Article

Education, cognitive skills and earnings in comparative perspective

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Abstract

This article investigates to what extent education is rewarded on the labour market because of the cognitive skills it indicates, using IALS data for the US, the UK, Germany and the Netherlands. By empirically distinguishing between general cognitive ability and work-specific cognitive ability, the article shows that the cognitive component of schooling is larger than anticipated by Bowles and Gintis. Instead of around 20 percent of the education effect being cognitive, the results indicate that between 32 and 63 percent of the education effect is cognitive, depending on the country and operationalization of cognitive skills. Moreover, it was shown that the relative importance of general vs work-specific cognitive abilities varies systematically between countries, with a larger fraction of the schooling effect being captured by the work-specific component in Germany and the Netherlands than in the US and the UK. This is explained by the different role of schooling between countries. Importantly, controlling for allocative processes related to the industry, organization and occupation of employment was particularly relevant in Germany, which supports the notion that this country is most credentialized.

Keywords

cognitive skills, earnings, education, human capital

Introduction

Schooling is an important determinant of labour market opportunities in many countries. The reason *why* education is so influential is, however, far from clear. Several mechanisms have been proposed to explain why people of higher levels of schooling have

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better labour market opportunities than people with lower levels of schooling. On the one extreme, human capital theory assumes that education provides individuals with productive skills, and employers are willing to reward productivity (Becker, 1962, 1976). On the other extreme, there are theories arguing that there is no productivity argument involved; education is just used as a legitimized means for social closure and exclusion (Collins, 1979). In between there are several theories proposing that education may not provide ready-to-use skills but indicates potential productivity or trainability on which applicants are screened (Arrow, 1973; Spence, 1973; Thurow, 1975).

Disputing the single-sided emphasis on productive skills of human capital theory, Bowles and Gintis (2000, 2002; Bowles et al., 2001) propose the alternative view that education gives an indication of whether potential employees match the employer's incentive-enhancing preferences; traits that 'assist in the exercise of the employer's authority' (Bowles and Gintis, 2000: 125). Examples of such traits are an inclination to truth telling, an orientation towards the future and identification with the organization's goals rather than with those of co-workers. Given that less than 20 percent of the schooling effect on earnings is cognitive, according to Bowles and Gintis, such incentive-enhancing preferences could potentially explain much of the remainder of the education effect. This conclusion on the size of the non-cognitive component of schooling stems from the comparison of two regression models predicting wages applied to a large number of empirical studies on the US: one with and one without a control for cognitive ability, with both including years of education. Because, on average, less than 20 percent of the education effect is reduced by including cognitive ability, the authors conclude that the remainder of the education effect is non-cognitive.

Although we are generally sympathetic to the claim that non-cognitive skills may play an important role for labour market outcomes, we maintain that it is essential to improve on the understanding of the role of cognitive skills first. Therefore, in this article we want to extend the explanation of the education effect by means of cognitive skills in two ways. First, although Bowles et al. (2001: 1157) conclude that 'it would be surprising if a general test of cognitive functioning were to alter significantly the conclusions of our survey', we argue that insufficient attention has been paid to a broader measurement of productivity-enhancing skills. Particularly because the human capital model assumes that skills learnt at school are complemented by skills acquired on the job, we should pay due attention to those cognitive qualities that are developed and mobilized at the workplace before we conclude that this approach has limited explanatory power. We therefore disagree with the idea that productivity-enhancing skills posited by human capital theory can adequately be measured by general cognitive ability alone.

Second, the works of Bowles and Gintis, as well as most of the studies they cite, pertain to data from the US, whereas we compare different countries. It is plausible that education functions in different ways in different countries (Carbonaro, 2006; Shavit and Müller, 1998), so the size and the form of the productive skills component of schooling may also vary across economically advanced countries. Educational achievement is less well linearly measured in many European countries than in the US. Whereas the unidimensional US system grants a reasonable measurement of educational achievement by years of education, many European countries have systems where a variety of numbers of years of schooling could lead to the same final level of schooling, and where a similar number of years of schooling could indicate strongly varying levels of educational attainment (Breen and Jonsson, 2000; Shavit and Müller, 1998). We argue, and our findings indicate, that human capital-type skills cannot be measured equally well on a linear scale in different countries, just as earlier research demonstrated with regard to educational attainment. More specifically, a simple general cognitive skills measure may take away more of the education effect in countries with a uni-dimensional educational system than in countries with a more differentiated educational structure.

