Fisher statistics in the last row of Table 3.3), the coefficients of the D variable are systematically positive, but significantly lower than those for the effective number of years of schooling. The results in the columns with $p = 0$ suggest that years spent at school beyond the effective (minimum) number yield positive returns as well, which are, however, much lower. This is inconsistent with the prediction of the screening hypothesis according to which these extra years should have a negative effect on wages. In the human capital view, these lower returns are likely to reflect that extra years allow individuals to better understand what they have learnt during the effective years or that they endow them with a smaller amount of relevant human capital.

Table 3.3 OLS estimates from specification (3.3)

	Women				Men			
	p = 0	p = 5	p = 15	p = 25	p = 0	p = 5	p = 15	p = 25
Intercept	1.8836	1.4941	1.4275	1.4752	1.8770	1.5883	1.4500	1.5497
	(0.0305)	(0.0306)	(0.0300)	(0.0297)	(0.0294)	(0.0292)	(0.0291)	(0.0289)
E	0.0782	0.0960	0.0977	0.0976	0.0708	0.0877	0.0890	0.0865
	(0.0007)	(0.0009)	(0.0008)	(0.0008)	(0.0007)	(0.0008)	(0.0008)	(0.0007)
D	0.0472	0.0296	0.0184	0.0146	0.0396	0.0237	0.0143	0.0140
	(0.0008)	(0.0009)	(0.0010)	(0.0010)	(0.0007)	(0.0008)	(0.0009)	(0.0009)
Age	0.0550	0.0560	0.0560	0.0517	0.0630	0.0598	0.0635	0.0579
	(0.0015)	(0.0015)	(0.0014)	(0.0014)	(0.0015)	(0.0015)	(0.0014)	(0.0014)
Age sq./ 100	-0.0513	-0.0475	-0.0477	-0.0430	-0.0571	-0.0486	-0.0531	-0.0472
	(0.0019)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Part-time	-0.1004	-0.0922	-0.0893	-0.0892	-	-	-	-
	(0.0045)	(0.0044)	(0.0043)	(0.0043)	-	-	-	-
N	25,243	25,243	25,243	25,243	30,018	30,018	30,018	30,018
Adj. R^2	0.38	0.41	0.43	0.43	0.38	0.41	0.42	0.42
	Fisher statistics for :							
$b = c$	1314.5	2587.3	3703.6	3977.1	1525.4	2690.2	3642.5	3517.3
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)

Source: Own calculations based on the 1995 French LFS. Endogenous variable is log of gross hourly wage.

The columns with positive values of p are much more difficult to interpret since the coefficients on the D variable measure the net effect of years below and beyond the effective number of years of schooling. To see this, it is interesting to note that these coefficients are systematically decreasing with the value of p. Such a decreasing pattern suggests that years below the effective number have a negative effect on wages while those beyond that number have a positive effect. This is very important as this would radically contradict the predictions of the screening hypothesis. To make this point clear, I report in Table 3.4 results from the estimation of a specification which generalizes equation (3.3). Let H (L respectively) denote a dummy variable taking value 1 for any individual with $D > 0$ ($D < 0$ respectively) so that equation (3.3) could be extended as

$$\ln(w) = bE + fD^*H + gD^*L + X\beta + \varepsilon \qquad (3.4)$$

As can be seen from Table 3.4, the coefficients on *D*H* and *D*L* are clearly different, hence suggesting that the specification of Table 3.4 is more appropriate than the one in Table 3.3. The table also shows that years beyond the effective number have no negative effect on wages, while those below that number have no positive effect. This is definitely in contradiction with predictions of the screening hypothesis.

Table 3.4 Returns to different components of schooling

	Women				Men			
	p = 0	p = 5	p = 15	p = 25	p = 0	p = 5	p = 15	p = 25
Intercept	1.8836	1.5409	1.4035	1.4607	1.8770	1.6235	1.4259	1.5291
	(0.0305)	(0.0594)	(0.0302)	(0.0298)	(0.0294)	(0.0479)	(0.0292)	(0.0290)
E	0.0782	0.0968	0.0980	0.0980	0.0708	0.0908	0.0902	0.0872
	(0.0007)	(0.0009)	(0.0008)	(0.0008)	(0.0007)	(0.0008)	(0.0008)	(0.0007)
*D*H*	0.0472	-0.0131	0.0592	0.0424	0.0396	-0.0084	0.0393	0.0390
	(0.0008)	(0.0516)	(0.0048)	(0.0045)	(0.0007)	(0.0379)	(0.0047)	(0.0044)
*D*L*	-	-0.0750	0.0121	-0.0173	-	-0.1028	-0.0335	-0.0362
	-	(0.0135)	(0.0083)	(0.0063)	-	(0.0111)	(0.0073)	(0.0058)
Age	0.0550	0.0580	0.0562	0.0517	0.0630	0.0600	0.0637	0.0583
	(0.0015)	(0.0015)	(0.0014)	(0.0014)	(0.0015)	(0.0015)	(0.0014)	(0.0014)
Age sq./ 100	-0.0513	-0.0497	-0.0476	-0.0427	-0.0571	-0.0485	-0.0530	-0.0474
	(0.0019)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Part-time	-0.1004	-0.0950	-0.0901	-0.0898	-	-	-	-
	(0.0045)	(0.0044)	(0.0043)	(0.0043)	-	-	-	-
N	25,243	25,243	25,243	25,243	30,018	30,018	30,018	30,018
Adj. R^2	0.38	0.39	0.43	0.43	0.38	0.39	0.42	0.42

Source: Own calculations based on the 1995 French LFS. Endogenous variable is log of gross hourly wage.

To sum up, the most striking of the results above is the rather large differences between the returns to effective and to actual numbers of years of schooling. The various specifications estimated suggest, however, that interpreting such differences in terms of signaling has no foundations. Probably, all what these results suggest is that qualification levels play an important role besides the number of years of schooling. I examine this issue in the following section.

3.4 Does certification matter?

One striking result of the previous section is the large value of the returns to effective years of education, as compared to the returns to the actual number of years of schooling. One possible interpretation of this result is that individuals who complete their qualification in standard time earn more than those for whom it takes a longer time to attain the same qualification. In other words, sheepskin effects are at work so that those individuals holding a given qualification would earn more than those who have spent the same number of years at school but failed to attain that qualification. If these extra returns can be shown to exist, then this has two important implications. First, that certification also matters, not only the number of years of schooling. Second, that these extra returns for finishing a degree or obtaining a diploma probably reflect personal attributes, such as the determination to finish tasks, that are valued by employers and are more likely to be present among graduates than among the drop-outs.

The usual approach to testing the existence of sheepskin effects consists in examining if only years of schooling have an effect on wages or if educational levels have an additional effect as well. If both schooling and educational levels have specific influences on wages, then the usually adopted hypothesis that the wage–schooling relationship is linear is no more justified. Hence, a natural way to see if sheepskin effects do exist is to test the linearity of the earnings–schooling relationship. Consider the specification

$$\ln(w_i) = X_i\beta + \alpha S_i + \sum_{j=1}^{k-1} \gamma_j D_{ij} + c + \varepsilon_i \,, \tag{3.5}$$

where X is a vector of regressors and S is the actual number of years of schooling. D_{ij}, $j = 1,2,\ldots,k$, are dummy variables for educational levels so that each γ_j measures the extra return to qualification j since years of schooling are also controlled for. Note also that each qualification is typically reached at a given age so that the qualification dummies also reflect the age at which individuals typically reach their highest qualification. Put this way, each γ_j could also be seen as measuring the 'bonus' return individuals would earn have they completed the degree they hold at the typical age j. Hence, rejection of the null hypothesis H_0:$\forall j = 1,2,\ldots,k-1$, $\gamma_j = 0$ implies that these 'bonuses' are not zero and that the wage–schooling relationship is not linear.

The interpretation of the coefficient a that is associated with the number of years of education is less clear-cut since the levels of qualification are already controlled for. One should probably think about it as the return to those years spent at school that are typically not required, such as repeated or non-graduating years. To be more specific, consider an individual with a high-school degree, who joins tertiary education for two years and then leaves without graduation. Since his highest qualification is still the high-school degree, the coefficient a would capture the returns to the two extra years he spent in tertiary education.

The above specification has been estimated for several countries. Table 3.5 summarizes the results. The first column indicates the country, the data set and the year(s) of observation. The second column shows the returns to schooling as estimated from a restricted specification not including qualification level dummies. When these are accounted for, as described in the 6th column, the resulting returns to years of schooling are reported in column 3 and an F test of the linearity hypothesis H_0:$\forall j = 1,2,\ldots,k-1$, $\gamma_j = 0$ is performed, the p value of which is reported in the 4th column. Since the estimated specifications as well as the educational classifications differ from one country to another, only general indications on these are reported in the 6th and 7th columns.

Table 3.5 shows that while the linearity hypothesis is strongly rejected for France, the United Kingdom and the USA, it seems to be acceptable in Canada, Ireland and Sweden. Note, however, that even though the overall F test suggests that the linear hypothesis is reasonable for these latter countries, separate t tests show that there are marked non-linearities in the wage–schooling relationship, mainly at higher levels of education. Hence, these results suggest that sheepskin effects are a rather common phenomenon and that, even in countries where the linear hypothesis is acceptable, there are 'bonus' returns to completing high-level qualification levels.

Another interesting result in Table 3.5 is that the returns to years of schooling are systematically lower when qualifications are controlled for. If the returns to years of schooling in the specification including educational attainment levels are to be interpreted as returns to those years that do not directly contribute to a qualification, then the main question is that of why do these extra years yield lower returns. The screening hypothesis would predict these extra years to have a negative effect on wages since slow completion is meant to be a signal of lower ability. Perhaps, only in the human capital framework could these low returns be interpreted. Indeed, as mentioned above, repeating a year

Table 3.5 Tests of the linearity hypothesis

	S $\gamma = 0$	*S* $\gamma \neq 0$	*p value for F test*	N	Educational classification	Other covariates
Sweden (1) IALS, 94-96	0.028 (.009)	NA	0.181	740	ISCED2 : Lower secondary	Age, age², marital status, industry, rural area.
USA (1) IALS, 94-96	0.072 (.008)	NA	0.008	815	ISCED3 : Upper secondary	Age, age², marital status, firm size, industry, rural area.
Canada (1) IALS, 94-96	0.039 (.015)	NA	0.562	1,066		
Ireland (1) IALS, 94-96	0.081 (.012)	NA	0.234	531	ISCED5 : Third level, non-degree	
GB (1) IALS, 94-96	0.087 (.011)	NA	0.000	987	ISCED6 or ISCED7 : Third level, degree and post-graduates	
UK, men (2) BHPS, 91-96	0.064 (.002)	0.026 (.003)	Reject	8,284	Non-vocational: Higher degree, degree, A-level, GCSE, CSE, other.	Year dummies, age, age², marital status, number of children in three age ranges, region dummies, regional unempl. rates.
UK, wom. (2) BHPS, 91-96	0.085 (.003)	0.036 (.003)	Reject	8,987		
UK, men (2) GHS, 84-96	0.050 (.002)	0.001 (.002)	Reject	18,746	Vocational: Teaching, other higher, nursing, commercial, apprenticeship.	Year dummies, age, age², marital status, number of children in three ranges, region, foreign qualif., regional unempl. rates.
UK, wom. (2) GHS, 84-96	0.085 (.003)	0.012 (.002)	Reject	17,924		
France, men FQP, 93 (3)	0.067 (.002)	0.056 (.002)	0.000	4,395	General lower secondary, Voc. lower secondary, Upper secondary, Undergraduates, Advanced undergraduates, Graduates, Doctors.	Potential labour market experience and its square.
France, wom. FQP, 93 (3)	0.067 (.002)	0.057 (.004)	0.000	3,835		
France, men LFS, 95 (3)	0.075 (.001)	0.039 (.001)	0.000	29,082		
France, wom. LFS, 95 (3)	0.081 (.001)	0.038 (.001)	0.000	24,683		

Source: (1) from Denny and Harmon (2001), (2) from Chevalier and Walker (2001) and (3) from Guille and Skalli (2001).

allows individuals to better understand what they have learned the previous year, not necessarily to accumulate as much human capital as those who do not repeat. Furthermore, detour years do not necessarily endow individuals with the relevant human capital. Finally, if drop-outs are low motivation failures, then they are likely not to exert enough ef-

fort to accumulate the minimum amount of human capital required to pass. This probably means that while years of schooling measure the potential amount of human capital individuals could typically accumulate, qualification levels measure that amount required from individuals to pass. If individuals attend for more years but do not accumulate that required level of human capital, they fail to pass the corresponding qualification level and benefit from lower returns to those extra years.

Thus, although the data reveal the existence of sheepskin effects, the way these should be interpreted is not clear-cut. A necessary hypothesis for sheepskin effects to be interpretable in terms of signaling mechanisms, is that years of schooling reliably measure human capital accumulation. In contrast, assuming that the amount of human capital accumulated during a given year depends on whether that year contributes or not to a qualification, makes sheepskin effects interpretable in terms of differences in human capital accumulation.

3.5 Concluding remarks

Using three alternative testing strategies and data from several countries, this study has attempted to discriminate between human capital theory and the screening hypothesis in the interpretation of the returns to education.

The first test relies on the distinction between employees and the self-employed. Under the assumption that these constitute differently screened groups of workers, the test consisted in examining whether the returns to education for the former group were higher than for the latter. No strong evidence for the screening hypothesis could be found. To be more specific, only in few cases do the returns to education reveal to be lower for the self-employed; namely France, women in Greece and men in Spain. It is, however, not clear whether the observed inter-country differences are due to institutional specificities or to the possible inaccuracy of the hypothesis that the self-employed are not screened workers while employees are.

The second test is based on the estimation of the returns to different components of schooling. The distinction between individuals according to whether they have completed their qualification in standard time, in shorter or in longer time shows that the usually estimated Mincer-type equation with aggregate number of years of schooling imposes a strong restriction on the estimate of the effect of

education on wages. Not only is the goodness of fit improved when a distinction between the components of schooling is made, but their effect on wages differs with the speed of completion. However, neither does fast completion increase the returns to education nor does slow completion decrease them. This contradicts the intuitive predictions of the screening hypothesis.

Finally, the third test performed consisted in examining the importance of sheepskin effects. By estimating earnings functions where education is controlled for via years of schooling as well as qualification levels, one is indeed able to test whether the schooling–wage relationship is linear or if there are extra returns to completing a degree or a diploma. The results highlight marked nonlinearities, suggesting that sheepskin effects are actually at work. Although an easy interpretation of these is that completion provides employers with a signal of ability, sheepskin effects might also be interpreted in terms of the amount of human capital a year of schooling endows individuals with depending on whether it contributes or not to the qualification.

To sum up, none of the results presented in this study could be considered as strong evidence that education serves mainly as a signaling device. Combining these results with those reported in Barceinas-Paredes et al. (Chapter 4 of this volume), we see that the outcome of any attempt to test the screening hypothesis depends crucially on the method of investigation and on the country under investigation. Thus, these two dimensions deserve more attention in future research than usually paid to them.

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Chapter 4

DOES EDUCATION IMPROVE PRODUCTIVITY OR EARNINGS ONLY? Evidence from France and Spain*

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* We are grateful to the EU–TSER programme for financial support for the PURE project (SOE2-CT98-2044)
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4.1 Introduction

The relationship between education and productivity has been the subject of a long debate in the economics literature. According to human capital theory, the role of education is to augment individuals' productivity (Becker 1964). In contrast, the so-called screening hypothesis argues that education merely signals individuals' innate ability to potential employers (Arrow 1973, Spence 1973, 1974, Stiglitz 1975).

Since education enhances individuals' lifetime earnings regardless of whether it signals their inherent productivity or augments it, it is certainly a good investment for individual workers. What is less clear is whether it is a good investment for society as a whole. Indeed, if the only role of education is to serve as a signaling device, then the absence of social benefits from it would imply that public funding policies of education are no more justified. If education plays both a signaling and a productivity augmenting role, then public resources should be mainly devoted to those qualifications which improve individuals' productivity to the greatest extent. In contrast, if the effect of education on individuals' earnings exclusively measures an effect on productivity, then social benefits might be substantial enough to justify that education be accordingly publicly funded.

A proper test to discriminate between the screening hypothesis and human capital theory would require that data on individuals' productivity be available. Obviously, such data do not exist so that an alternative test must rely on earnings functions where wages are assumed to proxy productivity. The problem, however, is that both the screening hypothesis and human capital theory predict a positive effect of education on wages and are, hence, observationally equivalent (Layard and Psacharopoulos 1974). To overcome this problem, empirical analyses consist in general in testing predictions of the screening hypothesis rather than the hypothesis itself.

The most popular approach consists in distinguishing between screened and unscreened groups of workers and on the comparison of the rates of return to education across these. Albrecht (1974) distinguishes between individuals that are outsiders to the firm and those hired from within. The productive capabilities of the latter are indeed known to the employer and should therefore yield no signaling value of education. In contrast, the analyses by Taubman and Wales (1973) as well as Riley (1979) are based on the distinction between occupational categories, some of which being treated as unscreened ones. Al-

ternatively, the *Wiles*-test approach consists in assuming that, compared to the privately employed, self-employed workers constitute the unscreened group since they have no need to signal innate ability (Wolpin 1977). Therefore, the returns to education for the self-employed are nothing but true returns to human capital.[1] Finally, advocates of the so-called *P*-test (Psacharopoulos 1979, Brown and Sessions 1999) compare returns across relatively competitive and non-competitive sectors. The idea here is that wages are closer to the marginal product of labour in competitive sectors than in non-competitive ones where wages are bureaucratically set and, hence, where screening is more likely. One of the several tests we perform in this study relies on the distinction between private and public sector employees.

The distinction between screened and unscreened groups of workers is not the only means of discriminating between human capital theory and the screening hypothesis. Alternative approaches have been adopted in the literature. For instance, the test by Kroch and Sjoblom (1994) is based on the argument that, if education is a signal, then its essence should be distilled in the position of an individual in the distribution of education for his cohort. As an example, an individual with a given qualification might be negatively signaled today although he could have been positively signaled had he entered the labour market some years ago. In the screening framework, individuals' rank in the cohort-specific educational distribution should have a greater impact on earnings than mere years of schooling.[2] In this study, we also adopt Kroch and Sjoblom's approach, which consists in comparing the relative importance of the impact on earnings of absolute and relative measures of education. It could be linked to the approach proposed by Jarousse and Mingat (1986). These authors compare the returns to education estimated using the actual number of years of schooling to those that these individuals would have got, had they completed their qualification in the same number of years as the modal individual of their co-

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1 This is the approach adopted by Lassibille (1994) for Spain using a sample of male heads of households from the Household Budget Survey-1980/81 (HBS-80/81). With rates of return of 7.04% and 7.42% for the self-employed and the privately employed, respectively, he concludes to a positive signaling value of education.

2 A similar approach is proposed by Blanco and Pons (1998) who use the percentile ranking in the regional distribution of years of education in Spain. Hence, the main difference between Blanco and Pons (1998) and Kroch and Sjoblom (1994) resides in the privileged dimension of the ranking of individuals which is spacial in the former case and temporal in the latter. In both cases, however, evidence for a weak signaling effect is found.

hort. They then conclude that faster completion signals higher ability and, therefore, yields higher returns.

The speed of completion is also central to the analysis by Groot and Oosterbeek (1994). Using a sample of Dutch individuals, they compare the returns to effective, drop-out, skipped, repeated and inefficient routing years of schooling in the Netherlands. This approach has been replicated for France by Guille and Skalli (2001). Like in the Dutch case, French evidence does not strongly confirm the predictions of the screening hypothesis.

Although also stressing the role of the speed of completion, Corugedo (1998) primarily aims at reconciling human capital and signaling theories. He estimates the impact of the actual number of years of schooling on the earnings of a group of graduate economists from Madrid. He finds this impact to be negative and concludes that the fewer years it takes individuals to complete their qualification, the more productive they are. However, this result might also reflect Groot and Oosterbeek's argument that faster completion provides potential employers with a signal of higher innate ability.

Note also that while Groot and Oosterbeek (1994) consider individuals with different educational records, including drop-outs, Corugedo (1998) focuses only on graduates, hence neglecting sheepskin effects, that is, 'bonus' returns for finishing a degree and obtaining a diploma.[3] To the extent that the graduates and the drop-outs are likely to accumulate comparable amounts of human capital, sheepskin effects probably reflect the idea that drop-outs signal a lesser ability to jump hurdles and to finish tasks. For this reason we also test in this study whether the returns to qualifications decrease according to the number of years it takes individuals to attain them. Following Park (1999), we are indeed able to investigate whether at a given time, among individuals having spent the same number of years at school, those who fail to complete a degree get lower returns.

One might argue that such testing strategies do not do justice to the screening hypothesis. Once an individual is hired, his employer might learn more about his actual capabilities and adjust his wage accordingly. This is the so-called weak version of the screening hypothesis. It would imply that the signaling value of education decreases over time and might, hence, be underestimated in cross-section analyses. Never-

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[3] See for instance Jaeger and Page (1996). For an analysis based on French data, see Goux and Maurin (1994).

theless, it is worth recalling that signaling models imply that as employers hire employees with different qualifications, they also learn about the relationship between education and productivity, so that their own expectations about individuals' ability become self-fulfilling (Spence 1974). This is the so-called strong version of the screening hypothesis. It implies that in a signaling equilibrium, a decreasing pattern of the signaling value of education is not justified (Psacharopoulos 1979, Tucker 1986, Lambropolous 1992, Arabsheibani and Rees 1997).

In our attempt to do justice to both the weak and the strong version of the screening hypothesis, we examine the life-cycle earnings profiles of individuals differing in their educational attainments. We start by examining whether the experience–earnings profiles of highly educated employees of the public sector tend to come closer to those of their public sector homologues. Next, we address the question of whether the effect of education on earnings decreases with individuals' tenure in their current job. In addition, we perform two complementary tests inspired by Psacharopoulos (1979). First, we re-produce the age–earnings profiles of highly educated people and examine whether they converge towards those of less educated individuals. Second, we compare the mid-to-early career earnings ratio for different sectors as years of schooling increase. Advocates of the signaling theory would indeed expect these ratios to decrease steadily and to be higher in non-competitive than in competitive sectors.

Hence, instead of relying on a single approach, this study examines the outcome of alternative testing strategies, each focusing on a specific prediction of the screening hypothesis. Moreover, the weak as well as the strong version of it are thoroughly investigated. Last but not least, each test is alternatively performed using French and Spanish labour market data. This means that the robustness of each result can be evaluated not only with respect to the theoretical approach underlying each test and the statistical technique that is used, but also in relation to the data sets under investigation and the institutional contexts they emerge from.

The chapter is organised as follows. Section 2 reports the results from our tests of the strong version of the screening hypothesis whereas section 3 focuses on the weak version of it. Section 4 examines the importance of sheepskin effects and section 5 concludes the paper.

4.2 The strong version of the screening hypothesis

In this section, two alternative testing strategies are adopted to examine whether the returns to education fully reflect productivity improvement or involve a signaling effect as well. Our first test is based on the distinction between screened and unscreened groups of workers. In our case, the screened group consists of public sector employees whereas the unscreened one includes the privately employed. In contrast, the second test relies on the idea that if education serves as a signaling device, then the relative position of individuals in the distribution of educational attainments specific to their cohort, should have more explanatory power on earnings than mere years of schooling.

The testing procedures are conducted using French as well as Spanish labour market data. These are the *1990–91 Household Budget Survey* (HBS), the *1994 European Community Household Panel* (ECHP), the *1985–96 Continuous Household Budget Survey* (CHBS) and the *1995 Wage Structure Survey* (WSS) for Spain. For France, nine waves of the *Labour Force Survey* (LFS) from 1990 until 1998 have been pooled.[4] To ensure sample homogeneity, we restrict the analysis to full-time male workers.

4.2.1 Do the returns to education differ between private and public sectors?

To the extent that the private sector is more competitive than the public one, it is reasonable to assume that wages are closer to the marginal product of labour in the former than in the latter where wages are in general rather bureaucratically set. As a consequence, one might expect signaling to be more likely in the public sector. Therefore, estimation of sector-specific earnings functions should indicate whether the returns to education are higher in the public than in the private sector and, hence, whether public sector employees are actually screened.

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[4] This is the so-called *Enquête Emploi* which is conducted by INSEE, the French national statistics institute.

To make our results as comparable as possible, we estimate for both countries Mincer-type equations that are as parsimonious as possible; that is, where potential labour market experience, its square and the actual number of years of schooling are the only regressors. Yet, such a comparison might obviously be misleading if based on OLS estimates. Indeed, the observed individuals might have chosen to work in the private or the public sector because of comparative advantages and/or because their individual endowments are differently remunerated in the two sectors and/or simply because of the existence of an inter-sectoral wage differential. Sector choice is therefore not random and neither are the separately observed samples of private and public sector employees. Consequently, self-selection is likely to be a major source of bias.[5] To avoid selectivity bias, we estimate switching regression models with endogenous switching.[6]

Table 4.1 reports, for each of our data sets, the estimated reduced-form probit equations where the endogenous variable takes value 1 for private sector employees. Apart from the regressors included in the wage equations, also other variables have been added, which are expected to help model identification.

For France, these are two dummy variables for whether the individual's father is (was) a public sector employee or self-employed, five dummies indicating father's occupational category, and two dummies for whether the individual is born French or has got French citizenship afterwards. The reason for this is that most public sector employees are tenured civil servants, which requires French nationality.[7] As can be seen from Table 4.1, all the variables are highly significant. Depending on their father's occupation, individuals are more or less likely to choose public sector employment. More importantly, those whose father is a public sector employee (self-employed) are more likely to become public sector employees. French citizenship seems also to be an important determinant of sectoral choice. In addition, as one could expect, the more educated individuals are, the more likely they are to work in the public sector. Finally, labour market experience seems to have a similar effect.

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5 See for instance Arabsheibani and Rees (1997), Brown and Sessions (1999), Dustman and van Soest (1998) and Lassibile (1998).

6 See Heckman (1979) and Maddala (1983) for a formal presentation.

7 The only exception is that of foreign academics. In general, one can reasonably assume that French citizenship widens immigrants' employment opportunities by making the public sector accessible to them.

Table 4.1 Reduced-form probit equations for sectoral choice*

	France Emploi 90-98		**Spain** ECHP 94	
	Coefficient	z-statistic	Coefficient	z-statistic
Constant	3.5765	124.81	1.9496	8.34
School	-0.0819	-81.62	-0.1082	-12.28
Potential experience	-0.0515	-49.79	-0.0148	-1.33
Experience squared / 100	0.0699	31.19	-0.0002	-0.124
Citizenship :				
Born French	-0.9917	-47.50		
Naturalised	-0.6947	-21.70		
Father's occupation:				
1 Farming	-0.0112	-0.51		
2 Craftsman, commerce	0.1060	4.98		
3 Manager, Engineer	0.0994	8.25		
4 Teacher, Supervisor	-0.0385	-3.94		
5 Service employee	-0.0725	-7.84		
Father's occupational sector:				
Public sector	-0.4279	-52.80		
Self-employed	-0.0790	-3.96		
Regions of Spain				
1 North West			-0.0663	-0.57
2 North East			0.1362	1.26
3 East			0.2000	1.87
4 Centre			-0.1290	-1.07
5 South			-0.2286	-2.01
6 Canary Islands			-0.2717	-1.75
Unemployment rate			0.0192	3.76
Log-likelihood	-126090.34		-1125.62	
N	260,270		2,181	
Private Sector	203,798		1,612	
Public Sector	56,472		569	

* Own calculations based on the French LFS and the Spanish ECHP, respectively. For France, year dummies were also included, the coefficients of which are not reported. In French data, the reference group comprises individuals who's father is/was a non-French labourer in the private sector. In Spanish data, it comprises Madrid inhabitants.

For Spain, the estimated reduced-form probit specification is based on the 1994 ECHP and includes the three human capital measures included in the wage equation, six regional dummies and the prevailing unemployment rate when individuals entered the labour market. Although the regional dummies are likely to be correlated with wages, they are expected to capture in some sense individual preferences. For instance, those who are reluctant to work in the public sector are likely

to live in those areas where private sector employment opportunities are the greatest. We see from Table 4.1 that, compared to Madrid, inhabitants of the north east and east (of the north west, centre, south and the Canary Islands) are more likely to be private sector (public sector) employees. In contrast, while current unemployment is likely to be correlated with current wages, the rate of unemployment that prevailed when individuals entered the labour market is likely to have the same impact on the current wages of all individuals. Furthermore, by influencing employment opportunities of individuals when choosing whether to join the private or the public sector, this variable is a potential determinant of sectoral choice. The results show indeed that it has a highly significant impact on sectoral affiliation and suggest that the higher the unemployment rate when individuals enter the labour market, the larger is the probability that they join the private sector. This result suggests that when unemployment is high, employment opportunities are wider in the private sector. It also reflects the fact that only since the 1980s have efforts towards the development of the public sector become significant in Spain. Prior to the last two decades, public sector employment opportunities were indeed very limited.

Table 4.2 Selectivity corrected wage equations by sector, full-time male workers*

	France LFS 90-98 Hourly wages		**Spain** ECHP 94 Hourly wages	
	Private	Public	Private	Public
Constant	2.7078	3.0394	6.0576	6.3706
	(456.09)	(145.16)	(89.85)	(20.30)
Schooling	0.0636	0.0588	0.0534	0.0623
	(165.25)	(101.27)	(7.88)	(6.08)
Experience	0.0353	0.0310	0.0351	0.0316
	(121.41)	(54.63)	(9.84)	(5.00)
Experience^2 / 100	-0.0449	-0.0380	-0.0436	-0.0358
	(-77.99)	(-34.24)	(-7.23)	(-3.46)
Inv. Mills' ratio	0.1006	-0.0774	0.3098	-0.0245
	(14.50)	(-10.64)	(2.56)	(-0.21)
Adjusted R^2	0.31	0.38	0.27	0.34
N	186,259	52,446	1,612	569

* Own calculations based on the French LFS and the Spanish ECHP, respectively. For France, year dummies were also included, the coefficients of which are not reported. Robust *t*-statistics in parentheses.

Based on these probit equations, inverse Mills' ratios have been estimated and included as additional regressors in the wage equations to correct for self-selection. Table 4.2 reports the results from this two-step procedure. An interesting result is that both in France and in Spain, only in the private sector is there a positive selection. Spanish public sector employees do not seem to self-select because of preferences for public sector employment. In contrast, the French results indicate that there is self-selection of employees into both sectors either/both because of individual preferences or/and comparative advantages. Besides, for both countries and all data sets, human capital variables are highly significant and are assigned the expected signs. In particular, experience–earnings profiles are concavely increasing.

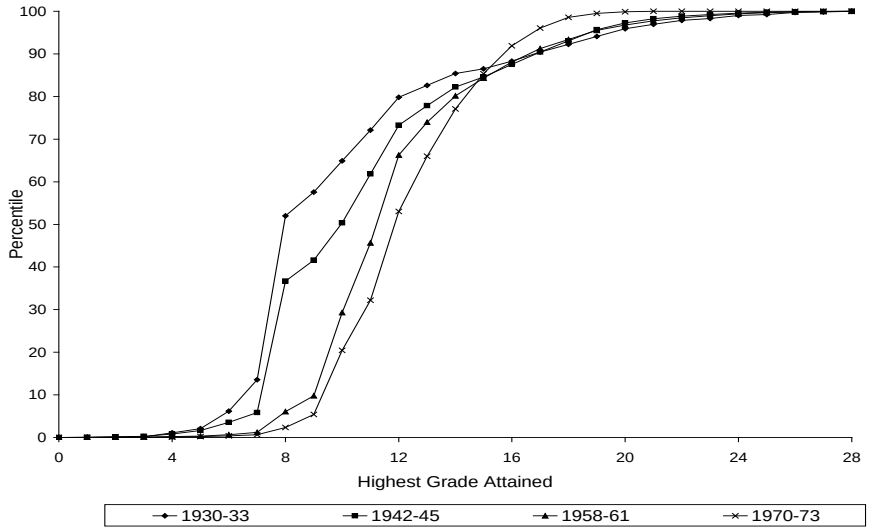
Summing up, these results can, by no way, be considered as evidence for the screening hypothesis. The only message they deliver is either that education plays no signaling role, or that the assumption that public sector employees are more screened than their private sector counterparts does not receive strong support from the data. We must therefore attempt to conduct an alternative testing strategy.

4.2.2 Is it how long or how much longer that matters?

Suppose education serves as a screen where employers read signals about their applicants' innate ability. Assume further that the value of such a signal is not constant over time so that a given number of years of schooling signals more ability potential when only few people have attained it than when the number of these has grown. Under these assumptions, it is to the relative position of individuals in the distribution of educational attainments that employers should pay the greatest attention, not to the absolute position. To be more specific, a high-school degree might provide potential employers with a positive signal if the proportion of high-school degree holders is rather low, and with a negative signal if the proportion of tertiary education attendees is much higher. It is on the basis of this idea that Kroch and Sjoblom (1994) claim that if education is a signal, then the essence of the signal should be distilled in the position of an individual in the distribution of education for his cohort.

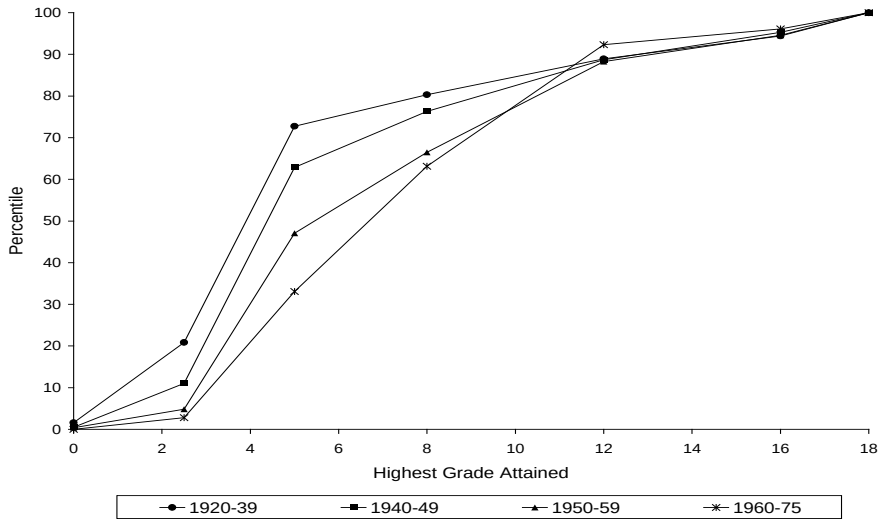
Figure 4.1a represents the distribution of educational attainments for four cohorts from the French pooled LFS of 1990 until 1998, while Figure 4.1b depicts such a distribution for four cohorts from the Spanish pooled CHBS of 1985 until 1996.

Figure 4.1a Distribution of educational attainments for four cohorts, male full-time workers, LFS



Source: Own calculations based on the French LFS.

Figure 4.1b Distribution of educational attainments for four cohorts, male heads of households, CHBS



Source: Own calculations based on the Spanish CHBS.

As can be seen from the French ogive, the median number of years of schooling of individuals born between 1930 and 1933 is around 8, whereas 50% of those born between 1970 and 1973 and observed in the labour market prior to 1998 – our final sampling year – attended school for more than 12 years. Similarly, the Spanish figure shows that while the median highest grade of the 1920–39 cohort is around 4, that of household heads born between 1960 and 1975 is 7. What these ogives suggest is that while the horizontal axis represents the absolute measure of individuals' educational attainments, the vertical one provides us with a relative measure. Indeed, it depicts the relative position of individuals in the distribution of educational attainments, which is specific to the cohort they belong to, depending on the number of years they have devoted to schooling. To put it simply, the vertical axis ranks individuals by years of schooling given the cohort-specific distribution of these.

This distinction between absolute and relative measures of education is very important as it provides a means of addressing the question of whether education augments productivity and/or serves as a signaling device. Human capital theory stresses that the longer individuals attend school, the more human capital they accumulate and, therefore, the more productive they are and that it is this productivity augmenting role that yields higher earnings. Consequently, it is the absolute amount of human capital accumulated as measured by the actual number of years of schooling that matters. In contrast, the screening hypothesis implies that it is the relative position of individuals in the distribution of educational attainments that counts. These contrasting implications may be exploited as foundations for an alternative testing strategy to discriminate between human capital theory and the screening hypothesis.

We estimate an earnings equation that includes two measures of education: the actual number of years of schooling (E) – the horizontal axis in Figures 4.1a and 4.1b – and the rank of E in the distribution of educational attainments for each cohort (R) – the vertical axis in Figures 4.1a and 4.1b. The equation we estimate is

$$\ln(w_i) = c + hE_i + sR_i + g_1 X_i + g_2 X_i^2 + \varepsilon_i \qquad (4.1)$$

where w denotes gross annual earnings in the Spanish case and gross hourly wages in the French specification. X is experience and ε is the error term. To the extent that potential employers infer individuals' position in the distribution of abilities from that of educational attain-

ments, the pure signaling hypothesis implies a value of b equal to 0, while the pure human capital model implies a value of s equal to 0.[8] If both theories play a role in the value of education, both b and s should be positive.

Table 4.3 reports the results. It highlights notable similarities between France and Spain. In both countries, the effect of the ranking variable is positive and highly significant, hence suggesting that, for a given number of years of schooling, the higher its relative position in the distribution of educational attainments the higher is its positive impact on earnings. This impact is, however, much lower in France than in Spain. A unit increase in the cohort-specific percentile that an individual belongs to, would increase his annual earnings by 20% in Spain and his hourly wage by no more than 0.1% in France. In both cases,

Table 4.3 Effects of the absolute and the relative measure of education on earnings*

	France		**Spain**	
	LFS 90-98 Gross hourly wages		CHBS 85-96 Gross annual earnings	
Constant	2.6809	2.7243	13.3036	13.2832
	(623.47)	(544.86)	(373.02)	(371.63)
Schooling (S)	0.0675	0.0598	0.0728	0.0621
	(337.50)	(119.60)	(51.67)	(23.79)
Ranking (R)		0.0010		0.2020
		(10.00)		(4.88)
Experience (X)	0.0375	0.0376	0.0430	0.0419
	(187.50)	(188.00)	(20.42)	(19.79)
Experience^2 / 100	-0.0477	-0.0493	-0.0604	-0.0600
	(-95.40)	(-98.60)	(-17.63)	(-17.52)
Adjusted R^2	0.34	0.34	0.27	0.28
Fisher	11823.9	10879.0	1145.4	868.9
N	250,009	250,009	9,109	9,109

* Own calculations based on the French LFS and the Spanish CHBS. For France, year dummies have also been included, the coefficients of which have not been reported. Robust t-statistics in parentheses.

[8] An implicit assumption here is that the distribution of innate ability does not change over time.

however, the effect of the schooling variable remains dominant and highly significant. Thus, the human capital effect is robustly persistent although the returns to schooling have decreased by some 0.8 percentage points in France and by almost 1 percentage point in Spain. One is tempted to conclude that this decrease in the returns measures exactly the signaling value of education. Such a conclusion would, however, be reliable only under the assumption that our parsimonious specification is immune from any source of bias. This is not guaranteed, as we have exerted no effort in examining the extent to which specification, ability and endogeneity biases are likely to influence the result.

Summing up, our estimates indicate that education is likely to serve as a signaling device but only to a rather limited extent. All in all, it is mainly the productivity augmenting role of education that private returns reflect. Probably, however, our cross-section estimates underestimate the signaling value of education. As underlined in our introductory discussion, it is possible that this value diminishes as workers' job tenure or experience helps employers to observe individuals' actual productive capabilities. We now turn to examine the extent to which such a hypothesis is compatible with our data.

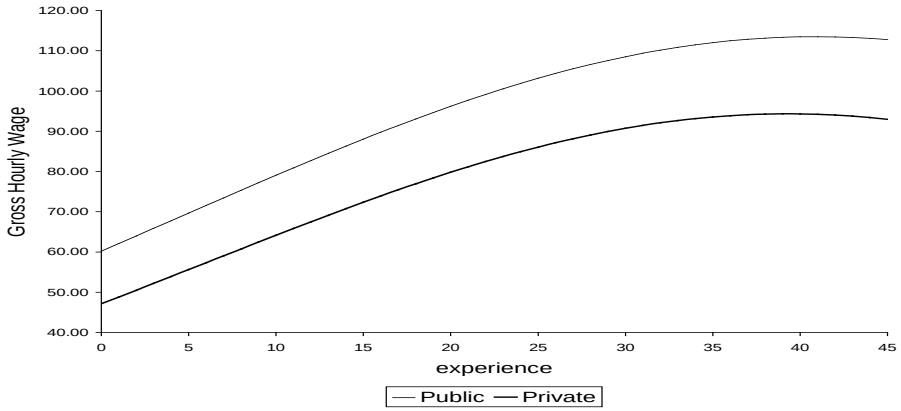
4.3 The weak version of the screening hypothesis

An implicit assumption underlying the testing strategies presented above is that there is a hysteresis in the signaling value of education; that is, one expects it to persist even for senior workers whose innate capabilities are no more a secret for their employers. Signaling theory claims that this is a realistic assumption since signaling equilibria imply that employers' expectations about individuals' innate ability, conditional on their educational levels, are self-fulfilling. This fundamental implication of the theory is sometimes ignored so that advocates of the screening hypothesis claim that the reason why empirical tests are so seldom conclusive is that the signal hysteresis is too a strong requirement. A corollary to this argument is that the returns to education should decrease along the life-cycle of screened workers. This is the prediction that this section focuses on. Here again, different tests are alternatively conducted.

As a first attempt, we examine the experience–earnings profiles of highly educated individuals from the public and the private sector. Fig-

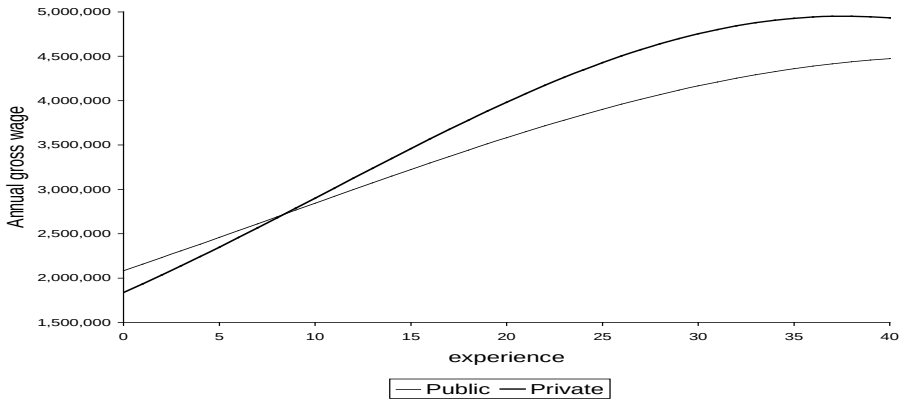
ures 4.2a and 4.2b depict these profiles for France and Spain, respectively, based on the estimations reported in Table 4.2. The Spanish ogive does not contradict the prediction of the weak version of the screening hypothesis. At the beginning of their working career, Spanish

Figure 4.2a Experience–earnings profiles of public and private sector full-time male employees with 18 years of schooling, France



Source: Own calculations based on the French LFS 1990-98.

Figure 4.2b Experience–earnings profiles of public and private sector full-time male employees with 18 years of schooling, Spain



Source: Own calculations based on the Spanish HBS 1990/91.

public sector employees earn some 13% more than their private sector homologues. In addition, their experience–earnings profile is much flatter so that after 9 years only, the sectoral earnings differential becomes favourable to private sector employees. However, it is not clear to which extent the observed pattern is due to the returns to experience increasing faster in the private sector – see Table 4.2 – or to the returns to education being decreasing in the public sector as the signaling value vanishes across time. The French results seem to plead in favour of the former hypothesis. One can see from Figure 4.2a that the experience–earnings profiles have comparable slopes since the returns to experience reported in Table 4.2 are not that much different. Consequently, the public and private sector profiles never intersect, hence eliminating any suspicion about decreasing returns to education in the public sector.

A possibly more direct test of the weak version of the screening hypothesis might consist in comparing the rates of return to education of groups of individuals differing in tenure in their current job. Indeed, if education has a positive signaling value and if this value really decreases as employers learn more about their employees' innate ability, then one would expect the impact of schooling on earnings to decrease with job tenure. To be more specific, the weak version of the screening hypothesis should result in education having an explanatory power – measured by *t*-statistics – on earnings that is declining with workers' seniority.

Our results for France as well as for Spain are reported in Table 4.4. Neither are the returns to education decreasing nor is the explanatory power of the schooling variable declining with job tenure. For France as well as for Spain, they peak for individuals who have stayed with the same employer for a period of 2 to 5 years. Only when seniority exceeds 5 years do they start to decrease very slightly. They, nevertheless, never go below the rates that newly hired individuals earn. One might argue that the observed patterns are due to the increasing amplitude of job tenure brackets that we consider. Note, however, that such an argument would have held only if a decreasing explanatory power of education had emerged. One can see from Table 4.2 that neither in France nor in Spain do the results confirm this. Instead, in both countries, the Student *t*-statistics are higher when job tenure exceeds 20 years than when it is less than 2 years.

Table 4.4 Earnings functions by current job tenure level, full-time male employees*

	France: LFS 1990-98			
	(0,1]	(1,5]	(5,20]	(20,50]
Constant	2.7175	2.7223	2.8209	2.7556
	(248.62)	(301.77)	(358.47)	(79.83)
Schooling	0.0620	0.0674	0.0662	0.0620
	(105.71)	(151.09)	(200.27)	(120.96)
Experience	0.0323	0.0307	0.0312	0.0418
	(58.65)	(63.95)	(66.74)	(20.54)
Exp.^{2}	-0.0005	-0.0004	-0.0004	-0.0005
	(-32.63)	(-37.09)	(-46.46)	(-17.82)
Adj. R^2	0.27	0.30	0.30	0.27
N	36,304	57,900	105,486	48,339
	Spain: WSS 1995			
	(0,1]	(1,5]	(5,20]	(20,50]
Constant	6.2582	6.1305	6.2648	6.3694
	(297.7)	(422.6)	(453.6)	(162.1)
Schooling	0.0634	0.0828	0.0794	0.0651
	(48.1)	(108.0)	(144.3)	(100.4)
Experience	0.0336	0.0402	0.0424	0.0482
	(27.5)	(42.9)	(51.8)	(23.1)
Exp.^{2}	-0.0004	-0.0005	-0.0005	-0.0006
	(-18.9)	(-28.6)	(-37.9)	(-20.6)
Adj. R^2	0.25	0.38	0.34	0.30
N	12,561	25,654	48,711	31,101

* Own calculations based on the French LFS and the Spanish WSS. Dependent variable is log of gross hourly wages. For France, year dummies have also been included, the coefficients of which have not been reported. Robust *t*-statistics within parentheses. The different columns in the table present estimated equations for individuals with different job tenure levels. For example, the indication (1,5] refers to individuals with a number of years of job tenure with their current employer that is between two and five years.

As an alternative approach, we next compare the tenure–earnings profiles of individuals with different qualifications. According to the weak version of the screening hypothesis, education-related wage differentials should decrease as employers increase their knowledge of employees' capabilities. This implies that tenure–earnings profiles of highly educated individuals should converge towards those of less educated ones.

Table 4.5a Earnings functions by qualification level, France, full-time male employees*

	Compulsory	Upper Sec.	Lower Voc.	Upper Voc.	Uni. Short	Uni. Long
Constant	3.7450	3.7450	3.6367	3.6667	3.8509	4.2049
	(604.93)	(307.54)	(970.27)	(448.96)	(521.06)	(500.59)
Tenure	0.0193	0.0346	0.0264	0.0367	0.0397	0.0304
	(45.88)	(32.59)	(82.46)	(46.73)	(51.17)	(34.84)
Tenure² / 100	-0.0203	-0.04569	-0.0300	-0.0487	-0.0652	-0.0590
	(-16.35)	(-14.14)	(-29.27)	(-19.43)	(-24.65)	(-20.00)
Prv. Exp.	0.0019	0.0207	0.0098	0.0186	0.0207	0.0120
	(4.59)	(13.51)	(30.49)	(21.49)	(23.79)	(12.67)
Prv. Exp.² / 100	0.0008	-0.01493	-0.0105	-0.0234	-0.0350	-0.0219
	(0.63)	(-3.80)	(-10.17)	(-7.53)	(-9.93)	(-5.86)
Adj. R^2	0.19	0.26	0.26	0.36	0.30	0.14
N	54,875	10,997	92,053	15,749	20,101	18,932

* Own calculations based on the French LFS 1990-98. Dependent variable is log of gross hourly wage. Year dummies have also been included, the coefficients of which have not been reported. Robust *t*-statistics in parentheses.

Table 4.5b Earnings functions by qualification level, Spain, full-time male employees*

	Compulsory	Upper Sec.	Lower Voc.	Upper Voc.	Univ. Short	Univ. Long
Constant	6.8936	7.1712	7.0153	7.1929	7.5026	7.6811
	(1000.0)	(599.2)	(462.8)	(750.5)	(542.7)	(582.2)
Tenure	0.0402	0.0535	0.0512	0.0519	0.0493	0.0607
	(61.0)	(43.3)	(33.2)	(41.5)	(27.5)	(27.8)
Tenure²	-0.0004	-0.0008	-0.0007	-0.0008	-0.0007	-0.0011
	(-19.6)	(-21.4)	(-14.6)	(-20.8)	(-13.6)	(-14.9)
Prv. Exp.	0.0193	0.0185	0.0197	0.0189	0.0214	0.0268
	(24.8)	(13.2)	(10.5)	(14.5)	(13.3)	(15.3)
Prv. Exp.²	-0.0003	-0.0001	-0.0002	-0.0002	-0.0002	-0.0002
	(-13.4)	(-2.4)	(-2.5)	(-4.4)	(-2.8)	(-2.4)
Adj. R^2	0.35	0.28	0.40	0.37	0.28	0.27
N	33,208	12,709	5,797	9,961	6,329	7,058

* Own calculations based on the Spanish WSS 1995. Dependent variable is log of gross hourly wage. Robust *t*-statistics in parentheses.

Tables 4.5a and 4.5b above report the results from earnings equations estimated by qualification levels for France and Spain, respec-

tively. We distinguish between individuals having left school at age 16 with at most a primary school diploma (Compulsory), those holding a secondary level qualification and those who graduated at the tertiary level. Within the secondary level group, we also separate between lower and upper secondary levels and, within each of them, between general (Upper Sec.) and vocational qualifications (Lower Voc. and Upper Voc.). Finally, among highly educated people, a distinction is made between the graduates (Uni. Long) and those who have left higher education before graduation (Uni. Short). For each sub-sample, the estimated specification includes the number of years of job tenure and its square as well as the number of years of labour market experience before individuals are hired by their current employer. This previous experience variable is labelled 'Prv. Exp.' in Tables 4.5a and 4.5b and its square is also included as a regressor.

For all categories and in both France and Spain the tenure–earnings profiles are significantly positive and concave. However, in none of the countries is a convergence scheme of these profiles highlighted by the results. In Spain, for instance, the tenure–earnings profiles of 'compulsory', 'upper secondary' and 'university long cycle' are divergent. In France, a similar divergent pattern emerges from the estimates for 'lower vocational' and 'university short cycle'. Here, not only is the marginal rate of return to tenure lower for the latter level, but the slope of both tenure–earnings profiles decreases at the same speed. Clearly, these figures do not support the weak version of the screening hypothesis.

Instead of estimating tenure–earnings profiles, one could alternatively measure the difference in earnings between individuals at the middle of their working career and those at the beginning of theirs. Such measures could then be compared among individuals with different educational attainments and/or among presumably differently screened workers. If these measures are computed as mid-to-early career earnings ratios, then advocates of the weak version of the screening hypothesis would expect them to decrease steadily as the number of years of schooling increases. They would also expect these ratios to be higher in non-competitive sectors where signaling is more likely than in competitive ones.[9]

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[9] See Cohn et al. (1987) for a formal presentation.

Tables 4.6a and 4.6b report the results that this approach led to for France and Spain, respectively. To calculate the mid-to-early earnings ratios, a distinction between individuals has been made according to whether they have less than 3 years or more than 8 years of job tenure. Mean earnings for these categories have been calculated by industry and by educational grade. In the Spanish case, however, the WSS, which has been used, does not include public sector employees. Hence, the analysis has been conducted by also using the HBS, which covers both the public and the private sector. Unfortunately, the latter data set does not provide information on job tenure. This is why our results based on the HBS make use of a different measure of the mid-to-early earnings ratio. Here, individuals are distinguished according to whether they are less than 25 years old or aged between 35 and 45.

Table 4.6a Mid-to-early career earnings ratios by number of years of schooling and by sector, France, LFS*

Years	EA	EB	EC	ED	EE	EF	EG	EH	EJ	EK	EL	EM	EN	EP	EQ	ER
Less than 10	1,19	1,33	1,22	1,16	1,23	1,27	1,35	1,13	1,20	1,32	1,29	1,32	1,27	1,28	1,04	1,18
10 to 12	1,35	1,39	1,38	1,40	1,36	1,38	1,28	1,24	1,30	1,50	1,38	1,30	1,38	1,42	1,49	1,27
12 to 14	1,49	1,57	1,49	1,52	1,47	1,52	1,28	1,40	1,46	1,58	1,27	1,37	1,45	1,66	1,63	1,32
14 to 16	1,68	1,61	1,53	1,54	1,56	1,59	1,50	1,64	1,57	1,56	1,38	1,27	1,44	1,57	1,38	1,37
16 to 18	1,66	1,41	1,45	1,53	1,45	1,36	1,54	1,49	1,56	1,38	1,29	1,42	1,46	1,53	1,33	1,32
More than 18	2,00	1,37	1,30	1,39	1,32	1,28	1,27	1,44	1,28	1,49	1,30	1,21	1,33	1,21	1,21	1,17

* Own calculations based on the French LFS 1995. Industries are defined according to the 2-digit ISIC, that is, EA Agriculture; EB Hunting and Aquaculture; EC Extraction; ED Manufacturing; EE Electricity, Gas and Water; EF Construction; EG Commerce and Repair; EH Hotels and Restaurants; EJ Transports; EK Finance; EL Retail Trade; EM Public Administration; EN Education; EP Health and Social Action; EQ Services; ER Extra Territorial Activities.

Table 4.6b Mid-to-early career earnings ratios by number of years of schooling and by sector, Spain, WSS and HBS*

	WSS-1995									HBS 1990/91	
Years	Extrac.	Manuf.	Utilit.	Cons.	Trade	Hotels	Trans.	Finan.	Buss.	Public	Private
8	1.6	1.6	2.1	1.6	1.7	1.5	1.6	1.2	1.7	1.4	1.3
10	1.7	1.7	2.1	1.8	1.9	1.4	1.7	1.7	1.8	1.3	1.2
11.5	1.6	1.6	2.0	1.5	1.8	1.5	1.6	1.4	2.1	1.3	1.4
13	1.8	1.7	1.9	1.7	1.9	1.2	1.8	1.7	1.7	1.2	1.2
16	1.4	1.7	1.7	1.7	1.9	1.8	1.5	1.6	1.9	1.3	1.3
18	1.5	1.7	2.1	1.6	1.7	1.4	1.5	1.5	1.9	1.2	1.7

* Own calculations based on the Spanish WSS 1995 and HBS 1990/91.

As can be seen from Tables 4.6a and 4.6b, neither French nor Spanish data do come in support of the weak version of the screening hypothesis. Indeed, hardly can one observe in these figures any decline in the mid-to-early earnings ratios as the number of individuals' grades increases. Although Spanish data seem to highlight a slight decrease in these ratios in the public sector, it is not obvious that this is due to signaling effects. First, the observed decline is rather limited and irregular. Second, the earnings ratios are not systematically higher than in private sector industries. Last but not least, the French figures eliminate any suspicion of the existence of signaling effects. Not only do the earnings ratios seem to be rather increasing in the whole set of industries under consideration, but also they are in general lower in public sector industries than in dominantly privately managed ones. For instance, neither in public administration nor in the manufacturing industry are the earnings ratios steadily decreasing. They are in addition lower in the former than in the latter industry.