In this article we elaborate on these two issues by expanding on the list of skills that we take into account, and by expanding the analysis to four countries that vary strongly in the kinds of skills that the educational system provides: the US, Britain, Germany and the Netherlands. This way we intend to answer the questions to what extent the effect of education is due to (a broad set of) productivity-enhancing skills related to schooling, and whether this differs across countries. We use data from the International Adult Literacy Survey (IALS) gathered in 1994.[1] This dataset has detailed cognitive tests, as well as measures on the cognitive skills used in the present occupation. Our main findings are that (1) general cognitive skills explain a larger part of the education effect than shown by Bowles and Gintis (2002) in all countries; (2) work-specific cognitive skills explain an additional fraction of the effect of schooling; and (3) general cognitive skills are a relatively important explanation for the education effect in the US and the UK, whereas work-related cognitive skills are relatively important in Germany and the Netherlands.

The claim that cognitive skills, once properly measured, explain more than is usually found has been made before (Green, 2001; Kerckhoff et al., 2001; Denny et al., 2004). Furthermore, we have found in the economic literature a few articles, often based on the IALS data, addressing the issue of cross-country variations in returns to education and to cognitive skills (Denny and Harmon, 2001; Denny et al., 2004; Leuven et al., 2004). However, unlike previous studies we focus on the extent to which different educational systems lead to differential contributions of general and work-specific cognitive skills to the explanation of the schooling effect. We show that educational systems differ in the extent to which they sort individuals on different types of cognitive skills, which in turn affects the level and shape of income returns to schooling in each country. The distinction between general and work-specific skills not only shows that cognitive skills are more important than earlier supposed, but also that their role varies across countries in line with what one would expect on the basis of the educational systems.

Theoretical background

Neoclassical economic theories and their sociological allies

The neoclassical model of the labour market is related to sociological approaches that have been labelled functionalist theory, technocratic theory, modernization theory, meritocratic theory and the liberal theory of industrialism. Both the neoclassical model and these sociological allies share the basic assumption that education indicates productivity relevant for labour market performance.

In the neoclassical model two variants exist. The first one, human capital theory, stresses that individuals acquire productive skills in school so that people invest in schooling in order to become more productive and get rewarded for it (Becker, 1976). The second variant sees education more as a positional good that indicates productivity in an indirect way. Some scholars from this perspective argue that although education does not generate ready-to-use skills, it makes people more easily trainable at the workplace, thereby reducing training costs (Thurow, 1975). Others argue that education is related to cognitive quality because education sorts on variations in intelligence prevalent before school enrolment. In other words, education is an easily observable attribute that is correlated to pre-existing variation in cognitive qualities, thereby enhancing education as a screening device that signals cognitive skills (Arrow, 1973; Spence, 1973). Although there are different views on the causality between education and productivity-enhancing skills, an essential aspect of all these approaches to education is that cognitive skills are the main reason why education is rewarded on the labour market.

The sociological allies, all from a functionalist stance, similarly assume that education indicates productivity through the cognitive skills associated with it. The basic argument of the functionalist approaches is that the increased complexity of the labour market requests that selection and allocation is based on educational attainment. This should have led to an increased impact of schooling on labour market outcomes because of the 'differential functional importance' of social positions and 'differential scarcity of personnel' for filling up those positions (Blau and Duncan, 1967; Davis and Moore, 1945: 243–4; Treiman, 1970). Thus, the interpretation of this perspective for an increased relevance of schooling for occupational attainment is grounded in the increased complexity of jobs, requiring high-level cognitive skills associated to schooling.

Critiques of the productive skills model of schooling

The explanation for the relevance of schooling of the functionalist and neoclassical models has met with a lot of opposition. The criticisms, which originate from various angles, mostly come down to the fact that this view about the role of schooling does not do justice to *allocative mechanisms* on the labour market. The fact that highly educated individuals are often allocated to high-earning jobs is, according to these criticisms, not (only) caused by the differential marginal productivity of workers of different skill levels, but by various other factors as well. First, Bourdieu's cultural reproduction theory holds that highly educated individuals have mastered acquaintance with the dominant cultural codes in society, which gives them an advantage on the labour market (Bourdieu and Passeron, 1999 [1977]). Because *social background* affects children's educational levels through the mechanism of class-differentiated attachment to the dominant culture, education effects may in fact reflect a reproduction of advantage in favour of people from higher social backgrounds. It should be noted that, in principle, what cultural capital comprises is arbitrary, as long as it shows affinity with the dominant culture in society. This arbitrariness puts cultural capital obviously at a long distance from an explanation the schooling effect that refers to productive skills.