Despite the variety of testing strategies and the different data sets we have used, none of the predictions of the screening hypothesis could be strongly confirmed in France or in Spain. Some authors have argued that one way to highlight signaling effects consists in examining whether certification yields higher returns to education. The idea is that degree completion is likely to provide employers with a signal of the applicant's ability to finish tasks rather than to merely attend school for a number of years. This is the so-called sheepskin effect argument, which we now turn to discuss.

4.4 Sheepskin effects

Consider two individuals having spent the same number of years at school. To the extent that years of schooling are appropriate proxies of human capital accumulation, these individuals should face the same returns to education since, *ceteris paribus*, they are equally productive from the point of view of human capital theory. Data from different countries show, however, that the earnings–schooling relationship is characterised by strong non-linearity for some values of the schooling indicator. In most countries, this non-linearity is strongest around 12 and 16 years of schooling, which are in general the typical numbers required for obtaining a high-school degree and for graduation. These findings suggest that certification yields higher returns than mere attendance for a given number of years. In other words, for our two individuals to

face the same return to education, both should fail or succeed in, say, the senior year of graduation. Otherwise, failure would yield lower returns than success in graduation. If one assumes that such a differential cannot be due to differences in human capital accumulation, then it is not unreasonable to interpret it as resulting from signaling effects. Indeed, if certification plays the role of credentials, then success in graduation is interpreted by employers as a signal of a higher innate ability.

This section aims at evaluating the importance of sheepskin effects in France and Spain. Although there are several simpler specifications that one could estimate to identify non-linearities in the earnings–schooling relationship, we estimate a less parsimonious equation due to Park (1999). Its main advantage resides in the fact that it imposes no specific non-linearity scheme. Moreover, it allows one to estimate the relationship between the returns to a given qualification and the number of years it takes an individual to attain it. It can be written as

$$\ln(w) = \alpha_0 + \alpha_1 X + \sum_{i \in I} \sum_{j \in J} \beta_{i,j} D(level = i) * D(S = j) + \eta \qquad (4.2)$$

where X is a set of control variables; S, the number of years of schooling; $I = \{3,4,5,6,7\}$, the set of qualification levels; J the set of possible years of schooling; $D(level = i)$, $i = 3,\ldots,7$ dummy variables for whether individuals hold qualification i; $D(S = j)$, dummy variables for whether individuals have attended school during j years; and η, the random disturbance.

The sets I and J have been differently shaped for France and Spain to account for national specificities. For France, I includes general or vocational lower secondary qualifications or lower (3), general upper secondary (4), vocational upper secondary (5), undergraduates (6) and graduates (7). For Spain, it includes compulsory level (3), upper secondary (4), lower vocational (5), short university cycle (6) and long university cycle (7). Although compulsory schooling lasts until age 16 in France, some individuals in our sample left school earlier. These are mainly workers who entered the labour market before 1956 when the age of compulsory schooling was 14 as is still the case in Spain. Hence, $J = \{8,9\ldots,24\}$ for France and $J = \{8,9\ldots,21\}$ for Spain.

Table 4.7 reports the French and Spanish estimates of this specification. Note that the interaction variables $D(level = i)*D(S = j)$ have been

Table 4.7 Returns to qualifications by schooling duration*

	France: LFS		**Spain:** ECHP	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Intercept	3.3137	310.14	6.5690	89.35
Experience	0.0351	46.10	0.0405	11.52
Experience^2	-0.0004	-24.98	-0.0006	-11.05
D3,8			0.0456	1.80
D3,9	0.0641	5.02	-0.1000	-3.02
D3,10	0.0754	7.89	0.1110	2.74
D3,11	0.1366	14.92		
D3,12	0.1739	18.96		
D3,13	0.2108	18.44		
D3,14	0.2228	16.17		
D4,10	0.2836	3.22	0.4039	4.53
D4,11	0.1597	3.51	0.4570	7.39
D4,12	0.3470	17.90	0.3961	8.82
D4,13	0.3440	17.58	0.4736	7.48
D4,14	0.3545	19.10	0.3495	2.32
D4,15	0.4100	18.53		
D4,16	0.4038	15.60		
D5,10	0.2493	6.35		
D5,11	0.3005	9.65		
D5,12	0.2956	16.56	0.2903	5.34
D5,13	0.3239	18.64	0.4590	8.62
D5,14	0.3358	21.27	0.3731	5.53
D5,15	0.3312	17.34	0.5038	6.89
D5,16	0.3402	14.79		
D5,17	0.3640	10.44		
D5,18	0.3411	7.01		
D6,12	0.4192	14.35		
D6,13	0.4725	17.22		
D6,14	0.5119	32.29	0.8207	14.98
D6,15	0.5064	34.22	0.6812	10.53
D6,16	0.4936	33.01	0.7905	10.10
D6,17	0.5363	30.77	0.7968	8.17
D6,18	0.5582	24.42	0.8275	11.27
D6,19	0.5483	17.68	0.6583	7.62
D6,20	0.5199	12.01		
D7,14	0.5480	14.97		
D7,15	0.6373	21.25		
D7,16	0.7271	35.76	0.9904	15.30
D7,17	0.7881	49.68	1.0612	20.93
D7,18	0.7319	47.43	1.0163	14.06
D7,19	0.7728	44.48	0.9691	8.78
D7,20	0.7575	35.47	0.9741	7.67
D7,21	0.7410	29.21	0.9541	7.97
D7,22	0.8138	26.42		
D7,23	0.7675	18.09		
D7,24	0.8610	19.05		
Adjusted R^2	0.37		0.37	
N	21,770		2,181	

* Own calculations based on the French 1998 LFS and the Spanish 1994 ECHP. Dependent variable is log of gross hourly earnings. Full-time male workers.

denoted $D_{i,j}$ in these tables.[10] Although rather tedious to read, the results highlight three main aspects. First, despite the large number of regressors that our specification includes, most of them remain highly significant. Second, the non-linear specification fits better to the data as indicated by the resulting coefficients of determination. Third, there is a relatively large variation in the returns to qualifications depending on the number of years it takes individuals to reach them. To make this last point more precise, we proceed as follows.

Let $\hat{w}_{i,j}$ denote the expected wage of individuals for whom it has taken *j* years to hold qualification *i*. That is

$$\hat{w}_{i,j} = \exp\left\{\hat{\alpha}_0 + \hat{\alpha}_1 X + \sum_{i\in I}\sum_{j\in J}\hat{\beta}_{ij} D(level = i) * D(S = j) + \frac{1}{2}\hat{\sigma}_\eta^2\right\}, \qquad (4.3)$$

where $\hat{\sigma}_\eta^2$ is the OLS estimate of the residual variance. One could then compute the rate of return to education for these individuals as

$$\frac{\hat{w}_{i,j} - \hat{w}_{3,8}}{n\hat{w}_{3,8}},$$

where *n* is the difference in years of schooling between the compulsory minimum level (3,8) and the (*i,j*) level.

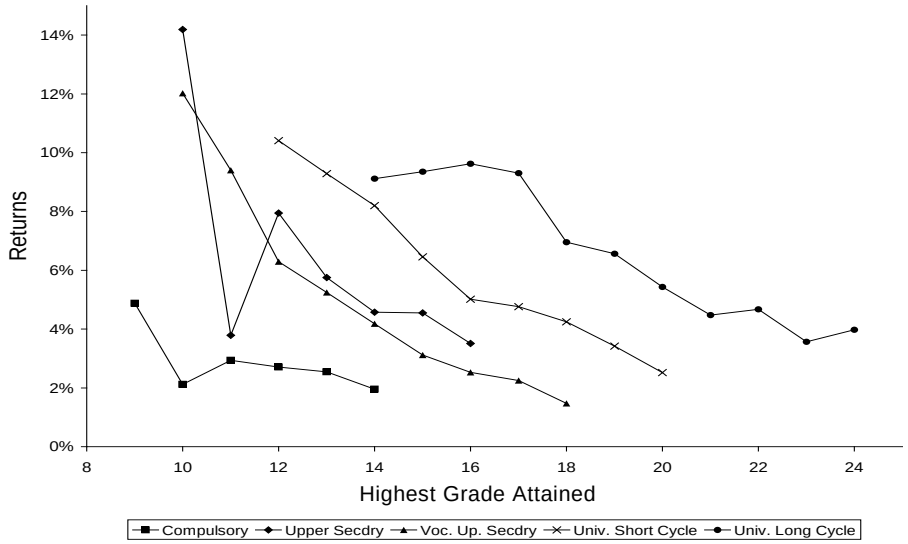
To make individuals comparable in terms of years of labour market experience and to account for the foregone earnings induced by each extra year of schooling, we do not assign to individuals their own experience as observed during the sampling year. Instead, we assign the sample average experience $\overline{X}$ to all individuals having spent no more than 8 years at school and, hence, whose highest qualification is the compulsory level. All individuals having attended school for $j = 8 + \nu$ years, $\nu \geq 1$, have been assigned $\overline{X} - \nu$ years of potential experience. This way, the estimated schooling duration related differentials in the returns to education between individuals having the same qualification reflect the loss in returns due to extra years of schooling had these individuals had the same labour market experience.

Figures 4.3a and 4.3b summarize the results for France and Spain respectively. French ones are based on the 1998 wave of the LFS whereas Spanish ones are drawn from the ECHP of 1994. In both cases, how-

[10] For instance, D4,13 is a dummy variable with value 1 for individuals with upper secondary level and 13 years of schooling.

ever, very similar patterns emerge. The longer it takes individuals to complete their qualification, the lowest are the returns they get.

Figure 4.3a Returns to qualifications by schooling duration, France



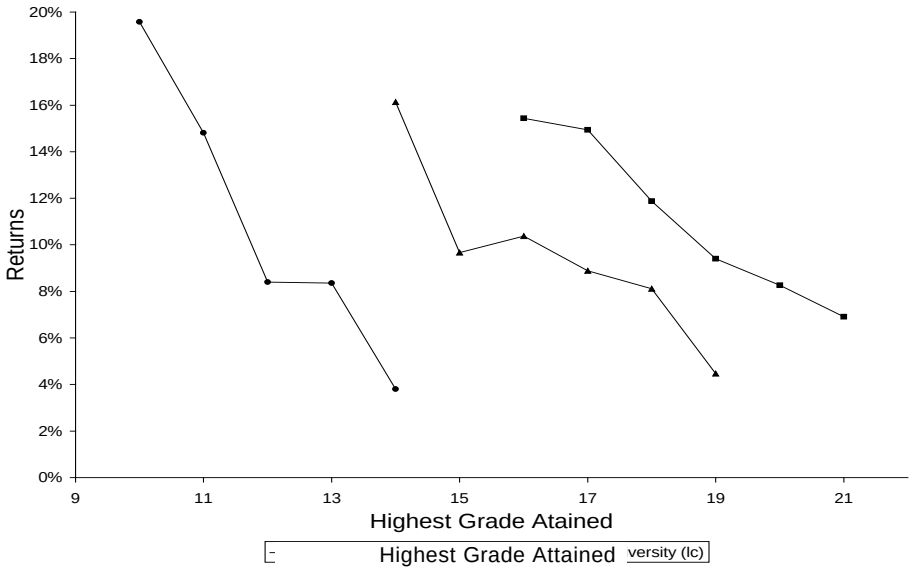
Source: Own calculations based on the French 1998 LFS. Gross hourly wages. Full-time male employees.

The French figure shows for instance that completion of the upper secondary degree within the minimum of ten years yields average earnings that are 14% higher than those of the earliest school leavers. Each extra year needed to complete the upper secondary degree reduces these extra earnings. Among holders of upper secondary qualifications, some have needed to spend 15 years at school so that the returns they get are close to 4%. One could interestingly compare this pattern to that of tertiary education graduates (University long cycle). The pattern for these is indeed less steep. Moreover, graduates earn the same returns whether it takes them 14 or even 17 years to complete their qualification. Only when they need 18 years or more do the returns start to decrease, although less fastly than in the upper secondary case.

The Spanish results are similar. For instance, those individuals who finish their university long cycle studies after 16 or 17 years of schooling have a rate of return around 15%. This rate decreases to some 12% if they need 18 years and goes down even more, to less than 10%, if

the total amount of years needed is 19. The profile is clearly decreasing until a low rate of return of 7.5% with 21 years of schooling.[11]

Figure 4.3b Returns to qualifications by schooling duration, Spain



Source: Own calculations based on the Spanish 1994 ECHP. Gross hourly wages. Full-time male employees.

Why do the returns to qualifications decrease systematically as the number of years needed to attain them increases? One is tempted to argue that this is a signaling issue. Fast completion would provide employers with a signal of higher ability and efficiency in finishing tasks. This is not necessarily true, however. First, why wouldn't employers positively value the perseverance ability of individuals who incur high opportunity costs to achieve a goal they have fixed to themselves? Second, extra years of schooling do not necessarily mean lower innate ability; instead, they might simply reflect exceptional circumstances such as schooling interruptions for illness, national service or family re-

[11] Although his approach is different from ours, Corugedo (1998) finds similar results.

sponsibilities. Third, it might be the case that all what these decreasing patterns highlight is the positive correlation between years of schooling and opportunity costs and the negative one between the latter and the payback period length. Finally, while the relevant variable is the stock of human capital individuals accumulate, only the number of years of schooling is observed. Thus, the need of an abnormally long period to attain a given qualification probably indicates a less effective transformation of years of schooling into effective human capital. Hence, to the extent that only when they accumulate a given amount of human capital are individuals re-compensated by certification, sheepskin effects measure a differential in human capital accumulation.

So far we have interpreted these results by focusing on how the returns to a given qualification vary with the number of years of schooling. Let us now examine how the returns differ between individuals having spent a given number of years in school. Figures 4.3a and 4.3b show that, for a given number of years, two individuals would get the same returns only if they have the same qualification. If one of them fails to attain that qualification either because he drops out or simply because of insufficient exam scores, he would get lower returns. Hence, with the same number of years of schooling, certification yields higher returns, reflecting sheepskin effects. Thus, as discussed above, sheepskin effects are not necessarily due to signaling effects. They might simply reflect the idea that drop-outs have lower returns because of the lower level of the qualification they hold and the higher opportunity costs they have had to incur.

4.5 Concluding remarks

The policy implications of the role of education are important enough to encourage empirical work aiming at discriminating between human capital and signaling theories. If private returns to education exclusively reflect the extent to which education improves individuals' productivity, then their comparison to social returns is certainly helpful in determining the funding effort society must devote to education. If in contrast, they exclusively measure the signaling value of education, then public funding has no more foundations. This latter possibility has, however, never been confirmed in any part of the long and diverse literature that addresses this question. Yet, even if only part of private returns is due to signaling mechanisms, their comparison to social re-

turns requires that this part is identified and measured. This is the goal we have assigned to each section of this chapter.

Several testing strategies have been alternatively adopted to evaluate the accuracy of the strong as well as the weak version of the screening hypothesis. In addition, these tests have been performed using a variety of labour market data sets from France and Spain. Our results suggest unanimously that the effect of education on earnings is primarily due to its impact on individuals' productivity. To be more specific, none of our tests of the weak version of the screening hypothesis suggested that it could be accepted. There is, indeed, no sign that the returns to education are decreasing along individuals' life cycle. Furthermore, our distinction between private and public sector employees has not highlighted any differential in the returns to education in favour of the presumably screened group of public sector workers, hence rejecting the strong version of the screening hypothesis as well. Only when the impact on earnings of the relative position of individuals in the educational distribution of their cohort is accounted for does suspicion for a rather small signaling effect emerge from both French and Spanish data.

Having found no strong evidence for the screening hypothesis when measuring education in terms of years of schooling, we have also examined the extent to which signals might be conveyed to employers via certification. Estimation of a general non-linear relationship between schooling and earnings allowed us to show that the longer it takes individuals to attain a qualification, the lower the returns to that qualification are. It is, however, not clear whether this declining pattern is due to fast performers providing employers with positive signals of innate ability or to the higher opportunity costs that slower ones have to incur.

Therefore, our findings confirm the idea that although there might be some elements of truth in the screening hypothesis, the returns to education are to the greatest extent due to human capital accumulation. These findings are in line with most of previous Spanish studies (Lassibille 1994, Corugedo 1998, Blanco and Pons 1998). Astonishingly, no comparable results exist for France where the screening hypothesis has been only superficially examined.[12] This is a gap to be filled in by future research. The international literature shows large variations in the

[12] To our knowledge, the only exceptions are Jarousse and Mingat (1986) and Guille and Skalli (2001).

conclusions from empirical analyses conducted for different countries. This suggests that institutional differences are likely to be important issues. For instance, a French stylised fact is that the best way to make money is to graduate from a *Grande Ecole* and it is not clear whether this is due to *Grande Ecole* graduates being inherently abler than their university counterparts or to them being endowed with a larger amount of human capital. Public sector hiring rules are also an example of institutional characteristics that may highlight the extent to which workers are screened.

Unfortunately, the empirical literature also reports different conclusions from analyses conducted for the same country. This indicates that institutional considerations are not the only dimension to be privileged in future research. In general, the conclusions are very sensitive to the adopted statistical approach as well. This means that the discrimination between human capital and signaling theories also requires further methodological efforts.

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Chapter 5

FIRM-SPECIFIC TRAINING AND JOB MOBILITY IN SWITZERLAND

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5.1 Introduction

In the 'knowledge-based' economy, training has become the centre of attention of public policy. Lifelong learning is promoted in order to adapt quickly to the ever-faster changing technological business environment. Although policy makers have recognised and widely accepted the need for continuous training efforts, the training incidence within the adult population has not changed much over the last decade.

The training incidence of the adult population in Switzerland is, as the OECD (2000) points out in its thematic review on adult education, in the middle field of all OECD countries, although Switzerland has one of the highest levels of initial training[1] among the OECD countries. According to OECD statistics roughly 32% of the employed population participated in adult education at least once a year in the period of 1994 to 1998.[2]

Two major motivating reasons for resistance to training by both employers and employees have been found. Employees complain about the lack of time, and employers point to the problem of poaching. The risk that non-training employers act as free riders and 'steal' the investments of other employers is often used as an argument, especially by small and medium-sized enterprises. Poaching in a strict sense can not be observed empirically with the data at hand. Therefore we restrict ourselves to verify whether firm-subsidised training increases the probability of voluntary job separations or not. The study complements the few existing studies insofar as it covers the most recent time span and is applied to the whole employed population. Previous Swiss and German studies cover only the first half of the 90s, years that were (with regard to the business cycle) characterised by growing unemployment and declining rates of turnover. Studies in the United States focused mainly on young workers or special targeted training programme that are difficult to generalise to the whole population. As it has become widely recognised that training has become vital for all ages, this study tries to close this gap.

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1 One of the highest levels of initial training means one of the lowest levels of people with no post-compulsory education.

2 OECD uses – as in this study – the *Swiss Labour Force Survey* as source of information.

5.2 The Human Capital theory assumptions

From the classical human capital theory's assumptions about training and turnover, we would expect that a firm-specific investment in an employee's human capital should reduce the incentive to search for a new job and the actual probability of separation.[3] At the same time, firm-specific investments should also reduce the probability that an employer dismisses the employee.

Contrary to firm-specific training, general investment in human capital that is transferable to other employers should increase search activities, as the assumed self-paid general training enhances the value of alternative wage offers relative to the wage paid by the current employer. In order to know about these alternatives, workers have to increase their search for new jobs. Under the assumption of an efficient labour market there should, however, be no impact on actual separations, as the current employer would raise the wage to equal the workers' outside opportunities. Finally, investment in general human capital should not affect the probability of dismissals since the employer, according to the theory, shares none of the costs or the benefits.

5.3 Firm-specific and general training

In theory, firm-specific and general training are defined according to their transferability to other employers. The definition therefore is related to the content of the training. In practice, this division is difficult to make and research shows that contrary to the theory, employers often finance, or participate in the financing of general training, or that workers do not share the costs of firm-specific training (see e.g. Barron et al. 1998). Different theories try to explain this deviation from the predictions of the classical theory.

Economists and human resource specialists have often argued that some of the assumptions made in the human capital theory are unjustified:

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[3] Of course one could also look at the relationship between training and turnover from the opposite view. Royalty (1996) found evidence in the NLSY data set that the predicted turnover of a worker has an impact on the probability of receiving training. This potential inverse relationship is also the source for an endogeneity problem that will be addressed later.

- Katz and Ziderman (1990) explain deviations from the classical theory by information asymmetries between the current employer and a potential future employer regarding the value of general training of specific workers.
- Acemoglu and Pischke (1999) emphasise the possibility that labour markets are imperfect, which is contrary to the human capital theory's assumptions. Non-competitive labour markets with compressed wage structures encourage firms to invest in general training. In the situation of a compressed labour market, the firm is ready to invest in the skills of its workers until the marginal profit of training equals the marginal cost of training. The possibility of paying wages that are below productivity turns general skills into *de facto* specific skills (p. F120).
- Investments in general training could serve as a form of marketing in the process of recruitment (see e.g. Sadowski 1980). In a situation of imperfect information the employer tries to attract the best workers with a reputation of offering general training.
- Another explanation assumes that training always contains a non-separable mix of firm-specific and general elements and that investments in general training by employers must not lead to higher probabilities of separation. Following the arguments of Feuer et al. (1987, p. 122) the worker has no incentive to leave the company as long as the sum of his return on his specific training investment and his share of the returns from his general training is higher than the enhanced value of an alternative wage offer due to the transferable part of his training.

Contrary to the hypotheses of the classical human capital theory the effects of training on turnover are in these cases not determined by the content of training but best defined by the question whether or not the training is financed by the employer. Therefore in this study we differentiate between firm-subsidised and employee-funded training, disregarding whether the training is firm-specific or general in its content.

We would expect that any rational employer will subsidise the training of his workers only if search activities for better opportunities or voluntary separations of trained workers will not increase as a consequence of the provided training. Therefore we expect no significant impact of firm-subsidised training on *on-the-job* search activities and quits. In the case where training was provided in order to attract new workers and reduce potential turnover, employers would even expect a

decreased interest of workers to look for outside opportunities and consequently lower turnover. Regarding firing of workers, we expect that any financial investment on the side of the employer goes to the most productive workers, whom he is most likely to keep, and therefore we should see a significantly lower number of these workers dismissed compared to workers who had not received firm-subsidised training.

With regard to employee-funded training activities, we still expect a positive impact on search effort. Whether there will be an increased number of actual job separations depends on the probability that the current employer will match higher outside offers. The ability and willingness of employers to improve the position of their current workers depend on many factors and we expect therefore that higher search activities will eventually also lead to a higher rate of voluntary job separations. Firing, finally, should not be affected by employee initiated and funded training activities.

5.4 The empirical literature

The most recent empirical literature so far can be divided into five different categories, depending on their treatment of the job mobility variable:

(1) Especially researchers from the United States are more interested in the impacts of training on job stability and therefore treat separations from employers uniformly. One of the important reasons for not separating quits and dismissals is also the fact that it is difficult to distinguish the two possibilities in the data. Many of the studies (e.g. Lynch 1991, Veum 1995, Parent 1999) concentrate on young people and initial training.

(2) European researchers (e.g. Backes-Gellner and Schmidtke 2000 or Zweimüller and Winter-Ebmer 2000) focus more on employers and separate turnover into two categories: voluntary (quits) and involuntary (dismissals).

(3) Only a few researchers (e.g. Royalty 1998) distinguish between job-to-job and job-to-non-job turnover. Royalty analysed the impacts of gender and differences in formal education on turnover but did not look at particular effects of job training on turnover.

(4) And finally, so far only Baenziger (1999) and Zweimüller and Winter-Ebmer (2000) differentiated between the impact of training on search behaviour and actual separations.

(5) Only a few studies (e.g. Dearden et al. 1997 for the UK) have tried to overcome the problems that arise from the possibility that in the mobility equation, unobserved determinants of mobility are correlated with the determinants of training (endogeneity). If this were the case, the estimates would be biased. A potential way to overcome these problems is by using simultaneous equations or instrumental variables (IV). The problem with the latter method is that it is very often difficult to find meaningful instruments and that the estimates react very sensitively to the instruments selected.

Contrary to the German and Swiss studies, the American studies found little evidence for any significant effect of training on turnover. The UK study finds a reduction in the probability of a job-to-job move when applying the before-and-after approach. When using the IV approach or the simultaneous equation models, the results tend to be less clear. The main shortcoming of the US and the UK studies, however, is that turnover data does not distinguish between quits and layoffs.

5.5 The data

The data used in this study come from the *Swiss Labour Force Survey* (SLFS) and cover the years 1996 to 1999. The SLFS is an annual telephone survey with a sample of some 16,000 persons in the working age (15–65). The questions relate to the working life and the definitions follow ILO standards in order to produce internationally comparable data; in fact about 70% of all questions are comparable to the US Labor Force Survey. Since its first year in 1991, SLFS data has been widely used in labour economics by Swiss and foreign researchers (e.g. Winter-Ebmer and Zweimüller 1997). The SLFS is a rotating panel in which one-fifth of the people interviewed are dropped randomly and annually. The interviews take place in May and retrospective questions relate to the last 12 months. In the 1996 survey some 8,000 persons interviewed were dependent (not self-employed) workers. They were asked about their training activities between t–1 (May 1995) and the

date of the interview.[4] For the years following the interview we analysed the mobility of those people interviewed in 1996 and still in the sample in the year of interest. Due to the rotating character of the sample we lose some 2,000 observations every year as we move forward in time.

In our analysis we use the data set from 1996 to 1999. The data covers the part of the business cycle when economic growth was picking up again. The unemployment rate fell from above 5% to around 2.5% by 1999. Using 1996 as the starting year is also essential to our analysis because the survey in that year was accompanied by an extension to the normal survey, covering the topic of continuous education. While this gives us the opportunity to analyse training activities of workers in more detail, it led also to a reduction of the questions related to training in the subsequent years. Because of these limitations we have to adopt a different strategy than the panel approach used by Zweimüller and Winter-Ebmer (2000) in their study. This results in a lower number of observations.

5.6 The definition of firm-subsidised training

We use one specific definition of employer provided (subsidised) training in our study, although different definitions were tested. A glance at Table 5.1 shows that training has at least two important components where the provision by firms or sharing between employers and employees matters.

Many of the previous studies neglect the time dimension and the opportunity costs that go along with it. The self-reported reasons of those having not participated in adult education give a hint, to what extent the time factor might be important in training decisions. Some 44% stated the lack of time as a reason for non-participating in work-

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[4] Some researchers are concerned with the validity of self-reported data on training activities. Krueger and Rouse (1998) find significant differences between self-reported training activity and data sampled by employers. They assume that only the administrative data are correct and that the higher participation rate measured in the self-reported data are due to measurement errors. While Barron et al. (1997) have found a substantial measurement error, in their data, however, firms tended to report more training than employees. In their matched survey, however, there appears to be no systematic variation in reporting errors based on firm or worker characteristics, and aggregate reported measures of the incidence of training are similar.

related training, whereas financial reasons were stated only by 14% and the lack of employer support by some 7% of the respondents. Although the cells where time[5] *and* financial resources come either from the employers or the employees' side are predominant, some of the arrangements show mixed sharing.

Table 5.1 Training according to time and finance dimensions

	Time				
Financing	Employer	Employee	Both	Not working	Total
Employee	84	1259	1	33	37.08
Employer	1415	347	26	113	51.18
U.I.	94	276	1	18	10.47
Others	22	1	20	4	1.27
Total	43.48	50.70	1.29	4.52	100

The definition used in this study is a very broad one and includes all training, where the employer participated either financially or with time. According to this definition 54.1% of the training was subsidised by the employer, 45.9% was not.[6]

5.7 Types of training

In the supplementary questionnaire in the 1996 survey, questions were asked about continuous education of workers. Besides questions about the financing of education, the providers (on-the-job or outside), the time spent in education, those participating in some form of continuous education were also asked about the type or content of training.

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[5] If time was provided by employers, the training took place during working time or the time spent in training was counted as overtime. This is regardless whether training takes actually place at the workplace or outside the company.

[6] Although our data allowed weighting participation by the number of hours spent in training, we only report results for the training incidence. The calculations presented are fairly robust to these alternative specifications, a result also reported by Krueger and Rouse (1998) in their study. Veum (1997) also differentiated actual training hours and the training incidence and also found that both specifications are fairly similar (p. 227).

Although workers were asked if the type of training they had followed was work-related or not, it is not possible to determine whether the training was strictly general or firm specific. The three most chosen categories of training were language courses, IT-training and management training. From the type of these courses we can deduce that their content is likely to be more general than firm specific. Judging from the content of training we should also expect poaching to be a real threat to employers' investments.

5.8 The potential problem of endogeneity

We would think that employers are more likely to subsidise training of employees whom they expect to retain longer and whom they also expect to remain longer with their firm. Any test whether the provision of firm-subsidised training reduces the probability that the beneficiaries voluntarily quit the company, however, suffers from the problem that one cannot distinguish easily between the effect training has on the probability to leave and on the selection of trainable workers by their employers. Theoretically an IV approach could provide a solution but, as stated earlier, the selection of a suitable IV is difficult and likely to distort the results rather than improve them. Our data did not offer such potential IV's, for which reason we used a more classical and simple approach to the problem. We estimated first the probability to receive firm-subsidised training in a probit equation and then used the same variables in the turnover equation. Thereby we control for the selection of trainable workers in the equation that tests the impact training has on mobility. Unfortunately we cannot claim that this procedure eliminates the potential endogeneity completely, as the method is only as good as the training equation is.

5.9 Who trains and who gets training?

We estimated participation probits for firm-subsidised and employee-funded training separately.

Our results in Table 5.2 confirm to most parts the results of previous studies insofar as they find that firm-subsidised training goes mainly to the well-educated men working in large firms and already occupying a function in the management. Part-time working, foreign

Table 5.2 Probit estimates of the determinants of training by type

Independent variables	Firm-subsidised		Employee-funded	
	Coef.	P>|z|	Coef.	P>|z|
Gender	**-0.11**	0.024	**0.37**	0.000
Age	**0.04**	0.000	0.02	0.140
Age²	**-0.06**	0.000	**-0.03**	0.047
Married	0.04	0.356	**-0.14**	0.001
Swiss nationality	**0.27**	0.000	**0.15**	0.017
Education				
- University	**0.62**	0.000	**0.17**	0.058
- University of Applied Sciences	**0.85**	0.000	**0.22**	0.070
- A-levels	**0.38**	0.000	**0.41**	0.000
- Higher vocational training	**0.64**	0.000	**0.43**	0.000
- Apprenticeship	**0.38**	0.000	**0.24**	0.000
Industries				
- Manufacturing	0.02	0.927	0.05	0.757
- Hotel, Restaurants	**-0.55**	0.019	-0.08	0.683
- Construction	-0.22	0.218	0.09	0.650
- Retail sales	0.03	0.851	0.06	0.725
- Communication	0.09	0.620	0.09	0.641
- IT	0.24	0.169	-0.01	0.966
- Banking & Insurance	**0.53**	0.002	0.04	0.819
- Public administration	**0.38**	0.029	0.07	0.728
- Education	0.26	0.139	**0.33**	0.080
- Health	**0.32**	0.056	0.10	0.571
- Other services	-0.04	0.830	0.22	0.245
- Agriculture	0.13	0.638	0.09	0.738
Job characteristics				
- Top management	**0.36**	0.000	-0.06	0.258
- Middle management	**0.22**	0.000	0.06	0.283
- Part-time worker	**-0.18**	0.001	**0.09**	0.060
- Tenure (*10)	**0.18**	0.000	-0.18	0.304
- Tenure² (*1000)	**-0.18**	0.047	-0.06	0.916
Firm characteristics				
- Small firm (< 20 employees)	**-0.19**	0.000	**0.12**	0.013
- Large firm (> 100 employees)	**0.18**	0.000	0.00	0.954
- Located in the Italian lang. r.	-0.16	0.154	-0.02	0.860
- Located in the French lang. r.	**-0.38**	0.000	0.03	0.554
Number of observations	6458		6458	
Log likelihood	-3070.15		-2706.57	
Pseudo R^2	0.11		0.05	

nationality or working in the less well-paid sectors, like construction or hotels and restaurants, and small firms reduce the probability of getting access to firm-subsidised training. Looking at employee-funded train-

ing we see that industry differences almost completely disappear (except for teachers), as do most other job- or firm-related characteristics. Some findings indicate that employee-funded training serves partially as a compensating mechanism for those not getting any support from their employers and that those already getting training from their employers are less likely to initiate additional training.

Women, part-time workers, or employees of small firms who get significantly less access to firm-subsidised training are significantly more likely to train without support from their employers. Differentiation according to educational levels points in the same direction; although higher educated people still train more, those with tertiary education have the highest coefficients in the regression on firm-subsidised training but smaller coefficients in the regression on employee-funded training than those with a post-secondary II-degree. The positive, but small relationship between firm-subsidised training and tenure is inconsistent with the human capital theory, which predicts that all training should be concentrated at the start of the employment. The findings could also indicate that in Switzerland, as in other countries having the Germanic type of apprenticeship training, a majority of general skills and occupational training is done during the apprenticeship and that this reduces the need for concentrated training at the start of employment.

5.10 Job mobility during the observed period

As expected, job mobility was somewhat higher in the period of 1996 to 1999 compared to the 8% observed in the study of Zweimüller and Winter-Ebmer (2000). Of the workers employed in 1996, 9.9% had changed their employer within one year. The turnover rate for men and women was almost equal. Looking beyond job-to-job mobility we find that job-to-non-employment mobility has almost the same size as job-to-job mobility.[7] Table 5.3 gives an overview of the turnover that took place between 1996 and 1997.

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[7] We also estimated the impact that training has on job-to-non-job turnover but the results are not reported in detail in this study. We found that training has no impact on job-to-non-job turnover but that firm-subsidised training reduces significantly the probability that a worker will leave the employer for self-employment. From the point of view of the employer a voluntary quit for self-employment would represent the same loss of investment as any other quit and a reduction in the probability of a quit is therefore desirable.

Table 5.3 Labour market status of dependent workers who were in the 1996 sample and were not retired by 1997

Labour market status	N of obs.	% of (a)	% of (b)
(a) In sample	5691	100	
(b) Dependent workers	5113	89.9	
(c) With the same employer	4607		90.1
(d) With a new employer (voluntary)	303		5.9
(d) With a new employer (involuntary)	203		4.0
(e) Self-employed	223	3.9	
(f) Housewife, Student	149	2.6	
(g) Unemployed	120	2.1	
(h) Rest	86	1.5	

One has to keep in mind that all the data are self-reported and that the distinction that is made between voluntary job separations (quits) and involuntary (firing) ones may be biased. Whereas there is no plausible reason why a person who leaves voluntarily would not report so, involuntary separations could be reported as voluntary and therefore have a positive bias on involuntary and a negative bias on the number of voluntary separations. Nevertheless we have used the data as they were reported. But to keep the potential bias small we created a category 'dismissals' where we added the involuntary separations and the people with the labour market status of unemployed.

In all, we created three different dependent variables of turnover that were analysed separately:

(1) *Movers:* All persons employed in 1997 who had changed their employer between 1996 and 1997.

(2) *Voluntary movers*: Only those persons of category 1 who had reported that they had changed employers voluntarily.

(3) *Dismissed:* Those persons of category 1 who had reported that they changed their employer involuntarily plus those unemployed at the date of the interview in 1997.

5.11 The model

To estimate the impact of training on turnover we ran probit estimates of the following type

$$y_i = x_i\beta + \alpha_1 F_i + \alpha_2 E_i + \varepsilon_i \quad (5.1)$$

analogous to the procedure applied by Backes-Gellner and Schmidtke (2000) and Zweimüller and Winter-Ebmer (2000). The dependent variable y_i is 1 if the worker was looking for a new job or had changed or left his employer. x_i is a vector of time invariant and time varying control variables and β the corresponding vector of coefficients to be estimated.[8] The treatment variables are F_i for firm-subsidised training and E_i for employee-funded training and α_1 and α_2 the parameters of interest. ε_i is an error term that satisfies the usual assumptions.

We use a simple before-and-after approach, where current mobility is explained by pre-determined factors, including past training.

In order to be able to separate immediate and more long-term effects on mobility we used three different time horizons. In the first step we analysed the turnover between 1996 and 1997, in a second step we included 1998, and finally 1999. Multiple job changes between t and $t+n$ were not counted, but hardly any occurred.

5.12 Results

Tables 5.4 and 5.5 show the detailed results for the probit estimates of the determinants of turnover in the short run. Workers receiving firm-subsidised training have no significantly higher turnover than those not getting this kind of training.

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[8] Personal and job characteristics in our model include age (and age squared), marital status, gender, nationality, education (school years and an additional dummy for apprenticeship), tenure (and squared), part-time, two dummies for the hierarchical position, twelve dummies for different industries, two dummies for firm size and additional dummies for the geographical location of the firm.

Table 5.4 Probit estimates of the determinants of job mobility (1996–1997), quits and firing

Independent variables	Quit (voluntary turnover)		Firing (involuntary turnover)	
	Coef.	P>|z|	Coef.	P>|z|
Socio-demographic variables				
- Gender	-0.06	0.413	-0.02	0.785
- Age	-0.03	0.260	-0.02	0.386
- Age^2	-0.00	0.958	0.02	0.480
- Married	**-0.13**	0.069	-0.05	0.455
- Swiss nationality	**0.21**	0.054	**-0.32**	0.000
Training variables				
- *Firm-subsidised*	***0.14***	*0.077*	***-0.25***	*0.017*
- *Employee-funded*	*0.05*	*0.581*	*0.06*	*0.463*
- Education				
- Years of schooling	0.01	0.532	0.02	0.357
- Apprenticeship	**-0.12**	0.086	0.02	0.754
Industries				
- Manufacturing	0.06	0.860	0.23	0.448
- Hotel, Restaurants	**0.72**	0.064	0.23	0.508
- Construction	0.24	0.529	0.42	0.190
- Retail sales	0.19	0.610	0.10	0.753
- Communication	-0.08	0.835	0.05	0.874
- IT	0.10	0.796	0.07	0.828
- Banking & Insurance	0.33	0.381	-0.40	0.266
- Public administration	0.02	0.955	-023	0.513
- Education	-0.01	0.972	-0.16	0.628
- Health	0.25	0.492	-0.19	0.544
- Other services	0.08	0.844	0.17	0.602
- Agriculture	0.06	0.912	0.02	0.958
Job characteristics				
- Top management	-0.17	0.100	-0.19	0.135
- Middle management	-0.03	0.692	0.16	0.119
- Part-time worker	0.09	0.292	-0.02	0.812
- Tenure (*10)	**-0.50**	0.000	**-0.43**	0.000
- Tenure^2 (*1000)	**0.07**	0.086	**0.05**	0.001
Firm characteristics				
- Small firm (< 20 employees)	-0.01	0.898	0.13	0.101
- Large firm (> 100 employees)	**-0.16**	0.060	**-0.08**	0.398
- Located in the Italian lang. r.	-0.09	0.663	0.21	0.245
- Located in the French lang. r.	**-0.24**	0.004	**0.13**	0.081
Number of observations	4150		4588	
Log likelihood	272.7		170.27	
Pseudo R^2	0.131		0.094	

Table 5.5 Probit estimates of the determinants of job mobility (1996–1997), searching and general turnover

Independent variables	General turnover (voluntary and involuntary turnover)		Searching	
	Coef.	P>|z|	Coef.	P>|z|
Socio-demographic variables				
- Gender	-0.08	0.233	-0.10	0.134
- Age	**-0.05**	0.008	-0.00	0.981
- Age^2	0.04	0.118	-0.02	0.452
- Married	-0.09	0.131	-0.04	0.454
- Swiss nationality	0.03	0.719	-0.17	0.026
Training variables				
- *Firm-subsidised*	*0.06*	*0.383*	*-0.10*	*0.142*
- *Employee-funded*	*0.07*	*0.386*	*-0.07*	*0.310*
- Education				
- Years of schooling	0.02	0.170	**0.03**	0.022
- Apprenticeship	-0.05	0.395	**-0.14**	0.013
Industries				
- Manufacturing	0.21	0.511	0.20	0.470
- Hotel, Restaurants	**0.86**	0.013	0.28	0.349
- Construction	0.46	0.161	0.13	0.636
- Retail sales	0.27	0.397	0.10	0.702
- Communication	0.05	0.887	0.10	0.736
- IT	0.15	0.639	0.06	0.823
- Banking & Insurance	0.24	0.471	-0.22	0.454
- Public administration	0.07	0.884	0.09	0.758
- Education	0.01	0.971	0.08	0.785
- Health	0.22	0.501	-0.04	0.891
- Other services	0.30	0.379	0.02	0.952
- Agriculture	0.13	0.780	-0.15	0.637
Job characteristics				
- Top management	0.03	0.746	0.08	0.349
- Middle management	**0.17**	0.053	**0.12**	0.088
- Part-time worker	0.05	0.514	**0.20**	0.003
- Tenure (*10)	**-0.54**	0.000	**-0.43**	0.000
- Tenure^2 (*1000)	**0.07**	0.000	**0.04**	0.000
Firm characteristics				
- Small firm (< 20 employees)	0.04	0.556	0.05	0.436
- Large firm (> 100 employees)	-0.11	0.140	0.05	0.479
- Located in the Italian lang. r.	-0.01	0.942	-0.00	0.996
- Located in the French lang.r.	**-0.14**	0.040	**0.16**	0.005
Number of observations	4150		5379	
Log likelihood	319.8		224.7	
Pseudo R^2	0.118		0.074	

The probability to look for a new job (Table 5.5) is also not significantly higher, but those employees receiving training are somewhat more likely (significant only at the 10% level) to quit their employer at least in the year following upon the training period. At the same time not getting firm-subsidised training increases significantly the risk for a worker to be dismissed in the following year.

As for the control variables, most of them are not significant but some of them (tenure, large firm, working in hotels or restaurants) indicate that those with a lower probability to quit receive more firm-subsidised training and vice versa. Other variables (nationality, firm located in the French speaking region) indicate the contrary. Even if we cannot rule out endogeneity completely we find that the assumption that only those with a predicted low turnover rate would get firm-subsidised training would not truly reflect reality.

5.13 A synthesis of all results

In order to give a clearer picture of the most important regressions run, the results found are summarised in Tables 5.6 to 5.9. The results shown in Tables 5.4 and 5.5 were extended in two directions; firstly we divided the full sample into men and women, and secondly we added to the short run the years 1998 and 1999 to see whether the results found in the short run also hold in the long run. In all cases we have run the same model as shown in Tables 5.4 and 5.5 with the same control variables. For the sake of space we only show the coefficients for the two training variables.

As in the findings of Baenziger (1999) and Zweimüller and Winter-Ebmer (2000), we find a negative relationship between firm-subsidised training and search activity, except for the year immediately after training (as shown in Table 5.5). Contrary to these studies using older Swiss data, we do not find that employee-funded training increases search activities of these workers.

Table 5.6 Influence on search behaviour

Full sample	Firm-subsidised	Employee-funded	Sample size / pseudo R^2
1997	-0.103 (0.0707)	-0.074 (0.0727)	5379 0.074
97-98	**-0.245***** (0.0776)	-0.063 (0.0768)	3491 0.087
97-99	**-0.282***** (0.0894)	-0.087 (0.0885)	2204 0.085
Men			
1997	-0.073 (0.0890)	-0.037 (0.1105)	3013 0.089
97-98	**-0.260***** (0.1001)	0.079 (0.1157)	1980 0.104
97-99	**-0.3406***** (0.1151)	-0.051 (0.1338)	1246 0.104
Women			
1997	-0.148 (0.1224)	-0.098 (0.0988)	2366 0.086
97-98	**-0.215**** (0.1272)	**-0.173**** (0.1049)	1511 0.095
97-99	-0.172 (0.1487)	-0.180 (0.1217)	958 0.095

Bold characters show significant variables with asterisks for the 1% significance (*), 5% significance (**), and 10% significance (***) level, respectively; standard errors are in brackets.

The general job-to-job mobility that does not separate between voluntary and involuntary separations shows no significant results when training is firm-subsidised, whereas employee-funded training leads to a higher separation rate at least for the longer period, 1997–1999. A result much in line with the findings of Baenziger (1999) and some of the studies from the United States (e.g. Veum 1997 and Lynch 1991).

Table 5.7 Influence on general turnover

Full sample	Firm-subsidised	Employee-funded	Sample size / pseudo R^2
1997	0.065 (0.0745)	0.066 (0.0768)	4150 0.119
97-98	0.051 (0.0810)	0.121 (0.0842)	2648 0.118
97-99	0.040 (0.0980)	**0.248**** (0.0978)	1663 0.118
Men			
1997	0.096 (0.0972)	0.189 (0.1223)	2241 0.139
97-98	0.127 (0.1040)	0.031 (0.1358)	1434 0.132
97-99	0.077 (0.1289)	**0.274*** (0.1539)	905 0.136
Women			
1997	0.004 (0.1203)	0.091 (0.1011)	1898 0.114
97-98	-0.118 (0.1363)	0.166 (0.1119)	1204 0.126
97-99	-0.021 (0.1602)	**0.247*** (0.1327)	758 0.135

For notes, see Table 5.6.

The positive effect of firm-subsidised training on quits found in Table 5.4 only holds for the full sample and the immediate period after training. For the longer periods and the sub-samples of men and women no significant effects can be found (Table 5.8). From this we can conclude that the overall effect of firm-subsidised training on voluntary mobility is almost insignificant. The significant effect of employee-funded training on quits in the longer period holds only for the full sample.

The separate regressions for different time horizons show interesting results regarding the dismissal of workers. Similar to the findings of the German study, it seems that participation in firm-subsidised training is increasing the job-security of workers only in the short

term. The probability of a lay-off was only reduced in the year following the training and had no significant effect in the subsequent years. The result could be interpreted as though much of the investment is depreciated at a very high rate. Whereas the Swiss studies had not found a significant reduction in the dismissals of workers who had benefited from firm-subsidised training, we find some evidence for this, which is consistent with the hypothesis that the employers only invest in those workers that they are more likely to keep. The different findings in the Swiss studies with older data also point to the potential influence of the business cycle on the results, as between 1991 and 1996 dismissals were much more likely than between 1996 and 1999.

Table 5.8 Influence on voluntary mobility (quits)

Full sample	Firm-subsidised	Employee-funded	Sample size / pseudo R^2
1997	**0.145*** (0.0819)	0.048 (0.0873)	4150 0.131
97-98	-0.004 (0.0886)	0.131 (0.0905)	2648 0.130
97-99	-0.031 (0.1053)	**0.215**** (0.1041)	1662 0.128
Men			
1997	0.161 (0.1193)	0.006 (0.1408)	2241 0.153
97-98	0.033 (0.1147)	0.054 (0.1463)	1434 0.159
97-99	-0.013 (0.1379)	0.245 (0.1621)	904 0.143
Women			
1997	0.079 (0.1299)	0.068 (0.1149)	1898 0.137
97-98	-0.154 (0.1489)	0.177 (0.1201)	1204 0.132
97-99	-0.105 (0.1751)	0.226 (0.1427)	751 0.145

For notes, see Table 5.6.

Table 5.9 Influence on non-voluntary mobility (dismissals)

Full sample	Firm-subsidised	Employee-funded	Sample size/ pseudo R^2
1997	**-0.249**** (0.1044)	0.064 (0.0870)	4588 0.094
97-98	-0.041 (0.1043)	0.107 (0.0957)	3047 0.077
97-99	-0.170 (0.1224)	0.029 (0.1097)	1929 0.065
Men			
1997	-0.194 (0.1309)	0.021 (0.1400)	2443 0.108
97-98	0.011 (0.1376)	0.023 (0.1623)	1597 0.110
97-99	-0.089 (0.1714)	-0.043 (0.1998)	1018 0.145
Women			
1997	**-0.319*** (0.1787)	0.083 (0.1143)	2145 0.093
97-98	-0.083 (0.1688)	0.158 (0.1241)	1437 0.077
97-99	-0.201 (0.1872)	0.065 (0.1392)	911 0.044

For notes, see Table 5.6.

5.14 Conclusions

In our study we find that training subsidised by firms goes mainly to the well-educated part of the workforce. Although these workers are more likely to look for outside opportunities, our results confirm previously found results that firm-subsidised training reduces effectively the probability that workers search for new jobs. Furthermore we find no overall significant impact of firm-subsidised training on voluntary job separations. Contrary to older Swiss studies but in line with the quoted German study, however, we find that training does not reduce

significantly the probability that a worker will voluntarily leave the company, which casts doubt on the claim of some researchers that companies can reduce turnover by offering training.

While this is no strict proof that poaching does not take place, we can at least interpret the results in the way to say that if poaching is taking place it is not successful. Overall, companies providing or subsidising training of their workers are not likely to lose their investment to free-riding competitors.

In line with our assumptions, we find that firms are less likely to dismiss a worker who has previously been trained at the expense of the employer, at least in the short run. This may be explained either by the selection of workers receiving training or the retention of workers who received training in cases of lay-offs.

Although we find evidence for the hypothesis that some workers compensate for non-receipt of training from their employers with self-initiative, employee-funded training has little impact on job mobility. Looking at the type of training that is employee-funded, we would deduce from this that most of the employee-funded training has little or no work relevance.

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Chapter 6

DO WE NEED ALL THAT HIGHER EDUCATION?
Evidence from 15 European countries*

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*Marianne Røed***

* We have benefited from other results produced within the PURE project, especially those on private returns to education, see Asplund and Pereira (1999) and Harmon et al. (2001). We are indebted to all PURE partners for providing us with national data on labour supply, educational systems, student support and public funding. Thanks also to Michael Wallerstein, who provided us with data on bargaining institutions. We have also benefited from the comments received at PURE's user-oriented Lisbon seminar, particularly from Lord Richard Layard.
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6.1 Introduction

Over the last twenty years the labour markets of the European Union have experienced a boom in higher education. On average, the number of employees with a tertiary education relative to those educated at a lower level has doubled from 1980 to 1996 in the 15 European countries covered by the PURE project. Behind this development lies educational policies in each of the countries, boosting enrolment into higher education. As we report below, the real value of total public expenditure on higher education has increased by almost 75% over the same period.[1] The questions we try to answer in this study are the following: How have the national labour markets responded to these changes in the composition of the labour force? Were the labour markets willing to absorb such an increase in higher educated workers, and how did the changes in demand affect the value of education?

The observation of a positive wage premium for education implies that employers value education. A standard demand curve for education is downward sloping, indicating that an increase in supply has to be met with a decline in the observed wage. However, if supply and demand shift simultaneously, wages may go either up or down, depending on the size of the shifts and the slopes of the curves.[2] An extensive literature has documented that skill-biased technological change has increased in importance during the last decades (see e.g. Berman et al. 1997). If this is the case, then the value of education in the labour market is increasing over time. Below we calculate the size of the increase in relative demand for education based on estimates from all PURE countries for the period from 1980 to 1995.

To get a flavour of the subsequent analysis, consider the illustration in Figure 6.1. The vertical axis measures the wage premium of education in the labour market; that is, the wage for higher educated employees relative to the wage of employees educated at a lower level.[3] The horizontal axis measures the relative employment of the highly educated; that is, the number of employees with a higher education divided by the number of employees without a higher education. The downward sloping curve il-

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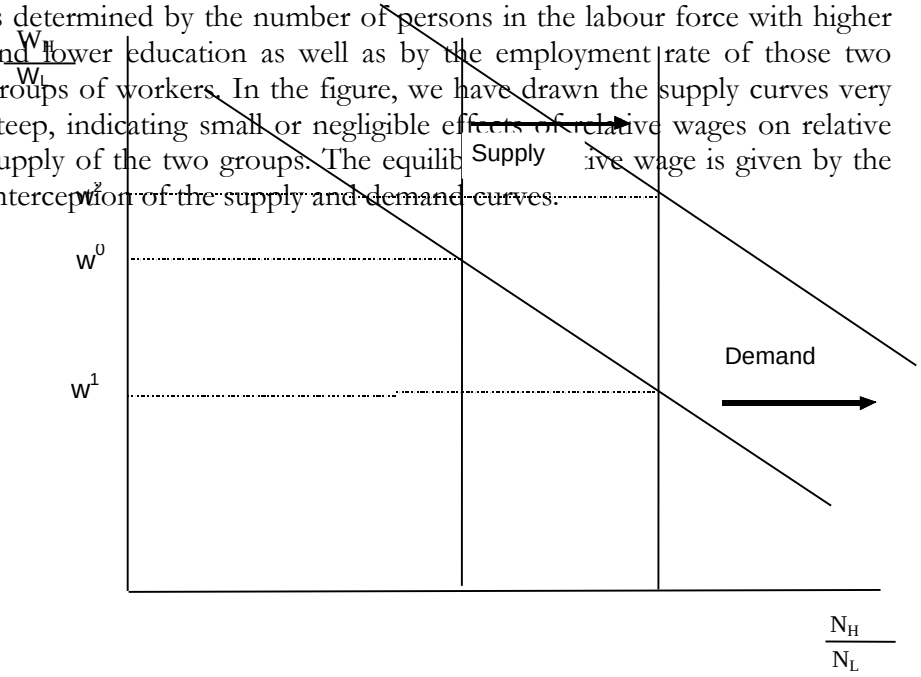
1 See Figure 6.2.

2 See Katz and Autor (1999) for an elaborate discussion.

3 Note that relative wages between educational groups provide a measure of the private return to education in the labour market. See Harmon et al. (2001) for a thorough discussion.

Figure 6.1 The race between technology and education

curve illustrates relative supply of higher education. The level of supply is determined by the number of persons in the labour force with higher and lower education as well as by the employment rate of those two groups of workers. In the figure, we have drawn the supply curves very steep, indicating small or negligible effects of relative wages on relative supply of the two groups. The equilib ive wage is given by the interception of the supply and demand curves.



[4] The curves are linear for expositional reasons only. In the subsequent analysis, the model is estimated under the assumption of constant elasticities rather than constant slopes, as indicated in the illustration. In this case, the relative demand and supply curves, measured in logarithms, would be linear.

Let w^0 be the initial equilibrium level of relative wages. Consider next a positive shift in relative supply, for instance as a result of increased public expenditure on higher education. Firms are willing to employ a higher share of educated workers only if the relative wage is reduced. Consequently, a new equilibrium level of relative wages is given by w^1. Thus, higher relative supply implies lower relative wages. However, if demand – due to a change in the underlying technology – shifts as well, the drop in relative wages is counteracted, possibly even to the point where relative wages rise, as illustrated by w^2 in the figure. Hence the figure illustrates that "the race between technology and education"[5] may shape the time path of relative wages.

The analysis reported below uses two-stage regression techniques to estimate the elasticity of supply and demand as well as relative wages. The analysis uses variation in public expenditure on education and in lagged relative supply, between countries and over time, to identify the underlying parameters. Differences in bargaining regimes and unionism over time and across countries are also used to identify the parameters of the model. The analysis is undertaken under the assumption that the underlying shifts in technology within industries are similar in the European countries. It is also assumed that there are barriers (costs) to labour mobility across national borders; that is, capital and technology are considered to be more mobile than labour.

Contrary to the picture displayed in Figure 6.1, our analysis allows for unemployment. Relative unemployment of the two types of labour creates a wedge between supply and demand. In this way, our analysis is related to that of Jackman et al. (1997), who argue, based on evidence mainly from the USA and UK, that relative wage rigidity cannot be the cause underlying the relatively high levels of unemployment in Europe as compared to the USA.