A second (related) perspective that puts allocative mechanisms central to the explanation for the education effect on the labour market is credentialism theory (Brown, 1995;

Collins, 1974, 1979). Rather than informing employers on productivity, educational qualifications (credentials) are used as a legitimized means for social exclusion and inclusion. The educational system provides formalized credentials that give access to 'political labour', which is not aimed at production but at the distribution of resources within organizations. Access to a large number of advantaged occupations is regulated through formal qualification requirements. Collins (1979) is very explicit on the non-productive element of schooling, and rejects the 'technocratic' (human capital) model of schooling for that reason. Central to the credentialism theory is that education effects on earnings are mainly manifested through the regulated access to *occupations*. Thus, in analysing the impact of education on earnings, the credentialism perspective argues that we should also include the allocation to different occupations in the model.

A third domain where criticism towards the productive skills model has been forwarded is the structural stratification literature, which shares some basic assumptions with segmented labour market theory. Both structural stratification researchers and segmented labour market theorists argue that allocation to jobs is not solely explained by human capital theory. There are segments of the labour market where well-paying jobs are situated, and where returns to education are higher than elsewhere. These *structural positions* are held to vary between primary and secondary segments, between industries, or organizations of different size (Beck et al., 1978; Carroll and Mayer, 1986; DiPrete and Grusky, 1990; Doeringer and Piore, 1971; Kalleberg and Berg, 1994; Kalleberg and Van Buren, 1996; Stinchcombe, 1979).

Also, Bowles and Gintis (2000, 2002) deny that education is mainly indicating the kind of productive skills posited by human capital theory. According to their work, the correspondence of school-based culture and future life is the reason why education pays off on the labour market. Comparing wage equations found in the literature with education as a regressor, and education and cognitive skills as regressors in a second model, Bowles and Gintis conclude that around 82 percent of the education effect is non-cognitive.

Cognitive and non-cognitive components of schooling: An elaboration

Bowles et al. (2001) estimate that cognitive functioning explains between 16 and 18 percent[2] of the wage premium associated with schooling. Hence, they claim, human capital accounts for only a small portion of returns to education and that non-cognitive skills should be given more attention. Three observations are in order. First, their residual interpretation provides weak evidence for the non-cognitive skill effects of education, because no other explanations are eliminated from consideration, for instance those based on structuralist sociological models that challenge skills-based explanations. Second, Bowles et al. (2001: 1140) tend to restrict the notion of human capital to general cognitive ability. Third, the meta-analysis that supports their conclusion is based on rather poor measures of general cognitive ability. A substantial fraction (two-fifths) of the cases in their meta-analysis is based, as they explicitly recognize, on a very short and simple test that captures almost exclusively IQ.[3] However, skills relevant as human capital are not restricted to IQ. It is not surprising, then, that they come to the conclusion that human capital does not matter much. If we define and measure human capital poorly, it will score poorly as a determinant of earnings.

We expand on the distinction between cognitive and non-cognitive components of schooling in three ways. First, we believe that a more elaborated notion of what counts as human capital is needed. In particular we need to distinguish between two components of cognitive skills. General cognitive ability (GCA) refers to information-processing skills that can increase the trainability and productivity of workers. These are general and abstract abilities that can be used in a wide range of domains, including the workplace. However, precisely because of their general nature, they only represent a stock of skills that *potentially* can be developed and converted into job-relevant skills. Measures confined to GCA do not tell us if, and to what extent, this process of 'human capital conversion' actually occurs. Individuals possess a wide array of reading, analytic, reasoning and communication skills, and they develop them to a different degree: some of these skills may be completely irrelevant for some jobs, and among the ones where they matter, some skills may matter more than others. If some workers have developed the 'wrong' skills, measures of GCA alone will score poorly. This does not mean that human capital does not matter: it simply means that there is a skill mismatch. Then, we need to assess whether these cognitive skills are really relevant in the work domain. We want to know whether individuals possess *and use* the cognitive skills that are supposed to be relevant for their occupational performance. Therefore, information on GCA needs to be complemented with information on work-specific cognitive ability (WCA).