At the national level, the demand curve is determined both by the technology of firms within industries and by the composition of industries in the economy. A positive demand shift may come about either by a technological change favouring higher education within all firms and industries or by a change in the distribution of total production from less to more education-intensive industries. Below we calculate the implied demand shift based on estimated slopes of the demand and supply curves and observed changes in wages and supply. We estimate the aver-

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5 This expression was originally coined by Tinbergen (1974).

age increase in relative demand for tertiary education in the European labour markets to have amounted to slightly more than 5% per year over the period 1980 to 1995. Demand has increased even more in the 1990s than in the 1980s. It turns out that most of the demand change has occurred within industries rather than between industries, at least according to our fairly coarse measure of industry.

The latter observation runs counter to the implications from trade theory (see Johnson and Stafford 1999) where changes in supply cause changes in demand through industry composition rather than through changes in factor prices and accordingly in factor use within industry. However, we also observe, as shown below, that differences in relative demand between countries are for the most part due to differences in industry structure, an observation which is more in line with trade theory interpreted in terms of long-run equilibrium analysis. Barth et al. (2001) use the PURE data to study the influence of openness in more detail.

In the contemporary European economies, wages do not necessarily reflect the forces of demand and supply only. Unions and bargaining institutions may also influence relative wages. In the analysis, we allow for the influence of wage-setting institutions on relative wages in addition to supply and demand forces. It turns out that coordinated bargaining as well as high levels of union membership and coverage of collective agreements tend to compress wages, producing a lower relative wage for workers with a higher education. Still, both demand and supply forces influence wages as well.

The next section outlines the expansion in public expenditure on education, the increase in enrolment rates for higher education, and trends in relative supply for the PURE countries. Section 3 describes the trend in relative wages. Section 4 reports on results from a simultaneous analysis of relative demand, supply and wages. Section 5 provides the calculated demand shifts, and section 6 concludes.

6.2 Public expenditure on higher education and the supply of higher education 1980–1995(96)

In this section we illustrate the changing pattern of higher education in the Western European countries during the past two decades. We focus on the level and the composition of public expenditure on education, enrolment rates and the development of the relative supply of workers with a higher education. Differences between countries and changes over time are at the centre of interest. By higher education we refer to tertiary education (ISCED=5,6,7).

Figure 6.2 describes the European time trend in total public expenditure on education and on higher education only, from 1981 to 1995. Both amounts are measured in 1,000 euro (1985 value) per individual in the labour force 1990. The trends are calculated in regression models with only time and country dummies on the right-hand side.[6] As can be seen, the time trends in the European averages are clearly positive with regard to both types of public expenditure. Compared to the European average in 1981, total public expenditure on education increased by 37% during the fifteen years studied. The corresponding increase with regard to public expenditure on higher education was 74%. Thus, at the European level, public expenditure on higher education has increased as a share of the total amount spent on education.

Table A.1 of the appendix gives the values of total public expenditure and public expenditure on higher education for each country in 1981 and 1995. The numbers reveal that there are great differences between the countries with regard to the level and the composition of public expenditure on education and the development over time. Even though the Nordic countries start out on relatively high levels in the early eighties, the growth rates of both amounts are high in the Nordic region.[7] This is particularly the case for the expenditure on higher education. The Southern European countries – Spain, Greece and Portugal – also display high growth rates. The development in these countries may be characterised as catching-up, since their levels of expenditure in 1981 were the lowest

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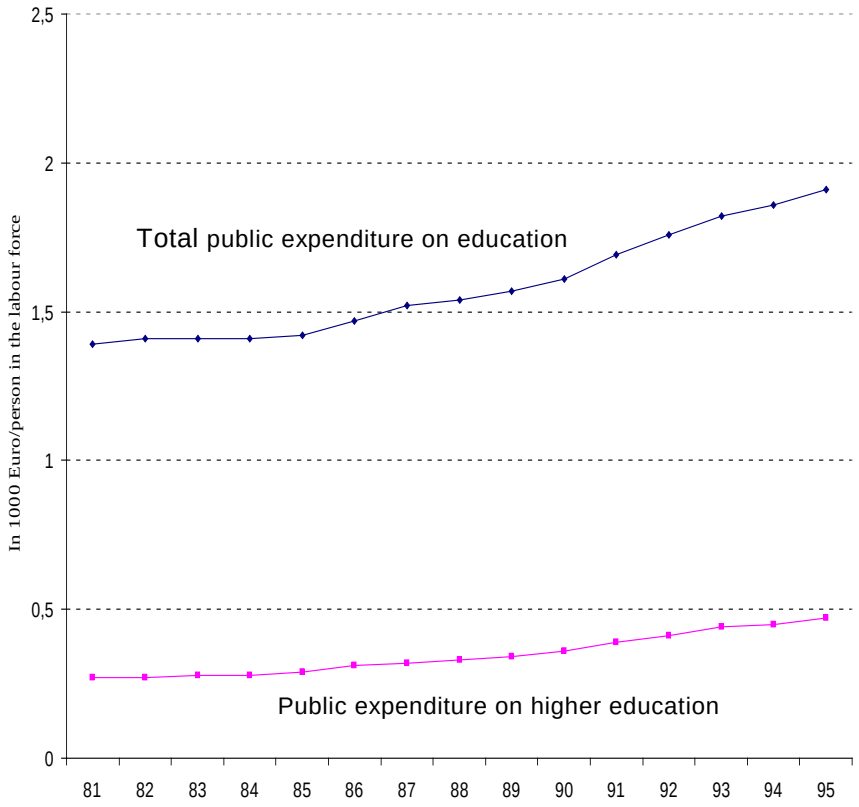
[6] Since information about public expenditure is missing for some of the countries, in some years, we use a regression model instead of just the yearly averages, to capture the European time trend.

[7] The exception is the Swedish growth rate of total expenditure, which is only 5% from 1981 to 1995.

among the covered Western European countries. In the Netherlands, there is an exceptional reduction in public expenditure on education. However, the Netherlands starts out with the highest amount of public money spent on educational purposes in 1981.

Figure 6.2 European time trends in the level and composition of public expenditure on education 1981–95*



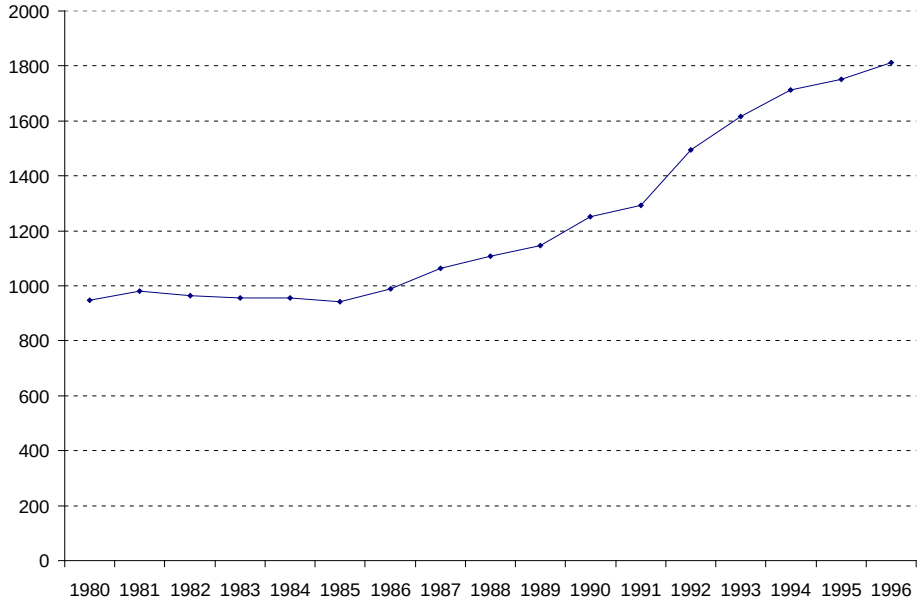
* Time trends as calculated from regression models with public expenditure, measured in 1,000 euro (1985 value) per individual in the labour force of 1990, as the dependent variable. Year and country dummies are the only variables included on the right-hand side.

Source: UNESCO Institute for Statistics (2000)

The 18 to 24 year-olds may be considered as the age group with the highest disposition to enrolment in higher education. Differences in the value of public expenditure per person in this group indicate

variations across countries in private investment costs related to higher education. Put differently, provided that the production costs of a certain level and type of education are given, the more the government contributes per individual in this age group, the less each person has to invest of private means to attain a certain level and type of education.

Figure 6.3 Public expenditure on higher education per person in the age group 18–24*



* Calculated as the sum of expenditure in 12 Western European countries – Norway, Sweden, Finland, Denmark, Switzerland, UK, Netherlands, Germany, Portugal, France, Austria, Italy – divided by the total number of persons aged 18–24 in the same group of countries, euro 1985 value.

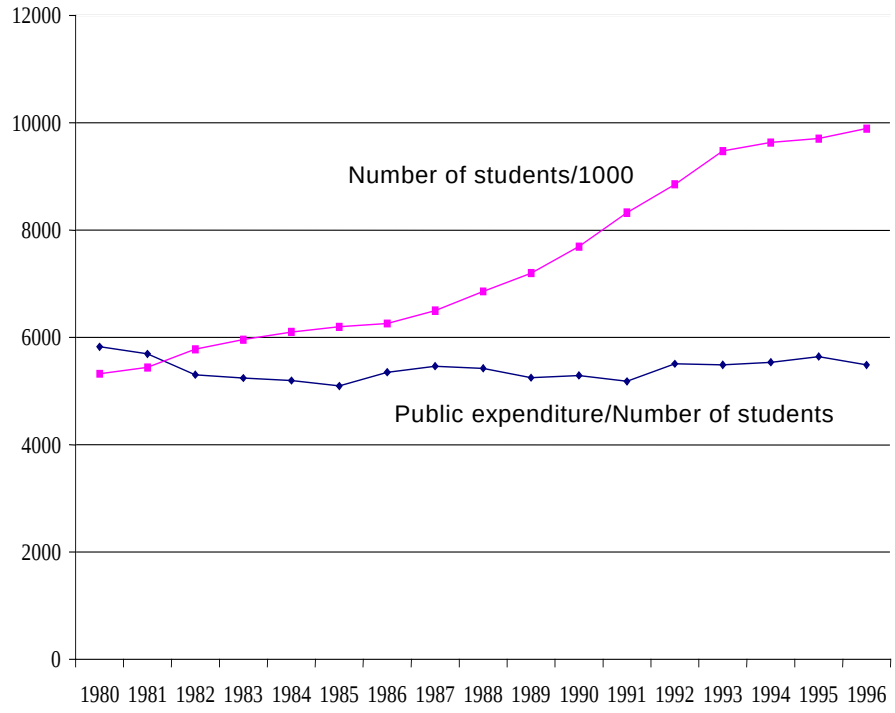
Source: UNESCO Institute for Statistics (2000)

Figure 6.3 shows the total sum of real public expenditure on higher education in 12 Western European countries, divided by the total number of persons in the age group 18 to 24 in the same group of countries. Measured by the growth in this summarised amount, the real value of public higher education expenditure per person between 18 and 24 years

has increased by almost 90% from 1980 to 1996. As can be seen from the figure, however, this increase did not start until the mid-80s.

As is apparent from Table A.2 of the appendix, there are great differences between countries with regard both to the level and the growth rate of this variable. Moreover, measured by the coefficient of variation, the average differences between countries did not change between 1980 and 1996. The Nordic countries, which were located more or less in the middle of the distribution in the early 1980s, had moved to the top of the distribution by the mid-90s. With the exception of Italy, the growth rate has been relatively high also in Southern Europe.

Figure 6.4 Enrolment into higher education and public expenditure on higher education per student enrolled (euro 1985 value)*

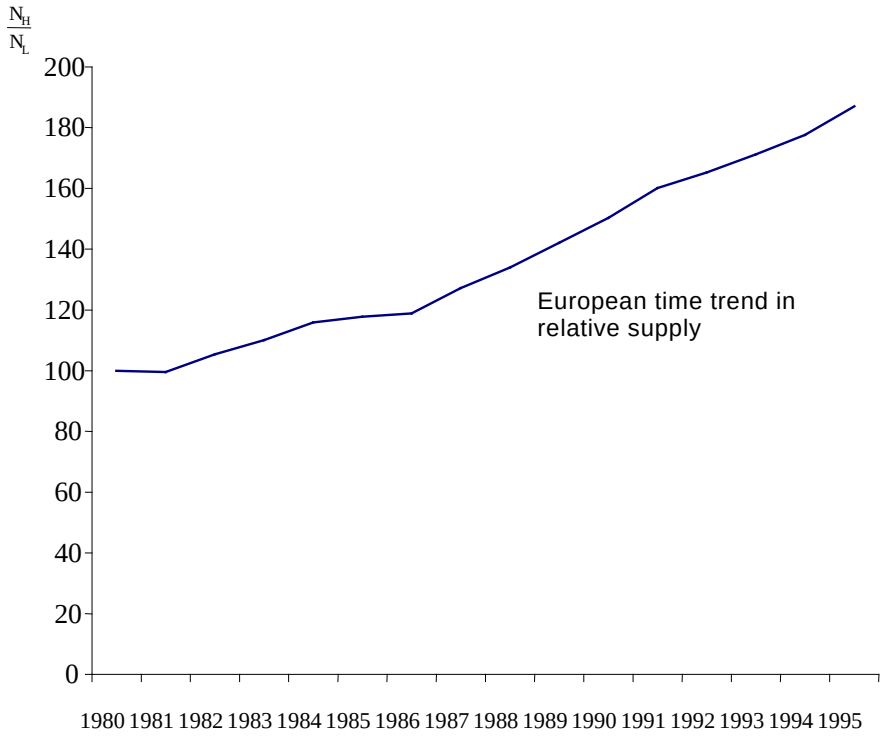


* Calculated as the sum of, respectively, expenditure on higher education and enrolment numbers for 12 Western European countries: Norway, Sweden, Finland, Denmark, Switzerland, UK, Netherlands, Germany, Portugal, France, Austria, Italy.

Source: UNESCO Institute for Statistics (2000)

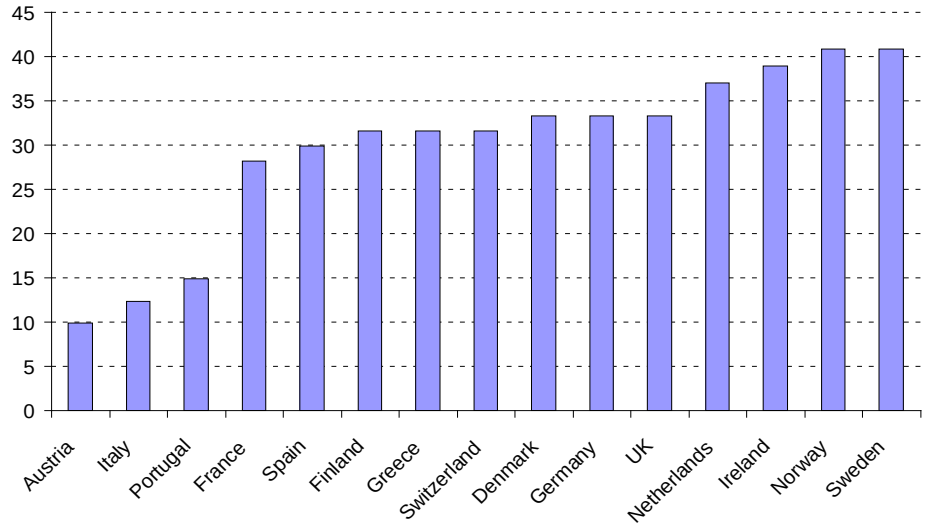
Figure 6.4 shows enrolment into higher education summarised for 12 Western European countries. In addition the figure shows real public expenditure on higher education summarised for these 12 countries and divided by the sum of enrolled in the same countries. While the number of students has increased by about 85%, public expenditure per student has decreased slightly (about 6%) during the investigated time period. Thus, measured by this indicator, the increase in public funding during the last two decades has expanded the Western European system of higher education quantitatively rather than qualitatively.

Figure 6.5 Index measuring the time trend in relative supply of highly educated labour in Western Europe (1980=100)*



* The time trend is calculated from a regression model of relative supply with only year and country dummies included. N_H is the number of workers in the labour force with a tertiary education (ISCED=5,6,7), N_L is the number of workers with a secondary or lower education (ISCED=1–4). Data from all 15 PURE countries are included in the calculations.

Figure 6.6 Relative supply of highly educated workers in the labour force of the PURE countries, $\frac{N_H}{N_L}$, 1996*



* N_H is the number of workers with a tertiary education (ISCED=5,6,7) in the labour force, 25–65 years; N_L is the number of workers with a secondary or lower education (ISCED=1–4).

Source: OECD Education at a Glance (1998)

Again there are large differences between countries. Table A.3 of the appendix displays the number of students as a percentage of the number of individuals in the age group 18 to 24 for the period 1980 to 1996. We refer to this as the enrolment rate. The table shows that the enrolment rate has increased strongly in all countries. The table also gives the development in real public expenditure on higher education per student enrolled. In all countries in the Northern and Southern regions of Europe expenditure per student has increased. In contrast, in some of the large countries in Central Europe it has decreased.

If the population cohorts available for the educational system have not strongly declined in number, then the increase in enrolment rates, apparent from Figure 6.4 and Table A.3, must have resulted in an increased supply of highly educated workers in the labour market. Based on data created within the PURE project, a time trend for the relative supply of highly educated employees is calculated in Figure 6.5. Relative supply is

defined as the number of employees with a completed education above the high-school level, N_H, divided by the number with a completed education at the high-school level or below, N_L. This ratio has increased by more than 80% from 1980 to 1996.

Figure 6.6 shows the same ratio for all 15 PURE countries for 1996, calculated from OECD data. There are still large differences between European countries with regard to the composition of the labour force.

6.3 The wage premium for tertiary education

The wage premium for tertiary education is calculated as the cumulative return to six years of education from Mincer-type wage equations.[8] The relative wage is calculated as the predicted wage for a person with 15 years of education divided by the predicted wage for a person with 9 years of education. In Figure 6.7 we display the overall trend in relative wages for the 15 PURE countries.

From 1980 to 1995 the calculated average has increased from 1.49 to 1.52. Thus, on average for the fifteen (PURE) countries, relative wages have risen slightly over this period. The pattern varies substantially between countries, however. Most countries have experienced a growth in relative wages or rather stable relative wages, while only a few have seen a decline in the relative wages of highly educated workers.[9] In other words, the trend displayed in Figure 6.7 is not the result of a consistent trend across Europe, but rather a summary of different national trends. Still it remains clear that we do not observe a general decline in relative wages over this period despite a considerable boom in the supply of workers with a higher education. Thus, in accordance with our analytical framework, demand must have boomed as well.

6.4 Results

In this section we present some results from a more elaborate analysis of supply and demand.

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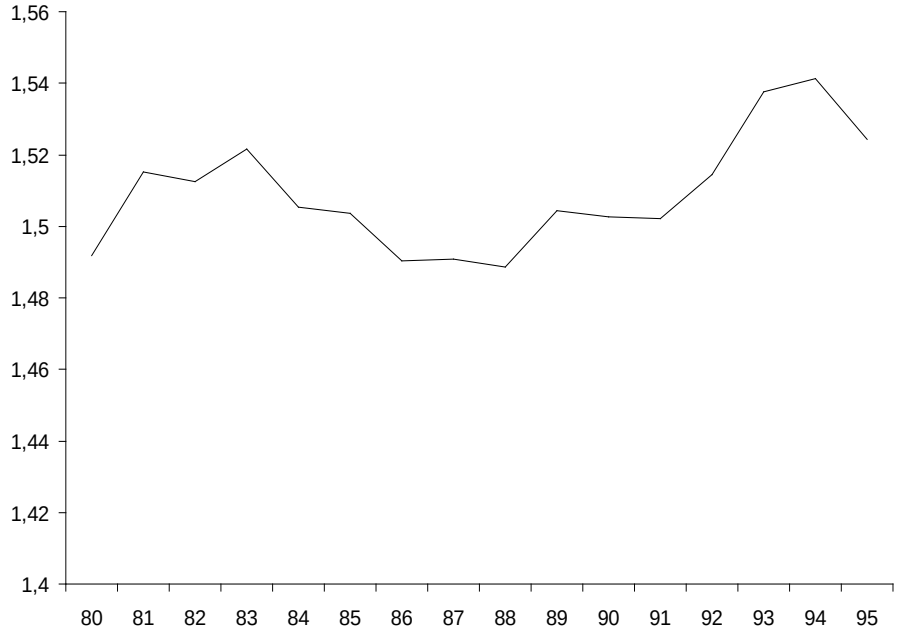
[8] All information on relative wages is derived from the PURE reports edited by Asplund and Pereira (1999) and Harmon et al. (2001).

[9] For details, see Harmon et al. (2001).

Figure 6.7 **Relative wages for higher education, $\frac{W_H}{W_L}$, 1980–95. Estimated trend for 15 Western European countries***



* W_H may be interpreted as the wage of a worker with 15 years of education; W_L as the wage of a worker with 9 years of education. The trend is calculated from the year dummies of a regression model of the return to education on country and year dummies. Data from the 15 PURE countries are included in the calculations.

6.4.1 Relative supply of higher education in the labour market

The process determining relative supply of higher education in the labour market is complex. Systems of public and private financing interact with patterns of demographic development, decisions about labour force participation, and wage formation in the labour market. The process also has a complicated time structure, since the individual decision to enrol in higher education obviously affects labour supply with a certain time lag. Within the economic framework such interdependent processes are described by means of simultaneous equation systems. Given the available

data we are, however, not yet able to analyse these complicated structures properly. In the following we only present the results from some very simple regression models describing correlation patterns between, on the one hand, the level and composition of public expenditure and the relative wage for highly educated labour and, on the other hand, the relative supply of highly educated labour.

It may be reasonable to regard the level and composition of public expenditure as exogenous variables in the process which determines a country's relative supply of higher education. In contrast, the relative wage between higher and lower educated labour is obviously an endogenous variable. In Table 6.1, models I–IV, relative supply is estimated with a two-stage least squares procedure. Instruments for the relative wage are variables reflecting the bargaining system and the character of the wage-setting institutions in each country. The dependent variable in these models is relative supply each year, in each country (in the years for which information about this variable is available). Since the relative supply in the preceding year is included on the right-hand side[10], it is actually the effect of the explanatory variables on the change in relative supply from one year to another, which is estimated. The explanatory variables are the relative wage, the real value of total public expenditure on education and the real value of public expenditure on higher education. The size of the countries' labour force in 1990 is used to scale both amounts of public expenditure, which are measured in euro 1985 value. To capture some of the complicated time structure – the delay between educational decision making and the effect on labour supply – all independent variables are included with their average value over the last three years.

In Model I we do not include country dummies. Thus, country fixed-effects are not accounted for. However, we include a dummy variable which indicates whether or not the students have to pay tuition fees in a major part of the universities and colleges, and a dummy variable which indicates if the number of places in higher educational courses are mostly limited. These variables are clearly measured in a very rough manner; however, they may capture some main qualitative differences in the educational system between countries.[11]

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[10] Since the variable relative supply is not available each year we use linear interpolations for the lagged dependent variable when missing in the preceding year.

[11] The values of these dummies vary almost exclusively between countries (not over time). In Model II they are excluded due to multicollinearity with the country dummies.

Table 6.1 Relative supply of higher educated labour, the level and composition of public expenditure on education* and the return to education (relative wage of highly educated labour)

Model	I	II	III	IV	V	VI
Dependent variable:	Ln(relative supply of higher educated labour in year t) 2SLS				Relative supply of higher educated labour, OLS	
Independent variables:					Ln (mean 90-95)	Ln (mean 90-95/ mean 85-89)
Mean public expenditure on *all levels,* last three years	0.05 (1.09)	0.18 (1.77)	0.19 (2.99)			
Mean public expenditure on *all levels*, 1987-91					0.50 (3.31)	0.51 (3.57)
Mean public expenditure on *higher levels,* last three years	-0.20 (-1.26)	0.01 (0.03)		0.40 (2.34)		
Mean public expenditure on *higher levels*, 1987-91					-2.43 (-4.02)	-2.43 (-4.21)
Return to education in year t	0.13 (1.10)	0.34 (1.19)	0.32 (1.12)	0.41 (1.38)		
Mean return to education 1987-91					1.56 (3.09)	1.43 (3.34)
Tuition fees in most parts of higher education (TUT)	0.06 (0.97)				-0.09 (-0.60)	-0.05 (-0.54)
Number of student places limited in most parts of higher education (FIX)	0.03 (0.71)				0.14 (0.68)	0.22 (1.51)
TUT * FIX	-0.08 (-1.15)					
Ln(relative supply in year t-1)	0.99 (55.4)	0.80 (15.93)	0.80 (16.3)	0.81 (16.1)		
Ln(mean relative supply 85-89)					1.08 (7.56)	
Country dummies	No	Yes	Yes	Yes	No	No
Adjusted R^2	0.98	0.98	0.98	0.98	0.92	0.56
N	131	131	131	131	14	14

* Expenditure amounts are measured in 1,000 euro (fixed 1985 value) per individual in the labor force 1990. *t*-values in parentheses.

In Model I we estimate the coefficients based on the variation both between countries and within countries over time. In Models II–IV we include country dummies. Thus here, the coefficients are estimated on within country variation only.

In Model I the estimated coefficient on total public expenditure is positive. Given that total expenditure is constant, the effect of increasing public expenditure on higher education is estimated to be negative. The relationship between relative wage, $\frac{W_H}{W_L}$, and relative supply is positive as well. However, none of these coefficients are significantly different from zero. Neither are the estimated coefficients related to the variables indicating the existence of tuition and limitations in access to higher education.

When country dummies are included in Model II the sign of the coefficient on public expenditure on higher education turns positive, but is still not significant. When estimated on within country variation only, the coefficient related to total public expenditure is positive and significantly different from zero at a 10% level. When the two expenditure amounts are included separately in Models III and IV each has a positive effect on relative supply which is significantly different from zero. Thus, the pattern of the public expenditure coefficients emerging from Models II–IV reflects that total public expenditure on the educational system and public expenditure on higher education are strongly correlated over time (within the same country). Comparing Models III and IV, the results indicate that an increase in public expenditure on higher education has a stronger effect on relative supply than a corresponding increase in the educational budget as a whole. However, from the results of models including both types of expenditure we are not able to sort out the effect of expenditure on higher education versus spending on lower levels of education, keeping total expenditure constant.

The return to education seems not to have a significant effect on relative supply in these models, thus indicating that the relatively steep slope of the supply curve in Figure 6.1 gives an appropriate picture of the market.

In Models V and VI the change in mean relative supply between 1985 to 1989 and 1990 to 1995 is analysed. The mean value of the relative wage variable from 1987 to 1991 and the mean values of the public expenditure variables in the same period are used as independent variables. While Models II–IV explore variation within countries only, Models V and VI use variation between countries only. We thus only have 14 ob-

servations. Exploring the variation between countries in this manner we detect a similar pattern as in Model I. In these specifications, however, both the positive relationship between total public expenditure and relative supply and the negative relationship between public expenditure on higher education and relative supply are significantly different from zero. This means that between countries there is positive correlation between total public expenditure and the supply of education. In contrast, given the total educational budget, a relative favouring of higher education is negatively correlated with the relative supply of highly educated labour. Exploring the variation between countries in this manner we also find a positive relationship between the return to education and the growth in supply of highly educated labour; countries with a higher return to education seem to have a higher supply growth.

6.4.2 Demand for higher education

Table 6.2 reports several estimates of the elasticity of relative demand with respect to relative wages. The table also reports some estimates of annual shifts in the demand function. A standard OLS without time and country dummies gives an estimated elasticity of substitution of 1.77 and an underlying growth rate in demand of about 6.5%. Using a two-stage least squares method to correct for the potential endogeneity of relative wages produces an estimated elasticity of substitution of 2.87 and a slightly higher estimate of the yearly growth rate in demand. Instruments include lagged relative supply in the labour force, some indicators of public expenditure and admission policies as well as some variables reflecting wage-setting institutions (see note to the table).

The next columns report estimates from models including country-specific effects and some specifications including country-specific linear trends as well. Using country fixed-effects reduces the estimated growth rate to about 4.5%. The two-stage least squares specification including both country-specific effects and trends, gives a point estimate of 1.3 for the elasticity of substitution.[12]

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[12] As a robustness test, we estimated a specification with lagged supply not included among the instruments, only public expenditure and support as well as variables reflecting the bargaining regime. The estimated elasticity is now 1.5, and still not significantly different from unity.

Table 6.2 The demand for higher educated labour in Europe. Regression results. Dependent variable: log (relative demand)*

	Without country-specific effects		With country-specific effects			
	OLS	2SLS	OLS	2SLS	2SLS	2SLS**
Relative wage	-1.772 (0.303)	-2.872 (0.405)	-0.455 (0.183)	-0.959 (0.323)	-1.297 (0.647)	-1.435 (0.675)
Linear trend	0.065 (0.008)	0.072 (0.009)	0.043 (0.002)	0.044 (0.002)	Country specific trends	Country specific trends
Country dummies	No	No	Yes	Yes	Yes	Yes
Year dummies	No	No	No	No	Yes	Yes
Adjusted R^2	0.362	0.394	0.962	0.960	0.976	0.973
N	139	139	139	139	139	139

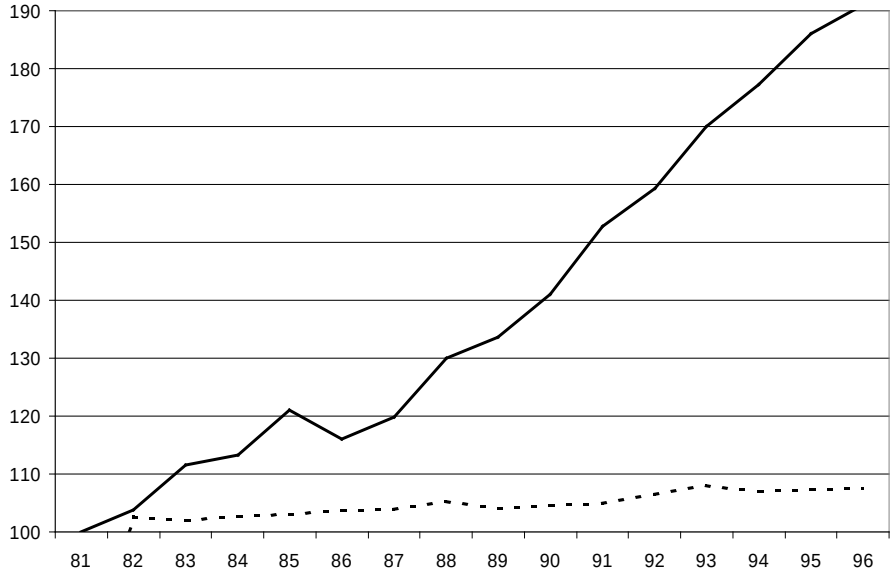
* In the 2SLS specifications, the relative wage is instrumented with: lagged relative supply of higher education in the labour force, public expenditure on higher education and public expenditure on total education as a share of GDP, the existence of tuitions and a dummy reflecting if access to higher education is limited by capacity constraints, in addition to union density, coverage (their interaction) and a centralisation index.

** In this model, lagged relative supply is not included in the instruments for the relative wage.

The fact that we find a higher elasticity of demand when not including country fixed-effects implies that there is a negative relationship between relative wages and the more permanent country-specific levels of demand for education.

Our preferred elasticity of relative demand to relative wages is thus estimated to about –1.3. This means that the elasticity of substitution between the two groups of labour is 1.3. The estimate is very close to the 'preferred' 1.4 for the USA as reported by Katz and Autor (1999) and the one estimated for the UK (1.04) by Jackman et al. (1997). Furthermore, we are not able to reject the null hypothesis of an elasticity of unity (Cobb–Douglas).

Figure 6.8 Estimated demand shift, average for PURE countries, 1981=100*



* Calculated from a 2SLS demand model (see Table 6.2) including relative wage, country and year dummies only.

With this elasticity of relative demand, a growth in relative employment of about 90%, as experienced in Europe over the investigated 16-year period, would imply a drop in relative wages of about 70%, given that the demand curve was stable. This has not occurred, however. Thus demand has shifted as well. Figure 6.8 shows an estimate of the shift in demand from 1981 to 1996.[13] Relative demand is fixed at 100 for 1981, and the curve displays the growth in demand that would have occurred for a given relative wage. We note from the figure that the shift in demand has been even stronger in the 1990s than in the 1980s and that the index ends up at about 190 for 1996.

As mentioned in the introduction, demand growth may come about as a result of within-industry growth or as a result of a change in the structural composition of industries. The dotted line in Figure 6.8 gives the calculated increase in demand from structural change between indus-

[13] The demand shifts are calculated from a regression model identical the one in column 5 of Table 6.2, but without country-specific trends.

Table 6.3 Industry structure and the demand for higher educated labour in Europe. Regression results. Dependent variable: log(relative demand). 2SLS.*

	Without Country Specific Effects		With Country Specific effects	
Relative wage	-2.843 (0.418)	0.294 (0.527)	-1.305 (0.654)	-0.986 (0.661)
Industry demand index	-	6.537 (0.851)	-	2.460 (1.390)
Country dummies	No	No	Yes	Yes
Country spec trends	No	No	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Adjusted R-square	0.339	0.568	0.974	0.975
N	135	135	135	135

* Relative wage is instrumented with: lagged relative supply of higher education in the labour force, public expenditure on higher education and public expenditure on total education as a share of GDP, the existence of tuitions and a dummy reflecting if access to higher education is limited by capacity constraints, in addition to union density, coverage (their interaction) and a centralisation index.

tries.[14] It may be concluded from the figure that, at least with a fairly coarse definition of industry, between-industry changes have contributed only marginally to the overall change in relative demand within the PURE countries.

However, when we compare differences in demand *between* countries rather than within countries over time, industry composition contributes considerably to the differences in relative demand. This is illustrated in Table 6.3 where we have estimated relative demand relations with and without control for industry composition.[15] Without control for industry

[14] The industry demand index is constructed from average European education intensities for 1-digit industries (times gender) in 1990 and changes in employment shares for 1-digit industries (times gender) from 1980 to 1996 relative to the 1990 industry structure. See Barth et al. (2001) for details.

[15] See note 14. The log of the industry demand index is regarded as endogenous in the 2SLS estimation.

composition, we obtain figures close to the ones reported in Table 6.2 (we have fewer observations in Table 6.3 since we lack information on industry composition from Switzerland).

Consider first the models without country fixed-effects. In these models, differences between countries contribute considerably to the variation in the data. In this case, controlling for industry composition completely eliminates the estimated elasticity of substitution (from -2.8 to an insignificant 0.3). Consider next the models including country fixed-effects, where the analysis is conducted on within-country variation in the data only. In this case, the estimated elasticity of substitution changes only marginally (from -1.3 to -0.99) when we include the industry demand index. This means that within countries, adjustment takes place within industries.

We did, however, in the previous table, find a negative relationship between the country-specific levels of demand (country fixed-effects) and relative wages. Here we find no significant relationship when country fixed-effects are not controlled for, after controlling for industry composition. We may thus conclude that the negative correlation between country-specific levels of demand and relative wages observed in Table 6.2. corresponds to differences in the industry structure rather than to differences in demand within industries.

However, once country fixed-effects are in place, the inclusion of the industry demand index reduces the estimated coefficient of labour demand only marginally. This means that transitory movements in relative wages within countries (around a country-specific linear trend as well as fixed year effects at the aggregate European level) affect demand within industries (at this level of definition).

In Table A.4 of the appendix, we have calculated average growth rates of relative supply, relative demand and relative wages. The first three columns report average annual growth rates (log points) of relative supply, employment and wages for the 15 PURE countries, estimated from the period 1985 to 1995. The highest growth in relative employment rates has occurred in Ireland and Finland, while Italy and the Netherlands show the lowest growth rates in relative employment of higher educated. We note that employment has risen at least as much as supply in 11 of the 15 countries. The unweighted average growth rate in relative employment is 4.5% while the average growth rate in relative supply is 4.4%. Greece, France and Italy have experienced the highest growth in relative wages, while several countries show a decline. We note, once more, that the unweighted average growth rate of relative wages is posi-

tive (0.6) even in a situation with a very high growth rate of relative employment.

The next two columns of the table report calculated growth rates for relative demand and supply indexes. The demand (supply) index is calculated as log relative demand minus log relative wages times the elasticity of labour demand. Similarly, the supply index is calculated as log relative supply minus the elasticity of supply with respect to wages multiplied by log relative wages. These indexes are interpreted as giving the size of the shift of the demand (supply) curves in Figure 6.1; that is, the growth in demand (supply) that has taken place at given relative wages. Annual growth rates are again calculated from country-specific trends in these variables while controlling also for country-specific effects.

We find that the underlying shifts in supply have been particularly strong in Ireland, Finland and Greece. In the Netherlands and Italy, the growth in supply has been very low over this period. The reported supply shifts should be interpreted as increased relative supply, *given relative wages*. Behind these shifts are to a large extent the expansion of the school system and increased public funding of higher education.

Large shifts in the underlying relative demand curves are found for Ireland, above 10% per year, as well as for Finland and Greece. The Netherlands and Germany turn out to be the countries with the lowest calculated shift in demand among PURE countries over this period. Behind these shifts are for the most part, as we observed in Figure 6.8, technological changes within industries (at least for the industry classification used in this study).

It should, however, be stressed that the specific numbers for the single countries are uncertain and calculated on the assumption of constant elasticities of demand and supply across countries and over time. Averaging across countries gives a demand shift of 5.3% per year, which has been met by a shift in supply of 4.2%.

6.5 Conclusions

The expansion of the educational system may be considered as a nation's attempt to influence its own endowment of human capital. Public expenditure on education, and on higher education in particular, has risen considerably from 1980 to 1995 in the countries included in this study. The increased spending has been used mainly to increase enrolment ra-

ther than to increase the quality of schooling. Public expenditure on higher education works to increase the human capital content of the labour force. We have found that such an expansion would, *ceteris paribus*, be accompanied by a reduction in the relative wages of the country. On the whole, however, the increasing supply of highly educated labour has not led to a reduction in relative wages in Europe. The reason is that demand has shifted as well. At the aggregate European level, the relative demand curve has shifted even more than the relative supply curve. The demand for education has increased by more than 5% per year and, moreover, with a higher growth rate in the 1990s than in the 1980s.

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Appendix tables

Table A.1 Total public expenditure on education and public expenditure on higher education, 1981 and 1995. Measured in 1,000 euro (1985 value) per person in the labour force 1990

		1981	1995	% change 81–95
Sweden	Total expenditure	1.93	2.02	5
	Expenditure higher ed	0.15	0.56	273
Norway	Total expenditure	1.73	2.77	60
	Expenditure higher ed	0.20	0.68	240
Denmark	Total expenditure	1.69	3.17	88
	Expenditure higher ed	0.26	0.68	161
Finland	Total expenditure	0.99	1.83	85
	Expenditure higher ed	0.18	0.50	177
Spain	Total expenditure	0.24	0.76	225
	Expenditure higher ed		0.11	
Greece	Total expenditure	0.07	0.14	100
	Expenditure higher ed	0.01	0.03	200
Portugal	Total expenditure	0.15	0.34	126
	Expenditure higher ed	0.01	0.05	400
Italy	Total expenditure	0.84	1.04	23
	Expenditure higher ed	0.08	0.15	87
France	Total expenditure	1.28	1.99	56
	Expenditure higher ed	0.16	0.34	53
Ireland	Total expenditure	1.03	1.53	48
	Expenditure higher ed	0.20	0.37	85
Austria	Total expenditure	1.43	2.16	51
	Expenditure higher ed	0.17	0.42	147
Switzerland	Total expenditure	1.95	2.77	42
	Expenditure higher ed	0.32	0.49	53
UK	Total expenditure	1.01	1.31	30
	Expenditure higher ed	0.21	0.31	48
Germany	Total expenditure	1.50	2.11	41
	Expenditure higher ed	0.36	0.62	72
Netherlands	Total expenditure	2.11	1.85	-12
	Expenditure higher ed	0.51	0.53	4

Source: UNESCO Institute for Statistics (2000)

Table A.2 Real total public expenditure on higher education, per person in the age group 18–24, in 14 Western European countries, 1980–1996 (euro 1985 value)

	1980	1985	1990	1996	% change 80–96
Sweden	916	1122	1303	3309	261
Norway	968	1027	1280	3590	271
Denmark	1464	2020	2341[1]	4163	184
Finland	850	1050	1939	3018	255
Spain	n.a.	181[2]	287	397	119
Portugal	63	73	163	248	294
Italy	347	304	511	658	90
France	671	825	981	1576	135
Ireland	n.a.	660[3]	807	1235	87
Austria	752	929	1268	1975	163
Switzerland	1695[4]	1705	2343	2898	71
Germany	1671	1485	2085	2945	76
UK	1023	793	922	1796	76
Netherlands	2098	1680	2329	2487	19
Coefficient of variation	0.57			0.57	

[1] For 1988. [2] For 1987. [3] For 1986. [4] Population number from 1981.
Source: UNESCO Institute for Statistics (2000)

Table A.3 Enrolment rates and public expenditure per student, 1980–1996*

		1980	1985	1990	1996	% change 80–96
Sweden	ENROLMENT RATE		22	23	35	56[1]
	Expenditure per student		5184	5684	9442	88[1]
Norway	ENROLMENT RATE	18	21	30	44	138
	Expenditure per student	5291	4838	4220	8216	55
Denmark	ENROLMENT RATE	20	21	26	36	75
	Expenditure per student	7270	9796		11669	62
Finland	ENROLMENT RATE	23	24	34	51	126
	Expenditure per student	3724	4326	5586	5838	56
Spain	ENROLMENT RATE	17	20	26	36	119
	Expenditure per student		787	1068	1088	
Portugal	ENROLMENT RATE	9	9	17	30	246
	Expenditure per student	735	830	968	839	14
Italy	ENROLMENT RATE	19	19	23	33	67
	Expenditure per student	1784	1639	2254	2021	13
France	ENROLMENT RATE	18	21	28	36	99
	Expenditure per student	3694	3904	3489	4343	17
Ireland	ENROLMENT RATE		18	23	28	
	Expenditure per student		3709	3493	3850	4[2]
Austria	ENROLMENT RATE	16	19	23	33	101
	Expenditure per student	4604	4942	5451	5988	30
Switzerland	ENROLMENT RATE	12	15	20	25	100
	Expenditure per student	13686	11192	11692	11591	-15
UK	ENROLMENT RATE	14	16	20	36	157
	Expenditure per student	7202	5064	4663	4962	-31
Germany	ENROLMENT RATE	16	18	23	28	78
	Expenditure per student	10522	8182	9148	10402	-1
Netherlands	ENROLMENT RATE	21	22	25	32	51
	Expenditure per student	9817	7596	9397	7687	-21

* Enrolment rate = 100 * (number of students)/ (number of individuals aged 18–24). Expenditure per student = (Real total public expenditure, euro 1985 value) / Number of students enrolled. [1] For 1984–96. [2] For 1985–96.

Source: UNESCO Institute for Statistics (2000)

Table A.4 Average annual growth rates in relative employment, relative wages and relative demand, 1985–1995. Log-points per country times 100*

	Growth in relative			Calculated growth in index	
	Empl.	Supply	Wages	Demand	Supply
Austria 85–96	6.1	6.1	-0,9	5.0	6.4
Denmark 85–96	2.9	2.8	0.8	3.9	2.6
Finland 87–96	9.0	7.5	-0.5	8.3	7.7
France 92–96	3.5	3.6	2.3	6.5	2.9
Germany 85–96	2.3	1.9	0.0	2.3	1.9
Greece 88,. 94–96	4.9	5.1	2.9	8.6	4.1
Ireland 86, 87, 91, 94–96	9.9	10.2	-0.3	9.5	10.2
Italy 85–96	1.5	1.5	2.2	4.4	0.8
Netherlands 86–96	-1.3	-1.4	0.9	-0.2	-1.7
Norway 87–95	5.9	5.7	0.1	6.1	5.7
Portugal 85–96	5.4	5.5	0.8	6.5	5.2
Spain 85–96	3.8	3.8	-0.1	3.7	3.8
Switzerland 91–96	2.4	2.3	0.6	3.1	2.1
Sweden 86, 91, 93, 96	6.7	6.4	-0.4	6.1	6.5
United Kingdom 83–96	5.3	5.3	0.2	5.5	5.3
Average	4.5	4.4	0.6	5.3	4.2

* Average annual growth rates for relative supply, employment and wages are (100 times) the coefficients of a linear trend in semi-logaritmic regressions for each country including a constant term and the time trend only. Average yearly growth rates of the demand and supply indexes are calculated for each country on the assumption that the elasticity of substitution is 1.297 and that the elasticity of relative supply equals 0.338 (from Tables 6.1 and 6.2).

Chapter 7

THE DETERMINANTS OF PARTICIPATION IN HIGHER EDUCATION
The case of Germany

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7.1 Introduction

In Germany, as in most other industrialised countries, the average level of education attained by the population has increased steadily over the past thirty years. This phenomenon has been encouraged by public policy, since raising the educational attainment of the population is commonly viewed as a way of promoting both economic and social development. Typically, the raise of educational attainment may be the result of a quantitative expansion of participation in education or of a qualitative improvement of human capital acquisition for those persons enrolled in education. This study deals with the former aspect and focuses more specifically on the issue of participation in tertiary education in West Germany.

Analysing the factors influencing educational participation may be of interest to policy-makers for several reasons. First, being aware of the way some variables affect educational decisions gives a hint on the possible impact that observed changes in those variables may have on the future qualification structure of the population and consequently on future labour supply. Second, this might also help to find out the extent to which public policy is likely to influence educational participation and thus improve the efficiency of the allocation of resources. Moreover, the empirical evidence on the determinants of educational decisions available so far mostly concerns the link between social origin and educational choices or outcomes, while very few studies, and this is particularly true for Germany, also examine the impact of economic considerations on schooling outcomes. This is rather surprising considering that one of the main objectives of educational policy for the past decades has been to provide financial incentives to youngsters to enrol in education, e.g. through financial support to enrolees from poorer social backgrounds. For such policies to prove efficient, however, youngsters, when making their educational choices, need to respond to some extent to cost considerations. Moreover, on a more academic level, it is rather astonishing that, though a large number of studies are based on the human capital theory, the main assumption of this theory – that individuals make their educational decisions by weighting the costs and the returns they expect from education – has very rarely been examined empirically.

Therefore, this contribution aims at investigating the main factors affecting participation in education, paying special attention to the impact of economic incentives. The study focuses on tertiary education

and addresses the following issues: (i) How determining is social background in explaining educational participation? (ii) To what extent are enrolments influenced by the expected labour market returns? (iii) To what extent may public funding influence enrolments? The chapter is organised as follows. After a presentation of previous research related to this topic in section 2, the modelling framework for the analysis is outlined in section 3. Section 4 motivates the choice and the definition of the variables. Section 5 presents the results of the analysis, and section 6 the results of simulation of changes in selected variables and their impact on enrolment probabilities. Finally, section 7 concludes.

7.2 Previous related empirical evidence

Most economic and sociological research focuses on the link between social origin and educational outcomes. Empirical evidence is rather unanimous in stating a positive correlation between family background and own educational achievement (Manski et al. 1992, Blossfeld 1993, Bogess 1998, Goux and Maurin 1998a and 1998b, Gang and Zimmermann 2000 to name a few).

However, various other factors can be considered to influence preferences and abilities and thus educational outcomes. According to the human capital theory, educational choices may be assimilated to investment decisions where rational individuals decide on the optimal amount of education they wish to acquire so as to maximise the net return to education. As a matter of fact, additional schooling is expected to generate benefits in terms of enhanced future earnings, but also to entail costs: direct costs as well as opportunity costs resulting from delayed entry into the labour market.[1] The human capital theory has provided the base for a large number of studies, in particular on the determinants of the wage structure and on the returns to education (see the survey of the empirical literature on this topic for Germany in Lauer and Steiner 1999). In spite of this, this basic assumption of the human capital theory, namely that people's educational decisions are the result of a maximisation calculus of net return, has rarely been tested empirically and no clear evidence emerges from the literature.

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[1] In Germany, educational provision is generally free of charge. Thus, the largest component of the costs of education is the opportunity cost of children's time diverted from labour market participation.

Few studies have investigated the role of return expectations on educational decisions. Generally, however, they do tend to confirm the theory, even though the approaches adopted and the entities observed are very different and do not provide for any real comparison. Goux and Maurin (1999), for instance, find out for France that neglecting the income expectations of students results in overestimating the impact of social background on educational achievement. Kodde (1988) integrates future income, foregone earnings, overall unemployment and education-specific employment opportunities in a model of demand for education and tests the model on a sample of Dutch high-school graduates. The estimations show that both monetary arguments and employment prospects influence the demand for education. The latter is also confirmed by Mingat and Tan (1998), who find out, on the basis of aggregate data, that college enrolment rates are sensitive to unemployment and economic conditions. Wilson et al. (2000) focussed explicitly on the extent to which American youth's high-school graduation decisions respond to economic incentives, in particular to the expected income return associated with graduating relative to dropping out. The results suggest that youths appear to be more likely to opt for graduating from high school when expected returns from additional schooling increase. Gianelli and Monfardini (2000) analyse the effects of expected earnings and local market conditions on the behaviour of high-school graduates, whereby the decision to either remain in the parental home or form a new household is modelled jointly with the decision to work or to invest in further education. Finally, Merz and Schimmelpfennig (1999) examine the career choices of German high-school graduates. Here again, the evidence suggests that high-school graduates' decisions are, at least partially, based on economic motives.

Another branch of recent empirical literature is concerned with the impact of financial variables, such as the costs of education and the availability of financial resources, on the demand for education. The positive correlation between family income and schooling attainment is well documented for the United States (e.g. Solon 1992, Hill and Duncan 1987) and has been widely interpreted as evidence of credit constraints, thus providing empirical support for public policies of financial support. Shea (2000) as well as Cameron and Heckman (1998), however, contest the causal nature of this link, arguing that parental income per se does not generate higher achievement of the children, but rather learning ability. Hence, the commonly observed income effect only reflects the correlation between parental income and parental ability, which, in turn, is correlated with the ability of the children. Conse-

quently, policies designed to induce college attendance by raising family income would essentially result in attracting substantially less able people. Neither do Cameron and Taber (2000) find any evidence of credit constraints. For Great Britain, Chevalier and Lanot (1999) find a rather limited direct effect of family income on the child's schooling, even though they do point out the existence of some short-term financial constraints which are likely to induce pupils from poorer backgrounds to exit the education system earlier than their ability would have predicted. Some other studies are more directly concerned with the impact of public policy on educational attendance. Schultz (1988), for instance, examines the relationship between the expansion of public school expenditure and aggregate enrolments for about 90 countries. More recently, Hilmer (1998) examines the effect of post-secondary fees on the college attendance decision of high-school graduates.

On the whole, very little empirical research is available at this stage for Germany, and the empirical evidence for other countries is mostly concerned with one particular aspect of the issue, typically the role of family background. Recent developments in economic research, however, tend to grant more importance to the analysis of the role of economic incentives for educational choices. Thus, there seems to be a need for a more comprehensive analysis of the determinants of educational decisions, particularly for Germany. This is the aim of this study, in which the effects of social background, return expectations and public policy on enrolment decisions are jointly examined.

7.3 Methodological approach

Analysing the determinants of educational decisions is subject to certain conceptual difficulties. This explains why different approaches have been adopted in the empirical research and why no clear evidence emerges from the literature. As a matter of fact, final educational attainment is the result of a sequential process during which a certain number of decisions are made at different points in time. In order to investigate the determinants of final educational achievement, some assumptions must be made with respect to the point in time in which decisions are taken and where some identified factors are supposed to exert an influence on those decisions. This difficulty has been circumvented in different ways in the empirical research. A widespread approach has been to concentrate the analysis on time-invariant factors

only, typically the family background the individual grew up in, which eliminates the need to make any assumption of this sort. The drawback of this approach is that it cannot account for the potential impact of economic considerations such as labour market conditions or the availability of educational grants.

Another approach, widely adopted, consists in decomposing the educational career into a finite number of sequences and concentrate the analysis on one particular stage of the educational process, e.g. the transition from high school to university or to employment. This approach enables one to consider the impact of labour market conditions or some other factor at the time of the observed transition. One problem, however, is that at each prior stage of the educational career, only the most fitted students have been selected for grade progression. Therefore, the sample of students observed at one particular stage is not random; it is subject to a selectivity bias due to sequential selection during the educational process (see Cameron and Heckman 1998). For instance, if the completion of a high-school degree is a condition for being eligible for tertiary level studies, part of the decision to enrol into higher education has been made at previous stages of the educational career. Thus, focussing on the selected sample of high-school graduates eligible for higher education and on their decision to enrol or not to enrol into higher education may not be really informative with regard to the determinants of educational achievement. In more practical terms, the transition approach is problematic to implement empirically due to a very small number of high-school graduates each year in the GSOEP data and their very unbalanced career choice.[2]

Therefore, the approach here consists in analysing the probability of being enrolled in higher education at the typical age at which people intending to complete tertiary level studies should be enrolled in tertiary education, irrespective of their previous educational career. Thus, examined is not the probability that an individual successfully completes a specific transition from one level to the next, but the probability that the individual has successfully completed all previous transitions until the one leading to higher education. In other words, this approach boils down to look at the proportion of an age group being enrolled in higher education rather than at the proportion of eligible

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[2] In Germany, the overwhelming majority of high-school graduates complete tertiary education.

students actually completing tertiary education. To the extent that drop-outs from university can be neglected, this approach gives information on the probability that an individual, given a certain number of characteristics, finally achieves a tertiary level degree. The decision to analyse the probability to be enrolled in higher education at a specific point in time rather than the final educational attainment was driven by the fact that I wanted to investigate the impact of labour market and educational funding conditions, for which I have detailed information only for the period covered by the data, namely 1984 to 1997. In order to analyse the determinants of the final educational attainment of older workers, I would have needed such information for an earlier period, that is, the one corresponding to the period in which they were likely to participate in education.

However, one has to be aware that this approach does not really make it possible to distinguish between the impact of the explanatory variables at the current time and at previous stages of the educational process. Instead, it should be understood as the cumulated impact of the considered variables on an individual educational career up to the observed point in time, with some variables exerting a stronger influence at earlier stages (possibly family background) and other variables affecting more strongly later educational decisions (possibly labour market considerations).

For the analysis, a model of utility maximisation inspired by that of Cameron and Heckman (1998) has been formulated. Let us suppose that any individual has the possibility of attending one of k educational tracks E_i, $i \in \{0...k\}$, of increasing levels. Let E_{i^*}, where $i^* \in \{0 \ldots k\}$, be the educational level that the individual would ideally like to attend. In practice, the desired level of education is not observable, only the actual decision of the individual[3] E_i, i.e. the educational level i actually attended. Of course, this decision relates to the desired E_{i^*}.

The individual is assumed to opt for the educational alternative which, given his endowment, personal characteristics and any other relevant factors, maximises his utility, the latter being defined in terms of expected net returns, i.e. the difference between expected returns and expected costs of attending each of the educational tracks E_i. Thus the optimal educational level attended by any individual with a given vector of characteristics x is given by

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[3] Or of the person really making the decision for the individual (e.g. the parents).

$$Max_{i\in\{0\ldots k\}} r(E_i / x) - c(E_i / x) \tag{7.1}$$

where r denotes the expected return and c the expected cost associated with the attendance of educational track E_i. It is assumed that both the returns and the costs are positive and increasing with the educational level. The cost and return functions are assumed to be of the following form:

$$r(E_i / x) = r(E_i)\varphi_r(x)\varepsilon_r$$
$$c(E_i / x) = c(E_i)\varphi_c(x)\varepsilon_c \tag{7.2}$$

where $\varphi_r(x)$ is a positive function defining the effects of the observed characteristics on the expected returns to education and ε_r is a random variable accounting for the effect of unobserved individual heterogeneity on the expected returns.[4] Similarly, $\varphi_r(x)$ is a positive function which defines the effects of the observed characteristics on the expected costs of education and ε_c is a positive random variable representing the impact of unobserved individual heterogeneity. Thus, the observed characteristics as well as the unobserved individual heterogeneity are allowed to affect the expected returns and the expected costs in different ways.[5] However, the personal shifters, φ_r, φ_c, ε_r and ε_c are assumed not to depend on the specific educational level. Without loss of generality, it is assumed that $E(\varepsilon_r) = E(\varepsilon_c) = 1$, i.e. unobserved heterogeneity has on average a neutral effect on the return as well as on the cost expectations.