We should also stress that skills that are rewarded on the labour market are not necessarily cognitive in nature, as sociologists have long advocated (Duncan et al., 1972; Jencks, 1972). For instance, a mason may have good construction skills. Hence, our focus on general and work-specific *cognitive* abilities does not pay full tribute to the skills that are rewarded for reasons explained by human capital theory. Our results about the cognitive component of schooling can then be seen as a lower-bound estimate of the tenability of the neoclassical and functionalist model of education.

At the same time, a first advancement of our study is that our analysis is one of the few attempts to include a measurement for both general and work-specific cognitive skills (cf. Carbonaro, 2006, 2007). A second advancement of our study is that we try to control as much as possible for selection processes in our empirical models, in order to be more confident about the productive skills component of schooling. Of course, this is a difficult task, as the list of potential confounders is not short. However, we believe that to do justice to the empirically grounded criticisms of human capital theory mentioned earlier, we need to control as much as possible for allocative processes that may 'interfere' with the human capital interpretation of schooling. Therefore, we control for parental background (to control for allocation on the basis of cultural capital), occupational status (to control for credentialism), firm size and industry (both to control for structural factors deviating from the human capital model). Certainly because our elaboration of the measurement of productive skills relies on survey questions asking about the *usage* (rather than possession) of various types of cognitive skill, it is essential to control for allocative mechanisms that could affect the likelihood that some people use more cognitive skills than others, even if they possess the same amount.

A third relevant extension is to examine cross-national variation in the cognitive and non-cognitive components of schooling. Bowles and Gintis's estimate of 82–84 percent of the education effect being non-cognitive is based on a meta-analysis of a large number of American empirical studies. It is likely that countries differ in the reasons why education pays off. In some countries, education may function more according to human capital theory with its strong emphasis on productive skills, than in other countries. Likewise, it is likely that countries differ in the extent to which education functions as a means to reward on the basis of non-cognitive qualities, for example in the form of credentialism, cultural capital, or structural location. Therefore, the value of social mechanisms explaining the education effect should be understood as conditional upon the structural-institutional setting in which employers and employees act.

Hypotheses

It is a well-established empirical finding that, even controlling for standard sociodemographic variables and information on occupational position, education and cognitive ability covary systematically (Farkas, 1996; OECD, 2000). However, we expect that education also affects work-specific cognitive ability. As far as students progress in the educational system, curricular specificity increases systematically. In some countries, such as the Netherlands, educational specialization begins already in lower secondary education, in many other countries only the upper secondary level is differentiated into tracks or streams, while everywhere university education is organized in fields of study. This means that more educated people possess not only higher general cognitive skills but also *specialized* knowledge and cognitive skills that may be relevant for their future job tasks. For instance, a university graduate in economics has an ability to understand, analyse and use budgets, economic projections, etc. This leads to *hypothesis 1*: work-specific cognitive skills further explain the effect of education on earnings, in addition to general cognitive skills.

Our distinction between different sorts of productive skills (general and work-specific) is an important start for studying cross-national variations. One important aspect in which countries vary, which has a large impact on the association between schooling and work, is the educational system. In particular the extent and nature of vocational education is relevant (Shavit and Müller, 1998). A vocationally oriented schooling system is characterized by having multiple tracks within educational levels, some of which are vocationally specific, and others more generally or academically oriented. This means that graduates from different educational qualifications do not always vary in the amount of schooling, but will do in the kinds of skills obtained. In countries with less vocationally oriented schooling (such as the US, and to a lesser extent the UK), educational qualifications are mainly indicative of the amount of general human capital school leavers have, whereas in vocationally oriented schooling systems (e.g. Germany, and to a lesser extent the Netherlands) qualifications also signal the vocational relevance of skills. Therefore, in Germany and in the Netherlands the overall amount of schooling is less strictly associated to general cognitive skills. Indeed, previous studies (OECD, 2000; Park and Kyiei, 2007) indicate that these two countries exhibit considerably smaller associations between cognitive skills and schooling than the US and the UK. Thus, we can expect that the reduction of the education effect after controlling for general cognitive ability will be stronger in the USA and the UK in comparison to Germany and the Netherlands, because both the association between amount of schooling and general cognitive ability, as well as between the latter and earnings, is stronger (*hypothesis 2*). On the other hand, the reduction in the education effect after controlling for work-specific cognitive skills is expected to be relatively strong in Germany and the Netherlands, because employers reward education because of the work-specific skills that are acquired in school (*hypothesis 3*).[4]