The optimal educational decision E_{i^*} is such that the net return is maximised; the net return associated with E_{i^*} must be positive and at least as large as the net return at the closest lower education level E_{i^*-1} and at the next higher education level E_{i^*+1}:

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4 Due to the multiplicative structure of the model, $\varphi_r(x)>1$ (resp. <1) implies that the observed characteristics of an individual, taken together, increase (resp. decrease) the return expectations. Similarily, $\varepsilon_r>1$ (resp. <1) means that the unobserved individual characteristics increase (resp. decrease) the return expectations.

5 A high scholastic ability, for instance, which is a typical unobserved factor, might reduce the cost of educational investments, but might not increase the return to educational investments to the same extent, since the way in which the acquired knowledge is 'transformed' into wages depends on some other kind of ability.

$$r(E_{i^*})\varphi_r(x)\varepsilon_r - c(E_{i^*})\varphi_c(x)\varepsilon_c \geq 0$$

$$r(E_{i^*})\varphi_r(x)\varepsilon_r - c(E_{i^*})\varphi_c(x)\varepsilon_c \geq r(E_{i^*-1})\varphi_r(x)\varepsilon_r - c(E_{i^*-1})\varphi_c(x)\varepsilon_c \quad (7.3)$$

$$r(E_{i^*})\varphi_r(x)\varepsilon_r - c(E_{i^*})\varphi_c(x)\varepsilon_c \geq r(E_{i^*+1})\varphi_r(x)\varepsilon_r - c(E_{i^*+1})\varphi_c(x)\varepsilon_c$$

This is equivalent to:

$$\varphi_c(x)\varepsilon_c\left[r(E_{i^*}).\frac{\varphi_r(x)\varepsilon_r}{\varphi_c(x)\varepsilon_c} - c(E_{i^*})\right] \geq 0$$

$$\varphi_c(x)\varepsilon_c\left[r(E_{i^*}).\frac{\varphi_r(x)\varepsilon_r}{\varphi_c(x)\varepsilon_c} - c(E_{i^*})\right] \geq \varphi_c(x)\varepsilon_c\left[r(E_{i^*-1}).\frac{\varphi_r(x)\varepsilon_r}{\varphi_c(x)\varepsilon_c} - c(E_{i^*-1})\right] \quad (7.4)$$

$$\varphi_c(x)\varepsilon_c\left[r(E_{i^*}).\frac{\varphi_r(x)\varepsilon_r}{\varphi_c(x)\varepsilon_c} - c(E_{i^*})\right] \geq \varphi_c(x)\varepsilon_c\left[r(E_{i^*+1}).\frac{\varphi_r(x)\varepsilon_r}{\varphi_c(x)\varepsilon_c} - c(E_{i^*+1})\right]$$

Let us define $\varphi(x)=\frac{\varphi_r(x)}{\varphi_c(x)}$ and $\varepsilon=\frac{\varepsilon_r}{\varepsilon_c}$, where $\varphi(x)$ measures the net impact of observed characteristics x and ε the net effect of unobserved individual heterogeneity on the expected relation of returns to costs.

Since $\varepsilon_r > 0$ and $\varepsilon_c > 0$, $\varepsilon > 0$, $\varphi_r(x) > 0$ and $\varphi_c(x) > 0$, one obtains, after simplification,

$$r(E_{i^*})\varphi(x)\varepsilon - c(E_{i^*}) \geq 0$$

$$r(E_{i^*})\varphi(x)\varepsilon - c(E_{i^*}) \geq r(E_{i^*-1})\varphi(x)\varepsilon - c(E_{i^*-1}) \quad (7.5)$$

$$r(E_{i^*})\varphi(x)\varepsilon - c(E_{i^*}) \geq r(E_{i^*+1})\varphi(x)\varepsilon - c(E_{i^*+1})$$

or

$$\varepsilon \geq \frac{c(E_{i^*})}{r(E_{i^*})\varphi(x)} > 0 \quad (7.6)$$

$$\frac{c(E_{i^*}) - c(E_{i^*-1})}{r(E_{i^*}) - r(E_{i^*-1})}.\frac{1}{\varphi(x)} \leq \varepsilon \leq \frac{c(E_{i^*+1}) - c(E_{i^*})}{r(E_{i^*+1}) - r(E_{i^*})}.\frac{1}{\varphi(x)}$$

Thus, for any individual with observed characteristics x, the expected net return is positive at the optimum and the unobserved individual component is bounded by the expected ratios of marginal costs to marginal returns of attending E_{i^*} rather than E_{i^*-1}, for the lower

bound, and of attending E_{i^*+1} rather than E_{i^*}, for the upper bound, given characteristics x.

Consequently, the probability for an individual to choose E_i is given by

$$\text{Prob}(E_{i^*}=E_i/x) =$$

$$\text{Prob}\left[\frac{c(E_i)-c(E_{i-1})}{r(E_i)-r(E_{i-1})}\cdot\frac{1}{\varphi(x)}\leq\varepsilon\leq\frac{c(E_{i+1})-c(E_i)}{r(E_{i+1})-r(E_i)}\cdot\frac{1}{\varphi(x)}\right] \tag{7.7}$$

This means that the enrolment threshold for an individual with characteristics x for attending E_{i+1} rather than E_i with $i\in\{0...k-1\}$ is given by the expected ratio of marginal costs to marginal returns given x

$$\text{Enrolment threshold } (E_{i+1}) = \frac{c(E_{i+1})-c(E_i)}{r(E_{i+1})-r(E_i)}\cdot\frac{1}{\varphi(x)} \tag{7.8}$$

Thus, any change in the observed characteristics x may change educational attendance decisions depending on the extent to which it affects the expected ratio of marginal costs to marginal returns. For example, if a change in x results in higher expected costs of E_{i+1}, this raises the enrolment threshold to E_{i+1} and results in a lower probability of being enrolled in E_{i+1} and a higher probability of being enrolled in E_i. If conversely a change in x brings about higher returns for E_{i-1}, this raises the expected cost-to-return ratio from going from E_{i-1} to E_i given x and, hence, increases the probability to be enrolled in E_{i-1} rather than in E_i. Note that for the present analysis, it is not necessary to assess the actual costs and returns of each educational track, but rather to determine how the observed characteristics influence the expectations regarding the ratio of marginal costs to returns.

Taking the logarithm of the expression and assuming that $\ln\varepsilon$ is normally distributed with mean 0 and variance σ^2 and that $\varphi(x) = \exp[\beta x]$, we obtain

$$\text{Prob}(E_{i^*}=E_i/x) = \text{Prob}\left[\frac{\mu_i-\beta x}{\sigma}\leq\ln\varepsilon\leq\frac{\mu_{i+1}-\beta x}{\sigma}\right]$$

or

$$\text{Prob}(E_{i^*}=E_i/x) = \Phi\left(\frac{\mu_{i+1}-\beta x}{\sigma}\right)-\Phi\left(\frac{\mu_i-\beta x}{\sigma}\right), \tag{7.9}$$

where $\mu_{i+1}=\ln\left[\frac{c(E_{i+1})-c(E_i)}{r(E_{i+1})-r(E_i)}\right]$ and Φ is the standard normal cumulative distribution function.

This expression takes the familiar form of an ordered probit model, where μ_i are the cut values. The ordered probit model written above can only be identified up to some factor of proportionality. Since it is the ratio of the parameters to σ that matters, it is convenient to normalise σ to 1 (Maddala 1997, p. 23). The log-likelihood function for the individual's educational attendance decision is given by

$$L(E_i / x) = \sum_i I_{E_i} \log\left[\Phi(\mu_{i+1} - \beta x) - \Phi(\mu_i - \beta x)\right] , \tag{7.10}$$

where I_{E_i} is an indicator variable equal to 1 if the individual chooses the educational alternative E_i and 0 otherwise. The parameters β and the cut values μ_i can be estimated by maximising this log-likelihood function.

7.4 Data and definition of variables

For the purpose of the analysis, data from the *German Socio-Economic Panel* (GSOEP, waves 1984 to 1997) has been merged with regional data. The GSOEP is a longitudinal household survey conducted on an annual basis since 1984. It contains information on various socio-economic factors like education, employment and income. In addition to information collected annually, the data set also retrieves some retrospective information about social background or employment history. The regional data was collected from various annual editions of publications from the Federal Office for Statistics (Statistische Jahrbücher, Fachserien 11 and 14, Bildung im Zahlenspiegel) as well as from the Federal Ministry of Research and Education (Grund- und Strukturdaten).

7.4.1 Dependent variable

The sample retained for the analysis entails West German residents aged 21 to 26, the typical age span in which those individuals willing to pursue tertiary level studies do so[6] (see Figure A1 of the appendix). The young persons are assumed to face two opportunities: attending university (E_1), or not attending university (E_0). Since those persons having already finished tertiary level studies have been excluded from the sample, one can

[6] Different delimitations of the age span were tested but proved not to change the results significantly.

consider that people opting for E_1 have a higher level of educational attainment than people opting for E_0. People engaged in military or civil service have also been excluded from the sample. The educational decision has been restricted to two categories only, because some of the explanatory variables did not allow for a further differentiation (in particular the variables related to public financial support).

Therefore, the general model described in the previous section may be simplified in the following way. Equation (7.7) becomes

$$\text{Prob}(E_{i^*} = E_1/x) = \text{Prob} = \left[0 < \frac{c(E_1) - c(E_0)}{r(E_1) - r(E_0)} . \frac{1}{\varphi(x)} \leq \varepsilon\right] =$$

$$\text{Prob}\left[-\infty < \frac{\mu_1 - \beta x}{\sigma} \leq \ln \varepsilon\right] \qquad (7.7')$$

and equation (7.9) becomes, with σ normalised to 1,

$$\text{Prob}(E_{i^*} = E_1/x) = 1 - \Phi(\mu_1 - \beta x) \qquad (7.11)$$

Thus, the model can be estimated with the help of a binary probit where μ_1 is equal to minus the constant term.

7.4.2 Explanatory variables

The attendance decision is determined by a series of observed characteristics x influencing the cost and/or the return of choosing E_1. Remember that we do not need to identify whether the variables affect the cost or the return (or both), but to merely estimate the net effect of the variables on the expected ratio of marginal costs to marginal returns, which determines the probability of enrolment. Some descriptive statistics for the estimation sample are given in the appendix (Table A1).

- *Family background*

A first series of variables which might affect the probability of enrolment into higher education concerns the social background of the individuals. Indeed, the ratio of costs to returns, or at least the way people perceive it, is likely to be influenced by the social environment they grew up in and so are, consequently, also their educational decisions.

Unfortunately, the GSOEP contains no direct information on parental income. However, the possible impact of short-term financial con-

straints can be captured to some extent by a variable giving net other[7] household income in the previous year. Moreover, the GSOEP contains information on the economic situation of the father at the time when the person was 15 years old. This may be used as an indicator of the probable permanent income during childhood as well as of the social status, which might affect the expectations regarding costs and returns of education. Hence, a set of dummy variables has been constructed to describe the occupational status of the father: whether the father was a blue-collar worker (reference category[8]), a white-collar worker, a civil servant or self-employed.

Furthermore, the educational level of the parents is also likely to play a role, regardless of the occupational situation. That is why two variables for the level of education of the mother as well as of the father, measured in terms of years of schooling, were included in the analysis.

- *Labour market return expectations*

According to human capital theory, individuals are supposed to expect their educational investments to improve their labour earnings, or generally speaking, their labour market position. Therefore, the impact on educational decisions of variables reflecting the labour market return to be expected from education should be examined empirically. Indeed, differences – across individuals or across time – in the labour market outcome of education are assumed to have an impact on educational choices since they influence the expected benefit that might be obtained from the acquisition of further education.

Here, the analysis focuses on the effects of expected outcomes in terms of gross hourly wages, unemployment risk and labour force participation (part-time employment and non-employment). Also the impact of the local structure of employment, in particular the extent of self-employment and of public sector employment, on educational decisions will be examined. The estimation of these labour market expectations is based on the assumption that people observe the current labour market situation of 'comparable' persons of the previous generation – meaning persons with the same observed characteristics – and expect their own situation to become similar. This assumption seems

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7 That is, total net household income minus own net income in the previous year.

8 Unknown or missing occupation of the father was considered as also belonging to the reference category.

rather realistic when considering that the current labour market situation represents the best information potential students dispose of on the labour market situation that can be expected in the future. Moreover, some recent studies (Dominitz and Manski (1996) for the USA and Wolter (2000) for Switzerland) provide evidence that student expectations do not deviate significantly from the currently observable wage structure. Finally, for the purpose of the analysis, it is not essential whether those 'expectations' really correspond to what people expect to be their labour market outcome given a certain level of education, but rather whether these 'expectations' influence the perceived ratio of costs to returns and therefore educational attendance decisions.

One particular issue of interest is whether it is the absolute level (e.g. the level of unemployment or the level of wages) or rather the relative situation (e.g. a decrease in the unemployment risk or in the wage premium associated with the completion of tertiary level studies) that matters. In order to examine whether youths rather respond to expectations for their total life-cycle or to expectations concerning the first stage of their life-cycle, the labour market return expectations are also estimated only for the first stage of the vocational career, i.e. up to age 40.

The computation of these variables is done with the help of out-of-sample predictions[9], i.e. predictions for the sample that we are interested in – individuals aged 21 to 26 – based on estimates drawn from a second sample. As far as gross hourly wage[10] expectations are concerned, the procedure is the following. In a first step, a (log) wage equation is estimated on a secondary sample of 'older' people by using a function of age, age squared, gender, nationality, family background, region and year.[11] Interactions between age/age squared and gender were included to account for differing age–wage profiles between men

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[9] Alternatively, one could simply take the average wages, rates of unemployment, part-time employment and non-employment in the region or differentiated by gender. The procedure applied here is not really different, but has the advantage of making it possible to differentiate the averages according to a greater number of variables and thus to compute personal expectations depending on a certain number of characteristics. A similar approach was adopted by Wilson et al. (2000).

[10] Deflated with the consumer price index, like all other variables expressed in DM amounts.

[11] The choice of the explanatory variables is restricted by the necessity of using variables which are also available for the sample of young individuals. All other variables (like marital status, labour market experience) are captured by the error term, which implies that individuals are assumed to adopt an average behaviour regarding these variables.

and women. The estimated coefficients were then used to predict the expected income of the primary sample[12], given their personal characteristics, for each age between 19 and 55. The net present value[13] of these expected income streams was computed and used as an estimator of expected life-cycle income given some personal characteristics.

Furthermore, the same procedure was repeated separately for tertiary level graduates and for individuals having a lower qualification. We thus obtain differentiated expected wage trajectories in case the individual completes university education and in case he does not**.** The ratio of the expected life-cycle income of the higher educated to that of the lower educated provides an indicator of the return to tertiary level graduation in terms of wages. Note that for the sample of higher education graduates, the expected income flows are estimated from age 26 and not 19 as for the less qualified. This makes it possible to account for the different lengths of studies and for the opportunity cost associated with longer studies.

The expected income trajectories for different groups of individuals in the primary sample are depicted in Figure A2 and Figure A3 in the appendix. The predicted wage profiles show a concave shape. Completing tertiary level studies brings a wage premium, which widens with age (Figure A2a). Predicted hourly wages are higher for men than for women at all ages, but the differential increases with age (Figure A2b and A3a). They are also higher for the sub-group of young people who are enrolled in higher education as compared to those who are not, whether they graduate or not (Figure A2c and Figure A3b). In other words, individuals who are not enrolled in higher education would earn less than people who are enrolled even if they graduated. Conversely, individuals who are observed to be enrolled in higher education would earn more than those who are not enrolled even if they did not graduate. This suggests the presence of a sorting into higher education of individuals with characteristics[14] providing them the best earnings prospects.

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[12] Due to the log-linear functional form of the wage equation and by assuming that the residuals are normally distributed, the prediction is given by $\exp \hat{\beta}X + \frac{1}{2}\sigma^2$, where $\hat{\beta}$ is the vector of estimated coefficients, X the vector of explanatory variables and σ the standard error of the prediction (cf. Greene 1993, p. 60).

[13] A real discount rate of 3% was used. Further tests with alternative discount rates did not appear to change the results significantly.

[14] For instance family background.

A similar procedure is applied in order to compute measures for the expected labour market outcome in terms of employment prospects. First, the probability of experiencing unemployment expresses the extent to which the investment in education is risky in the sense that the wage premium associated with university graduation cannot be drawn in case the person is unemployed. The probability of being unemployed was estimated with the help of a simple probit model as a function of gender, nationality, family background, region and year on a sub-group of the secondary sample, namely those persons being either employed or unemployed.[15] The prediction applied on the primary sample gives a measure of the average unemployment risk to be expected by an individual given his personal characteristics in his working career.

Moreover, the reduction of the unemployment risk due to higher education can be seen as a return to education in itself. Here again, the estimations were also run separately for poorly and highly educated workers, and the ratio of the predicted unemployment risk in case of non-graduation to the unemployment risk in case of graduation provides an estimate of the return to tertiary level studies in terms of reduction in the unemployment risk. Figure A4a in the appendix shows that higher education reduces significantly the unemployment risk. Women have a higher probability of being unemployed than men (Figure A4a), and this is true both in the case with and without a higher education degree (Figure A4b). Young people enrolled in higher education appear to dispose of characteristics which predispose them to face a lower unemployment risk (Figure A4a), whether they graduate or not (Figure A4c), than those who are not enrolled. This confirms the presence of a streaming into higher education of persons with characteristics promising them the best employment prospects.

The extent of labour force participation may also affect educational decisions, since not participating in the labour market, whatever the reason, means abstaining from reaping the benefits of education in terms of wages. Thus, differences in educational decisions across individuals, e.g. between men and women, might be due to the fact that differences in labour force attachment are anticipated at the time educational decisions are made, which modifies the perception of the return to education. Therefore, some measures of part-time work and non-employment propensities were added. The probability of working

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[15] This sample definition, excluding persons who are out of work for some other reason (e.g. housekeeping), ensures that the estimated probability is close to the usual definition of the unemployment rate.

part-time was estimated by a probit model – using as explanatory variables gender, nationality, family background, region and year – on the sample of employed people in the secondary sample and the prediction applied to the primary sample. Identically, the probability of being out of work was estimated on the sample of those persons being either employed, unemployed or not-employed and a personal propensity to be out of work estimated for the primary sample. The relative propensities of weak labour force attachment depending on education were computed by estimating the propensities separately for the poorly and highly educated and building the ratio of the former to the latter.

The variables depicting the local structure of employment were built from the prediction of a probit model for the probability of being self-employed and of being employed in the public sector[16] depending on gender, nationality, family background, region and year. Indeed, the employment structure may modify the perception of the utility in the labour market of a tertiary level degree.[17]

- *Educational policy*

A further set of variables attempts to capture to some extent the effects of public policy variables, particularly those related to educational policy, as far as these might affect the cost-to-return ratio. First of all, the regression includes a variable for public expenditure on higher education per student. The decision to relate educational expenditure to the number of students is imposed by the necessity to avoid endogeneity problems, since total expenditure depends directly on the number of students. This variable, obtained from the official regional statistics, gives information on public financial involvement in the provision of education in the region, which might influence the perception of the

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[16] Also the impact of the sectoral distribution of employment (defined as employment in agriculture, industry and services) was explored, but since these variables proved systematically insignificant, they were eventually dropped from the regressions.

[17] A look at the correlation matrix of these labour market variables (available upon request) does not point to serious collinearity problems, except between the probability of non-employment and the probability of part-time employment. However, even in case of collinearity, the coefficient estimates are consistent. Only the standard errors are overestimated and the *t*-values underestimated. Since for these two variables, the *t*-values proved to be already above the critical 1% level of significance (see Table 7.1), they were both included in the regression. Omitting one of them would result in inconsistent estimates of the coefficient of the remaining variable (see Greene 1993, chapter 9.2.).

quality of education provided and the expectations regarding the future return to education accordingly. Also the regional average number of students by teacher in the previous year can be taken to capture to some extent the quality of educational provision, i.e. it is assumed to be an indicator of the internal efficiency of educational provision, since the larger the number of students per teacher, the lower the quality of education is expected to be.

Furthermore, the impact on student enrolments since the mid-eighties of measures of public financial support to students is worth being examined, because raising enrolment rates is the primary aim of such measures. Public financial support of education in Germany essentially takes place within the framework of the BAföG (Bundesausbildungsförderungsgesetz), introduced in 1971. Three variables were included in the model. First, the expected chance of being entitled to a BAföG grant/loan was approximated by estimating, using the GSOEP data, the probability for students to receive BAföG as a function of family background (in particular net household income in the previous year, parental education and occupational position), nationality, year and region. Secondly, the expected BAföG amount among the beneficiaries was estimated with the GSOEP data as a function of the same variables. Finally, the share of BAföG which takes the form of a repayable loan[18] is also included. Indeed, at the time BAföG was introduced, it was a mere subsidy, i.e. not repayable. However, from 1974 onwards an increasingly important part of the grant had to be reimbursed and in 1983, all of the BAföG had to be reimbursed. However, the system was reformed again and since 1990, half of the BAföG amount is a grant, half of it a repayable loan.

Also the regional environment may matter. For instance, demographic factors might put pressure on public finance, e.g. if the proportion of children in age of being enrolled in education is high compared to the total population. The effect of the wealth of the region, defined by the gross domestic product per head, might also highlight the extent to which the region is subject to financial constraints.

- *Further control variables*

Finally, some further control variables were included in order to reduce unobserved individual heterogeneity and control for sample composi-

[18] Repayable from the 5th year on after graduation and not submitted to interest payments unless the regular duration of studies is exceeded.

tion effects. Age and age squared are expected to account for the observed concave profile of participation in tertiary education (see Figure A1b). Dummy variables for gender and nationality were also added, as well as a linear time trend and its square.

7.5 Estimation results

Specification tests show that the social background variables explain the major part of the variation in enrolments in tertiary education (see the results of tests reported in Appendix Table A2). Indeed, the inclusion of the family background variables causes the *Pseudo* R^2 to rise strongly compared to a regression including the control variables only, and the likelihood ratio test performed between those two models shows that the family background variables proves extremely significant.

However, the addition of further variables for labour market return expectations and/or educational policy does improve the fit. The *Pseudo* R^2 value increases, though only slightly, with the inclusion of the labour market variables in addition to the family background and control variables, and the likelihood ratio test shows that these variables are jointly significant. Similarly, further addition of public policy variables improves the fit and these variables proved jointly significant.

Table 7.1 reports the estimation results. The coefficients reported should be interpreted in a qualitative way, since they do not express the effect of the variables on the enrolment probability itself, but rather on the latent utility index. The quantitative effect of selected explanatory variables on the enrolment probability itself will be computed and reported in the next section.

- *Effect of social background*

All family background variables have a significant coefficient at a 1% significance level. As expected, the educational attainment (measured in years of schooling) of the parents – both the mother and the father[19] –

[19] The father's schooling level seems somewhat less determining than that of the mother, but this might be due to the fact that part of the schooling effect is of an indirect nature and goes via the occupational attainment, for which no information is available for women while it is separately captured for men.

Table 7.1 Binary probit estimates with robust standard errors*

Explanatory variables	Coefficient	t-statistic**
Social background		
Schooling mother	0.205	9.79
Schooling father	0.131	5.47
Father white-collar	0.909	7.82
Father civil servant	0.720	4.65
Father self-employed	1.366	5.08
Net other household income last year/1000	0.144	6.20
Labour market expectations		
Expected hourly wage (net present value)	0.018	0.64
Expected hourly wage return (net present value)	2.155	2.77
Expected unemployment probability	3.448	2.61
Expected relative unemployment probability	0.224	3.79
Expected part-time employment probability	-2.509	-4.71
Expected relative part-time employment probability	-0.040	-0.40
Expected non-employment probability	-3.516	-3.17
Expected relative non-employment probability	0.002	0.28
Expected self-employment probability	-5.868	-3.03
Expected public employment probability	3.279	4.10
Educational policy		
Expenditure for higher education by student	0.001	0.03
Students-teacher ratio last year	0.025	2.29
Expected chance of receiving BAföG	3.994	8.53
Expected monthly BAföG amount	0.002	4.12
BAföG loan share	-0.010	-4.55
GDP per head/1000	-0.016	-3.55
Ratio of pupils/students to total population	0.345	0.27
Control variables		
Age	2.907	8.72
Age squared	-0.060	-8.25
Male	-1.325	-2.86
Foreign	0.894	4.19
Trend	0.046	1.19
Trend squared	0.001	0.14
Constant ($-\mu_1$)	-43.82	11.15
Log-likelihood	-3448.6	
Pseudo R^2	0.238	
Sample size	12,091	

* Dependent variable: 1 = enrolled in higher education, 0 = not enrolled in higher education.

** If $| t | > 1.96$ (resp. 2.58, 1.65), then the hypothesis that the coefficient is equal to zero is rejected at a significance level of 5% (resp. 1%, 10%).

seems to be significantly correlated with the enrolment probability of their children. Thus, children of more highly educated parents are more likely to attain tertiary level education. This might be due to the fact that their parents value more education and are, consequently, more likely to encourage them to pursue further studies. Thus, the perception of the return might be higher. Another reason could be that highly educated parents are in a better position to help their children in their schooling duties or are more likely to have children with a higher learning ability. A higher ability is expected to drive down the expected cost-to-return ratio, since it reduces the cost of acquiring education and might also help to take better advantage of the qualification acquired.

The occupational position of the father is also clearly related to the enrolment probability of the young persons. The coefficients reported should be interpreted in relation to the reference category, which consists of blue-collar fathers (or fathers for whom no information on occupational status is available, not known or missing). Hence, having a white-collar worker or a civil servant as a father instead of a blue-collar worker increases significantly the chances of being enrolled in higher education, even after parental education has been controlled for. The same holds for sons and daughters of self-employed. This may be the consequence of long-term financial constraints which, under the hypothesis of imperfect capital markets, incite children to start working at the first possible opportunity instead of continuing further studies.

Furthermore, net household income in the previous year has a positive effect on the enrolment probability, even though parental education and occupation have been controlled for. In other words, children in families experiencing financial difficulties have lower chances of reaching a high level of educational achievement. This points to the presence of short-term liquidity constraints binding participation in higher education and legitimates *a priori* policies of financial support to potential students of poorer family background.[20]

A test regression only including the family background variables in addition to the control variables[21] shows that adding variables for labour market return expectations and/or public policy seems to lower slightly the impact of parental education on educational decisions,

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[20] However, this argument has to be interpreted with caution since the presence of financial constraints does not necessarily imply *per se* that a policy of financial support to poorer families will prove efficient in inducing a stronger enrolment probability.

[21] Available upon request.

which means that omitting to do so results in overestimating the impact of parental education. This result confirms the one found by Goux and Maurin (1999) for France.

- *Effect of labour market expectations*

Labour market expectations appear to have a significant impact on enrolment decisions. Concerning wages and unemployment expectations, youths seem to respond more to the outcome of the next older generation than to life-cycle expectations, since the expectations of wages and unemployment up to the age of 40 proved to affect educational decisions more strongly and more significantly than the expectations for the whole working career. For these reasons, the variables depicting wage and unemployment related expectations up to age 40 were included. As far as labour force attachment (part-time work and non-employment propensities) and the extent of public and self-employment are concerned, the results do not differ significantly, whether expectations for the first stage or for the whole working career are considered. Therefore, the variables for the whole life-cycle were included.

The absolute wage that an individual can expect to earn might affect the probability of attending a tertiary level institution in different ways. First, the prospects of earning a higher hourly wage might increase the incentive to pursue further studies in order to benefit in the future from this high wage. On the other hand, a higher wage, especially among young people, implies higher opportunity costs for studying, which should decrease the incentive to pursue further studies. Therefore, the cost effect and the return effect go in opposite directions and the net effect of this variable on the expected cost-to-return ratio is *a priori* unclear. The estimation results show that the absolute level of the expected wage does not influence the probability of attending a tertiary level institution in any significant way. However, the expected wage return to education, i.e. the wage premium associated with the completion of higher education, which was expected to decrease the expected ratio of costs to returns via the return side, proves to have a significant and strong positive impact on higher education attendance. Thus, the results provide empirical support for the human capital theory.

As far as unemployment is concerned, the reverse pattern is observable: whereas the absolute level of the unemployment risk has a very strong impact on the probability to be engaged in higher education, the unemployment return of education, i.e. the reduction of the unem-

ployment risk due to a higher educational degree, has a much lower impact on attendance decisions. However, even though the effect is rather limited, the impact on enrolments of the unemployment return to tertiary education is highly significant. Beyond the obvious utility of further education with a view to diminishing one's unemployment risk in the future, one further reason for the strong effect of the unemployment risk variable might be that in times of high unemployment, especially high youth unemployment, remaining in the education system might be seen as a worthwhile alternative in the short run (a high unemployment risk means lower opportunity costs for studying). Thus, the cost effect and the return effect go in the same direction and both contribute to lowering the enrolment threshold, i.e. the expected marginal cost to marginal return ratio, and thus to favouring the enrolment decision.

As expected, since it affects the extent to which individuals are likely to take advantage of their education, the extent of labour force participation matters. Individuals with a higher risk of being employed only on a part-time basis, i.e. who face lower return expectations, are significantly less likely to be enrolled in higher education. Similarly, the prospects of being non-employed appear to have a strong negative influence on higher education enrolments. One further assumption we wanted to test empirically was the following: The more education contributes to reducing the probability of working part-time or to be out of work (i.e. affects positively the expected return), the greater should be the participation in higher education. If so, a significantly positive coefficient would have been expected for the variables depicting expected relative part-time and non-employment propensities. However, this assumption was not confirmed by the regression results, since the coefficients of these variables were not significantly different from zero.

The local structure of employment also affects enrolments. High prospects of becoming self-employed reduce educational participation in a very strong and significant way. A possible explanation for this may be that educational credentials could act as a signal of productivity in the eyes of employers and lose relevance if one is due to become self-employed. In other words, the return to education is lower for self-employed. Finally, the higher the probability of being employed in the public sector, e.g. because there is a tradition in the family to work in the public sector, the higher the participation in higher education. This may be due to the fact that wages are indexed on qualification in the public sector, and thus having a higher education level necessarily re-

sults in higher wages, and the wage return to be expected from education is highly reliable.

- *Effect of educational policy*

The estimates found for the public policy variables give an idea of the possible effectiveness of public policy in influencing enrolments into tertiary education, whilst controlling for the influence of other variables such as family background and return expectations. Rather surprisingly, the extent of public investment in tertiary education, measured as educational expenditure by student, proved insignificant. One explanation could be that this is too broad a measure of the intensity of educational efforts, since the total costs of education per student arise from many sources (e.g. subjects offered, real estate prices, etc.). Against the expectations, the impact of the students–teachers ratio in the previous year proved significantly positive. This is not consistent with the interpretation of a high students–teacher ratio as an indicator of poor quality of education. An alternative interpretation could be that a high students–teacher ratio signals a high popularity of universities in the region concerned which, in turn, might be seen by potential students as an indicator for a good quality of education being offered there.

Public financial support to students aims at reducing the cost of education in order to increase enrolments. The results show that the prospect of being entitled to BAföG seems to have a very strong positive influence on the probability of pursuing education. Also the amount granted by BAföG plays a role in higher education attendance decisions, though to a lesser extent. Thus, the higher the amount of BAföG that individuals can expect to get, the higher the probability that they are enrolled in education. Conversely, the BAföG loan share has a negative impact on enrolments: the larger the part of the BAföG to be reimbursed, the lower the probability to be enrolled in higher education. This negative coefficient is explainable by the fact that if BAföG has to be reimbursed after the end of the studies, this is expected to diminish the return to education in the future.

The regional GDP per head variable has a negative coefficient, implying that, all else being equal, living in a poorer region is associated with higher chances of participating in higher education. There is no evidence for effects of demographic pressure in the sense that the coefficient of the ratio of the population in the age of being enrolled to the total population proved insignificant.

- *Effect of control variables*

The coefficients of the age and age squared variables, highly significant, account for the concave pattern of participation in higher education. The trend terms proved insignificant.

Being a male, all else being equal, is associated with lower chances of being enrolled in tertiary education. Interestingly, further tests showed that adding labour market return expectation variables causes the sign of the gender variable to reverse: while it was positive in the absence of labour market expectation variables, it turns negative as soon as these are controlled for. This means that though women have, generally speaking, a lower probability of being enrolled in tertiary education, they tend to invest more than men in their education given their labour market prospects.

The same holds for foreigners: while a simple regression with the control variables only produces a negative coefficient for foreigners, suggesting that these have lower overall educational prospects, adding the variables for family background causes the coefficient to turn insignificant, and the addition of variables for labour market prospects and public policy causes it to turn positive and significant.

7.6 Simulation of changes in expected returns and educational policy

The coefficient estimates indicate the direction of the effects and their significance, but provide little information on the quantitative impact on the enrolment outcome of changes in the variables. However, the estimation results can be used to simulate the effect of changes in selected variables and assess their quantitative impact on the enrolment threshold and on the enrolment probability of a person with given observed characteristics. Changes in some variables will affect the expected ratio of marginal cost to marginal return of attending university. If the changes turn out to increase the expected ratio of costs to returns, this will reduce the probability of enrolment into higher education accordingly. If the changes lower the ratio of costs to returns, this will raise the probability of participation in higher education.

More formally, following equation (7.8), the enrolment threshold for attending education level E_1 rather than E_0 is given by the ratio of expected marginal cost to marginal return of attending university given

characteristics x, which can be recovered from the $\hat{\mu}_1$ and $\hat{\beta}$ coefficients drawn from the probit estimation

$$\text{Enrolment threshold } (E_1/x) = \frac{c(E_1)-c(E_0)}{r(E_1)-r(E_0)} \cdot \frac{1}{\varphi(x)} = \frac{\exp\left[\hat{\mu}_1\right]}{\exp\left[\hat{\beta}x\right]} = \exp\left[\hat{\mu}_1 - \hat{\beta}x\right] \tag{7.8'}$$

and the attendance probabilities are given by equation (7.11).

In Table 7.2, the effects of a 10% change in the labour market return expectations and in educational policy on the expected ratio of marginal cost to marginal return of enrolment and thus on the enrolment probability itself are simulated for an individual with average characteristics.

Table 7.2 Effect of a 10% increase in selected explanatory variables on the participation in higher education

	Enrolment threshold	Enrolment probability
Reference situation	4.14	7.78
Changes in labour market returns		
Expected hourly wage return	3.42	10.96
Expected unemployment probability	4.11	7.89
Expected part-time employment probability	4.33	7.16
Expected non-employment probability	4.42	6.85
Changes in educational policy		
Net other household income last year	3.97	8.38
Expected chance of receiving BAföG	3.60	9.99
Expected monthly BAföG amount	3.78	9.17
BAföG loan share	4.25	7.40

As can be seen, for an individual with average characteristics, the expected ratio of marginal cost to marginal return of enrolment into higher education amounts in the reference model to some 4.1% and the enrolment probability predicted by the model to about 7.8%.

- *Effect of changes in labour market return expectations*

If the expected hourly wage return, i.e. the ratio of the expected life-cycle wage for holders of a tertiary level degree to the expected wages

in the absence of such a degree, increases by 10%, this lowers the expected ratio of marginal cost to marginal return of enrolment into higher education by 0.7 points for an average individual while the enrolment probability accordingly increases by more than 3 percentage points. Also a 10% increase in the personal unemployment risk drives the higher education enrolment threshold down and causes the enrolment probability of an average person to rise accordingly.

Conversely, a rise of 10% in the propensity of an average person to work part-time induces a rise in the expected marginal cost to marginal return ratio and thus a lower probability to be enrolled in tertiary education. However, the effect on the enrolment probability of the propensity of being completely out of work is stronger, which is consistent with intuition.

- *Effect of changes in educational policy*

Let us imagine, for instance, that parents or any other household member were given an educational allowance to compensate for the foregone earnings of the potential student, which amounts to 10% of net other household income of the previous year. If everything else remained unchanged, this would lower the higher education enrolment threshold, but to a limited extent. As a result, the enrolment probability would increase only slightly.

If the coverage of BAföG grants/loans was extended so that the expected chance of an average individual of being entitled to BAföG increased by 10%, this would significantly lower the expected marginal cost to marginal return ratio and induce an increase in the enrolment probability by about 2.2 percentage points. An increase of 10% in the BAföG monthly amount that the average beneficiary may expect to receive also lowers the enrolment threshold and increases the enrolment probability, but to a somewhat lower extent than an extension of BAföG coverage. Therefore, at the same financial cost, extending BAföG coverage proves more efficient in increasing enrolments than increasing the average BAföG amount granted. Finally, raising by 10% the proportion of BAföG which has to be reimbursed induces a small increase in the expected ratio of marginal cost to marginal return, but the quantitative effect is rather small.

7.7 Conclusion

If the empirical evidence available so far has been rather unanimous in stating a positive correlation between social origin and educational achievement, very few studies analyse the role of economic incentives, in particular the influence of expectations regarding the labour market return of education and of educational policy on educational decisions, especially for Germany. This study has tried to provide a more comprehensive analysis of the determinants of participation in higher education in West Germany, by also modelling the impact of economic considerations.

The estimations are based on a model of utility maximisation, where the decision to attend one of several educational tracks of different level is determined by the expected ratio of marginal cost to marginal return for different enrolment alternatives, given some personal characteristics. The model is estimated empirically on the basis of data from the German Socio-Economic Panel as well as regional data. The analysis concentrates on the impact on the enrolment probability of social origin, expectations regarding the labour market outcome of higher education, and public educational policy. The results were quantified in a simulation exercise of the impact of changes in selected variables on the enrolment threshold and on the enrolment probability itself.

The results show that the probability of enrolment into higher education is strongly influenced by social origin. Parental education and occupational position, in particular, are essential. Thus, sons and daughters of blue collars have the lowest prospects of pursuing higher education. Moreover, there seems to be evidence of financial constraints binding participation in higher education, which *a priori* legitimates policies of financial support for education.

Even though family background seems to be the main determinant of participation in higher education, the enrolment probability also depends on labour market return expectations. Thus, this seems to accord with the human capital theory. The results are based on measures for expectations of the education-specific labour market outcome constructed by running out-of-sample predictions of life-cycle wages, unemployment risk and labour market participation, given some personal characteristics. The absolute level of the unemployment risk given observed characteristics appears to be a strong incentive to participate in higher education, more than the reduction of the unemployment risk

due to a higher educational degree. As far as wages are concerned, the expected return to education in terms of life-cycle wages affects significantly educational decisions, whereas the level of expected wages proves insignificant. A 10% change in the expected wage return to higher education was simulated and found to reduce significantly the expected ratio of costs to returns of an average person, i.e. his enrolment threshold, and to raise significantly the enrolment probability. A higher risk of being employed part-time and, especially, of being out of work proved to reduce the utility of higher education and thus the probability of being enrolled in higher education.

The results concerning the impact of public policy variables give an idea of the possible effectiveness of public policy in influencing enrolments into tertiary education. Whereas the overall level of public expenditure on each student engaged in tertiary education did not prove to have a significant impact, there seems to be evidence that policy measures more specifically directed to potential students do have an impact. In particular, the simulation using the estimation results shows that, at the same financial cost, extending the coverage of public financial support in the form of the BAföG is expected to be more efficient in increasing enrolments than increasing the amount of BAföG granted. The extent of the repayable part of the financial aid, conversely, has a dampening, though limited, influence on enrolments.

On the whole, the analysis suggests that even though social origin is a strong determinant of educational decisions, individuals do consider economic motives, in particular the labour market outcome they may expect of education, and that they respond to some extent to financial incentives such as policies of financial support for education in the form of BAföG. These results provide empirical support for the human capital theory.

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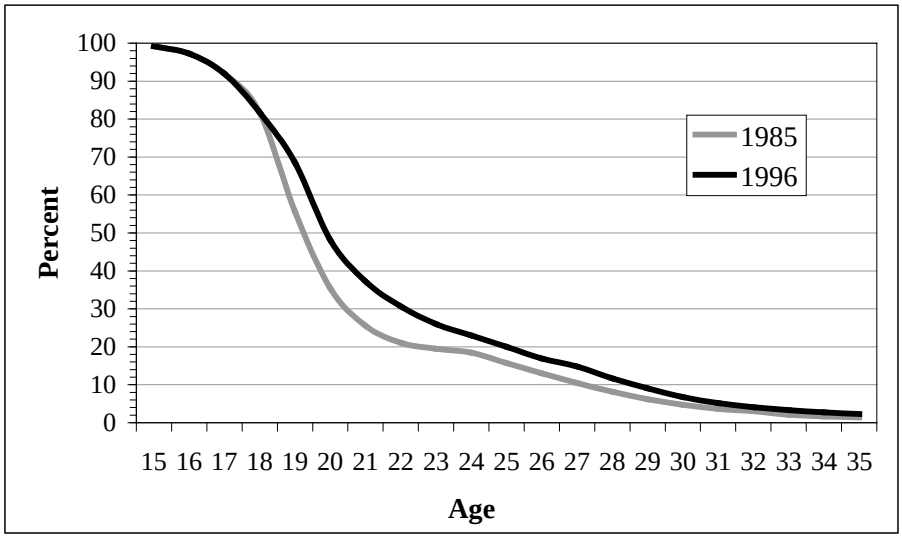
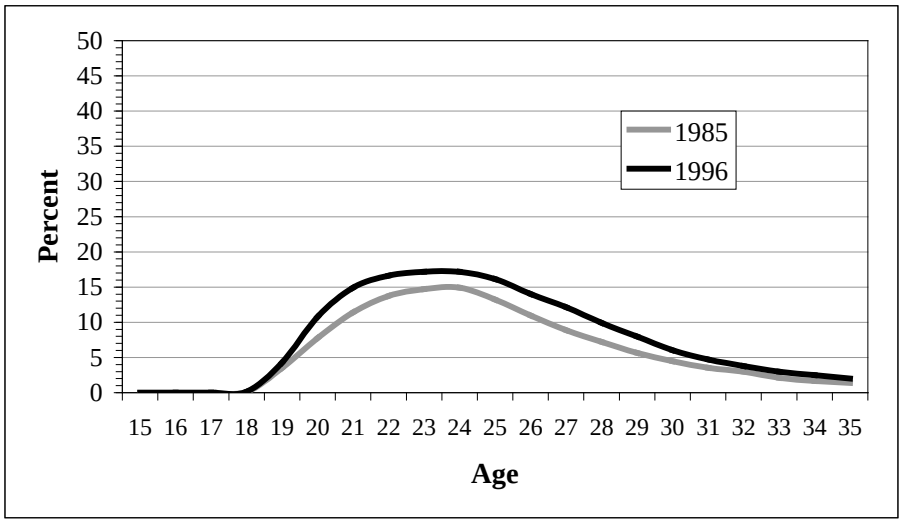
Appendix

Figure A1. Participation in education by age (% of individuals of same age)

a) total enrolments in education



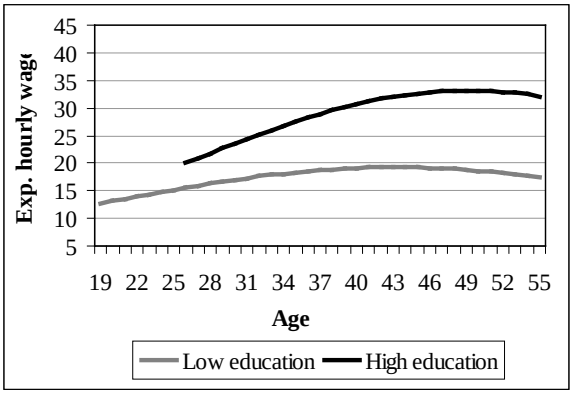
b) enrolments in tertiary education



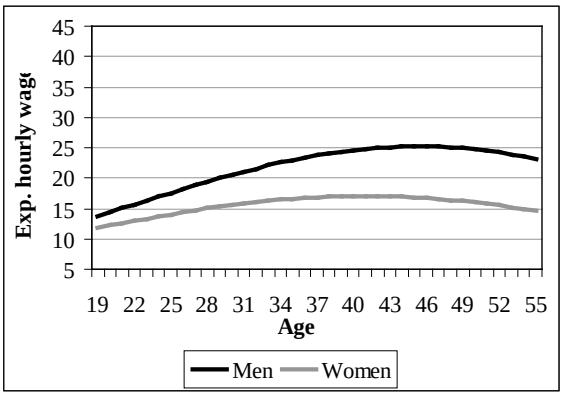
Source: Bildungsgesamtrechnung des IAB, BeitrAB 226 (2000).

Figure A2. Expected wage profiles (estimation sample)

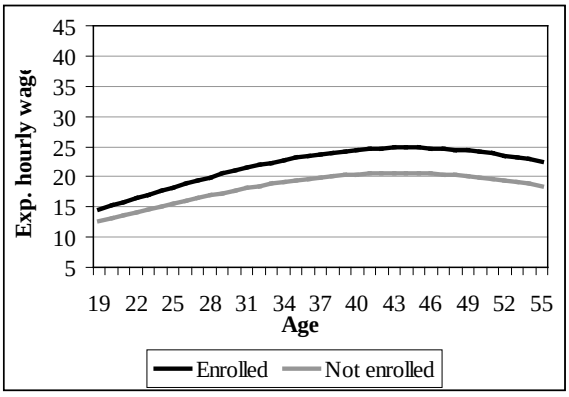
a) by education



b) by gender



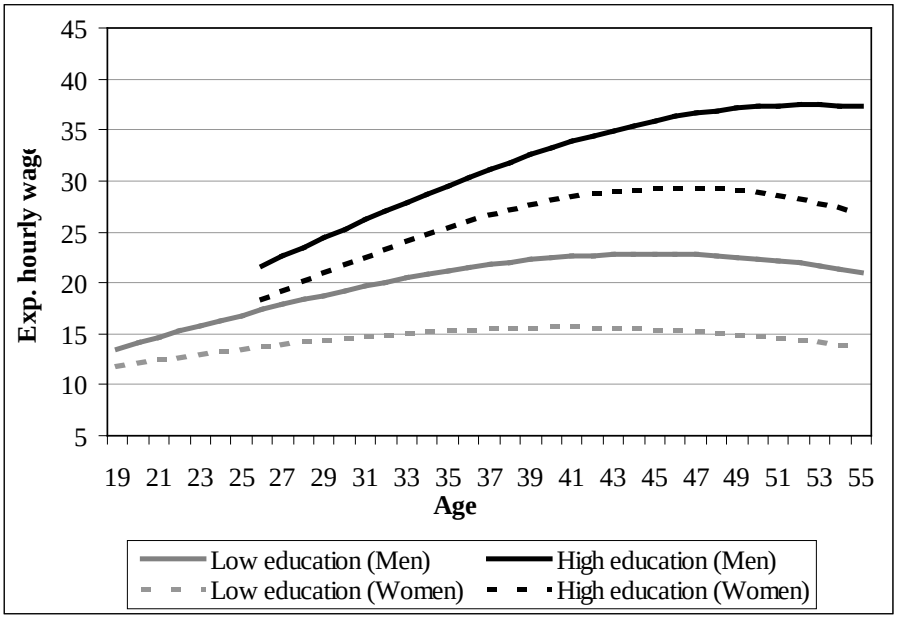
c) by enrolment decision



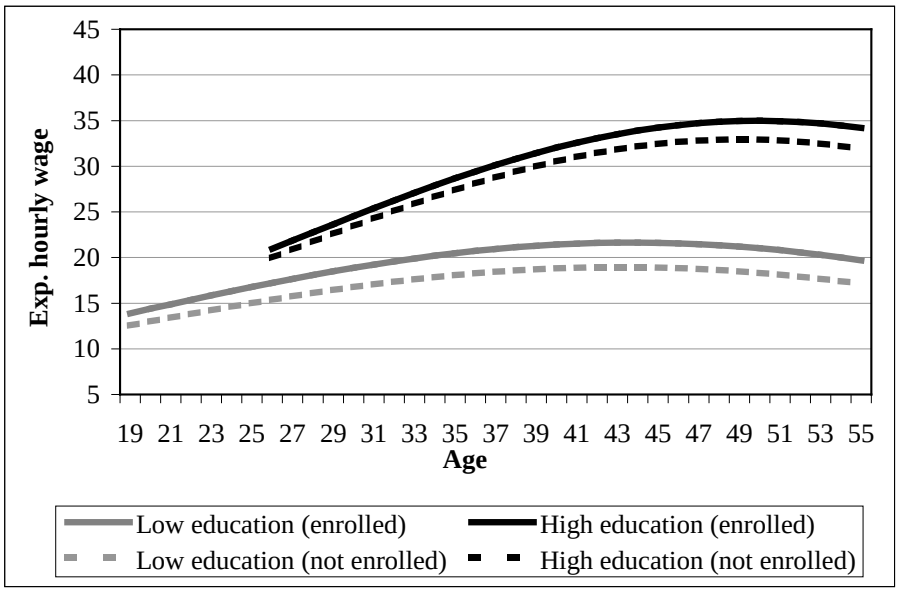
Source: GSOEP, own calculations.

Figure A3. Expected wage profiles by education (estimation sample)

a) by education and gender



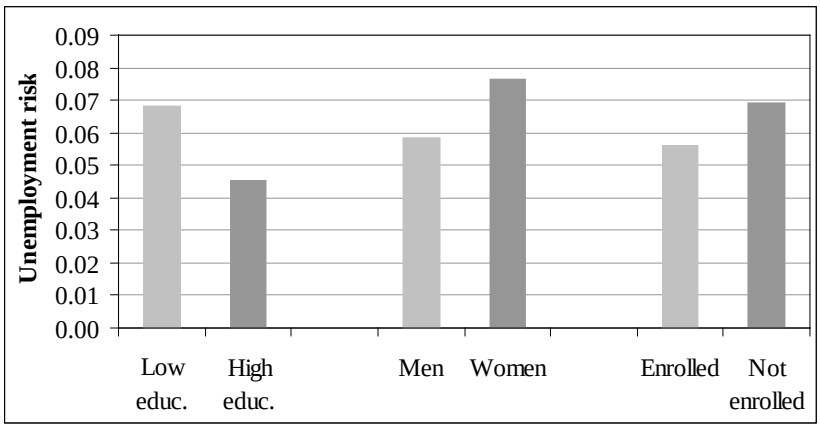
b) by education and enrolment decision



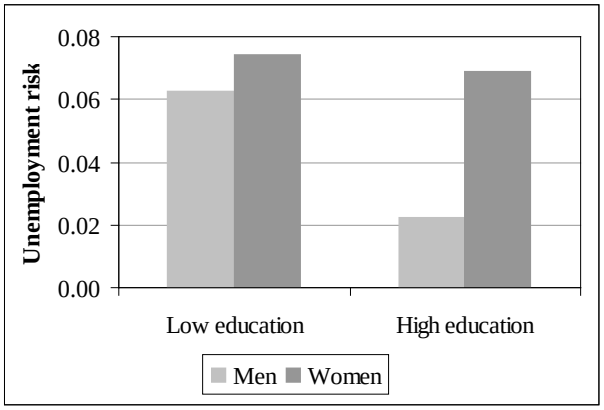
Source: GSOEP, own calculations.

Figure A4. Expected unemployment risk (estimation sample)

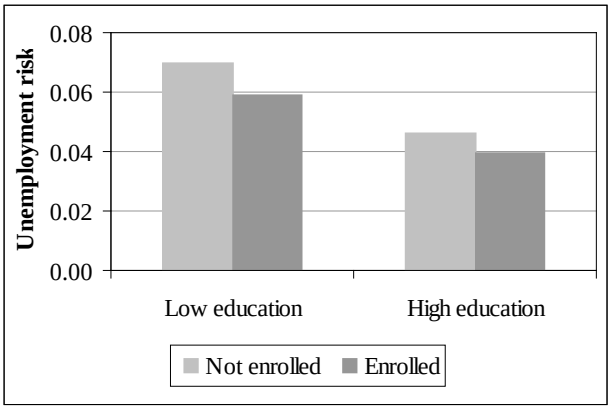
a) overall



b) by education and gender



c) by education and enrolment decision



Source: GSOEP, own calculations.

Table A1. Summary statistics

Variable	Mean (s.d.*)	Minimum	Maximum
Enrolled in higher education	0.133	0	1
Age	22.7 (1.7)	20	25
Age squared	516.2 (77.4)	400	625
Male	0.51	0	1
Foreign	0.11	0	1
Trend	7.3 (3.6)	2	14
Trend squared	66.5 (56.1)	4	196
Schooling mother	10.2 (1.7)	7	18
Schooling father	11.1 (2.3)	7	18
Father white-collar	0.22	0	1
Father civil servant	0.10	0	1
Father self-employed	0.14	0	1
Net other hh. income last year/1000	2.8 (2.3)	0	57.9
Expected hourly wage (net present value)	20.9 (4.8)	11.3	39.9
Expected hourly wage return (idem)	1.16 (0.11)	0.80	1.48
Expected unemployment probability	0.067 (0.03)	0.011	0.245
Exp. relative unemployment probability	2.3 (1.8)	0.9	14.4
Exp. part-time employment probability	0.192 (1.8)	0.001	0.558
Exp. relative part-time empl. probability	0.84 (0.50)	0.01	2.67
Expected non-employment probability	0.183 (0.15)	0.017	0.449
Exp. relative non-empl. probability	3.75 (4.97)	0.63	69.58
Expected self-employment probability	0.086 (0.05)	0.020	0.417
Exp. public employment probability	0.266 (0.09)	0.054	0.606
Expenditure higher education by student	17.57 (4.34)	11.71	39.75
Students-teacher ratio last year	14.39 (3.06)	5.97	22.00
Expected chance of receiving BAföG	0.34 (0.16)	0.00	0.78
Expected monthly BAföG amount	498.2 (79.3)	220.7	798.9
BAföG loan share	74.5 (23.7)	49.4	99
GDP per head/1000	34. 3 (5.62)	24.0	62.2
Ratio of pupils/ students to total population	0.17 (0.02)	0.06	0.21

* standard deviation

Tabel A2. Likelihood ratio tests: restricted against full model[a)]

		Variables included in full model[b)]			
		Control Fam. Background Labour market Public policy	Control Fam. back-ground Labour market	Control Fam. back-ground	Control
Variables included in restricted model	Control Fam. back-ground Labour market	188.38 (0.00)			
	Control Fam. back-ground	227.93 (0.00)	39.55 (0.00)		
	Control	1554.12 (0.00)	1365.74 (0.00)	1326.19 (0.00)	
Pseudo R^2		0.2376	0.2168	0.2124	0.0659

a) All the regressions are run on the same sample. The null hypothesis is that the variables omitted in the restricted model, but present in the unrestricted model, are jointly insignificant. In the table, the χ^2 values are reported and in parentheses the significance level at which the null hypothesis is rejected.

b) *Control variables*: age, age squared, gender, nationality, trend, trend squared.

Family background variables: schooling mother, schooling father, father white-collar, father civil servant, father self-employed, net other household income last year.

Labour market expectation variables: expected gross hourly wage, expected wage return, expected unemployment risk, expected unemployment return, expected part-time employment propensity, expected relative part-time employment propensity, expected non-employment propensity, expected relative non-employment propensity, expected self-employment propensity, expected public employment propensity.

Public policy variables: expenditure for higher education by student, students-teacher ratio last year, expected chance of receiving BAföG, expected monthly BAföG amount, BAföG loan share, GDP per head, ratio pupils/ students to total population.