Data, variables and statistical models

To test the magnitude of the productive skills component of schooling on the labour market in the UK, the US, Germany and the Netherlands, we make use of the International Adult Literacy Survey (IALS). IALS is a large-scale comparative survey realized under the auspices of OECD and coordinated by the Canadian statistical office that involved representative samples of civilian, non-institutionalized population aged 16–65 of 21 industrialized countries between 1994 and 1998 (NCES, 1998).

The main focus of the IALS survey is literacy, defined as 'using printed and written information to function in society, to achieve one's goals and to develop one's knowledge and potential'. Based on item-response theory, three domains of literacy were tested on respondents: prose literacy, document literacy and quantitative literacy. We combined the underlying items into one scale of literacy, which we use as our measurement of general cognitive skills.[5]

Our statistical models include also three variables aimed at measuring, albeit indirectly, work-specific cognitive abilities. Respondents were asked how often they mobilized their cognitive skills at work in activities such as writing reports, reading budget tables, using foreign language texts, etc. (every day, a few times a week, once a week, less than once a week, rarely, or never).[6] Factor analysis was used to derive three scales from 13 items referring to three dimensions: linguistic skills, financial skills and skills that are technical in nature.[7]

Schooling of respondents is expressed as the number of years of formal schooling completed by respondents (not counting repeated years at the same level). We prefer a linear measurement of schooling to a set of dummy variables for qualifications attained, because it allows a direct comparison of our results with those of Bowles and Gintis, and because the interpretation of results is more straightforward with one single continuous measure. With regard to parental schooling level, we apply the dominance criterion that selects the highest school degree among the mother and the father. For reasons of cross-national comparability we use an aggregated version of the ISCED with only three categories for parental education (primary or lower secondary, upper secondary and tertiary education).

Gross personal income from wages, salary, or self-employment is available in quintiles of the national income distribution. In order to control for working time, our models include a variable referring to the number of working hours per year.[8]

Gender, age, parental education and country of birth are introduced as control variables. The squared term for age is also included.

As our conclusions remain unchanged no matter if we include or exclude self-employed and agricultural workers, we present results that include them in order to increase sample size and to rely on more robust estimates. We include only people aged 25 or older.

Given the nature of our dependent variable, it is undesirable to use ordinary least squares (OLS) regression. Interval regression, a generalization of censored normal regression, represents the best solution in this context. This statistical technique assumes that the observed discrete response variable is derived from a continuous unobserved variable. Assumptions concerning the distributional properties of the unobserved variable and error terms are very similar to assumptions of standard OLS. It should be noted that our interval regression estimator produces more consistent estimates than OLS regression using mid-points of the wage bands (Stewart, 1983). Moreover, this technique does not require the strong assumptions of ordinal logistic regression (i.e. the proportional odds assumption). Furthermore, it is a linear technique that allows for causal decomposition of the effects of covariates, just as in OLS-based path analyses.

Results

Our starting model estimates the total effect of education, controlling for sociodemographic variables. We can see from Table 1 that in all countries education exerts a strong effect on earnings. For instance, in the US one year of education ensures a wage return of 2.42 percentiles. This means that eight years of schooling 'move up' an individual by almost one quintile in the income distribution (2.42*8 = 19.4). In accordance with other research, the wage returns to education are strongest in the US, closely followed by the UK, while they appear considerably lower in Germany and in the Netherlands (Devroye and Freeman, 2001; Harmon et al., 2003). This is in line with the previous observation that years of education is a poorer measurement of educational attainment in stratified educational systems (such as Germany and the Netherlands) than in countries with a more hierarchical system like the USA and to a lesser extent the UK (Leuven et al., 2004).

As for the other parameters reported in Table 1, they refer to control variables, therefore we do not comment on them extensively. Gender has the expected negative effect on earnings, also controlling for level of education and working hours. This latter variable has a predictable positive effect. Table 1 also indicates that work income increases with age at a decreasing rate and that parental education has a relatively weak, positive impact on income, at least in the US and in the Netherlands, once we control for respondents' education. Country of birth only affects earnings in Germany.

Table 2 describes the results of two subsequent models for each country. The first one adds to the previous model the average score in the IALS literacy tests, i.e. our measure of general cognitive ability. The second model includes also the three measures of work-specific cognitive abilities. Both kinds of measures are based on normalized variables.

Our relevant finding is that, if we compare the effect of education on earnings in Tables 1 and 2, we can conclude that it is explained away to a relevant extent by our two measures of productivity-enhancing (cognitive) skills. Namely, including only our measure of general cognitive skills results in a reduction of the effect of education of 36.6 percent in the UK, of 34.4 percent in the US, of 24 percent in Germany and of 33.4 percent in the Netherlands. The IALS literacy scales are particularly valuable for our purposes because they are not intended to measure merely IQ, abstract reasoning, or any other ability specifically valued at school, rather they are explicitly designed to capture literacy skills *applicable* in daily life.

Table 1. The relationship between schooling and earnings in the UK, US, Germany and the Netherlands

	Model 1			
	UK	US	Germany	Netherlands
Gender (female)	−13.447 (11.16)**	−9.707 (8.75)**	−12.514 (7.64)**	−13.535 (10.18)**
Age	2.220 (5.20)**	2.105 (4.78)**	0.289 (0.44)	2.160 (4.40)**
Age squared	−0.026 (5.13)**	−0.021 (4.12)**	−0.001 (0.15)	−0.020 (3.42)**
Immigrant status	−1.126 (0.49)	−2.377 (1.62)	−6.757 (2.52)*	0.735 (0.31)
Parental education: upper secondary	−1.576 (0.72)	5.021 (3.79)**	−1.909 (0.74)	1.937 (1.55)
Parental education: tertiary	0.512 (0.31)	5.051 (3.16)**	−4.974 (1.61)	5.627 (3.68)**
Years of schooling	2.360 (12.65)**	2.418 (13.56)**	1.552 (6.62)**	0.990 (8.18)**
Working hours	0.016 (16.69)**	0.013 (12.49)**	0.017 (13.09)**	0.012 (11.36)**
McKelvey and Zavoina R^2	.47	.41	.42	.43
N	1788	1343	732	1489

Notes: Reference categories: gender: male; immigrant status: native; parental education: primary or lower secondary. Robust z statistics in parentheses. * = significant at 5 percent; ** = significant at 1 percent.

Table 2 also indicates, however, that general cognitive ability does not tell the whole human capital story. Indeed, if we add also the information on work-specific cognitive skills, the reduction of the education effect amounts respectively to 62.8 percent, 50.8 percent, 53.1 percent and 63.1 percent for the UK, US, Germany and the Netherlands. Hence, after adding indicators of these different dimensions of productivity-enhancing skills, the effect of schooling is at least halved (as in the US) and at most reduced by around two-thirds (as in the UK). Although it still remains significant, the education effect is now of moderate size. Thus, our support for the cognitive skills explanation of schooling is much stronger than anticipated by Bowles and Gintis, albeit using different measures of cognitive abilities. Yet, a substantial fraction of the education effect remains unexplained by our extensive list of cognitive qualities.

In Table 3 the results are displayed of similar models as in Tables 1 and 2, but now with an extensive control for selection and allocation variables that could affect the usage of cognitive qualities. In other words, we try to incorporate the above-discussed theoretical arguments implying that economic rewards inhere not only to skills but also to structural positions in the labour market. These variables are organizational size, industry, occupational status, supervisory status and self-employment.[9] Similar to our models excluding these structural variables, general cognitive ability explains the education effect substantially (between 23 and 32 percent). The extension of the model by

Table 2. The relationship between schooling, cognitive skills and earnings in the UK, US, Germany and the Netherlands

	UK		US		Germany		Netherlands	
	Model 2	Model 3	Model 2	Model 3	Model 2	Model 3	Model 2	Model 3
Gender (female)	−12.113	−12.160	−10.332	−11.200	−12.214	−11.957	−13.896	−13.658
	(10.38)**	(11.09)**	(9.48)**	(9.95)**	(7.57)**	(7.46)**	(10.53)**	(10.77)**
Age	1.836	1.671	1.978	2.059	0.317	0.183	2.045	2.035
	(4.39)**	(4.22)**	(4.63)**	(4.91)**	(0.48)	(0.29)	(4.21)**	(4.40)**
Age squared	−0.020	−0.018	−0.019	−0.020	−0.001	0.001	−0.018	−0.018
	(4.14)**	(3.95)**	(3.90)**	(4.20)**	(0.11)	(0.08)	(3.07)**	(3.30)**
Immigrant status	1.972	1.337	2.561	3.606	−3.284	−1.236	2.904	2.412
	(0.90)	(0.66)	(1.65)	(2.38)*	(1.17)	(0.45)	(1.29)	(1.20)
Parental education: upper secondary	−3.429	−3.027	2.253	1.870	−2.312	−3.449	1.101	−0.174
	(1.62)	(1.57)	(1.71)	(1.46)	(0.90)	(1.36)	(0.89)	(0.14)
Parental education: tertiary	−1.390	−1.086	2.774	2.296	−6.170	−6.002	4.421	3.124
	(0.85)	(0.70)	(1.79)	(1.54)	(1.99)*	(1.95)	(2.90)**	(2.17)*
Years of schooling	1.496	0.877	1.585	1.189	1.180	0.728	0.659	0.365
	(7.60)**	(4.69)**	(7.66)**	(5.75)**	(4.83)**	(3.01)**	(5.17)**	(2.99)**
Working hours	0.015	0.013	0.012	0.011	0.017	0.015	0.012	0.010
	(17.15)**	(14.18)**	(11.64)**	(10.61)**	(13.47)**	(11.78)**	(11.10)**	(9.43)**
General cognitive skills	7.502	4.586	6.652	5.433	4.315	3.497	4.260	2.256
	(11.08)**	(6.89)**	(8.37)**	(6.56)**	(5.28)**	(4.42)**	(7.07)**	(3.65)**
Work-specific linguistic skills		8.426		5.355		5.612		5.947
		(15.59)**		(8.55)**		(7.67)**		(10.50)**
Work-specific financial skills		2.312		−0.023		2.462		2.422
		(5.00)**		(0.05)		(3.25)**		(4.72)**
Work-specific manual skills		1.503		0.309		0.551		0.326
		(3.29)**		(0.60)		(0.76)		(0.65)
McKelvey and Zavoina R^2	.51	.58	.44	.48	.45	.49	.45	.50
N	1788	1788	1343	1343	732	732	1489	1489
Reduction in education effect relative to model 1 (%)	36.6	62.8	34.4	50.8	24.0	53.1	33.4	63.1

Notes: Reference categories: gender: male; immigrant status: native; parental education: primary or lower secondary. Robust z statistics in parentheses. * = significant at 5 percent; ** = significant at 1 percent.

Table 3. The relationship between schooling, cognitive skills and earnings (*controlling for selection processes*) in the UK, US, Germany and the Netherlands

Variable	Country											
	UK			US			Germany			Netherlands		
	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6
Gender (female)	−13.540 (12.14)**	−12.712 (11.44)**	−12.015 (10.90)**	−9.800 (8.78)**	−10.028 (9.13)**	−10.393 (9.22)**	−12.651 (7.29)**	−12.451 (7.20)**	−11.976 (6.79)**	−14.670 (11.01)**	−14.669 (11.07)**	−13.958 (10.76)**
Age	1.921 (4.70)**	1.763 (4.36)**	1.730 (4.35)**	1.964 (4.74)**	1.829 (4.50)**	1.894 (4.62)**	−0.196 (0.30)	−0.128 (0.20)	−0.111 (0.17)	1.915 (4.06)**	1.827 (3.88)**	1.874 (4.09)**
Age squared	−0.022 (4.50)**	−0.019 (4.03)**	−0.019 (3.96)**	−0.019 (4.07)**	−0.017 (3.77)**	−0.018 (3.90)**	0.005 (0.60)	0.004 (0.55)	0.004 (0.51)	−0.018 (3.18)**	−0.016 (2.86)**	−0.017 (3.03)**
Immigrant status	−1.357 (0.61)	0.016 (0.01)	−0.341 (0.16)	−1.018 (0.75)	2.541 (1.72)	3.460 (2.37)*	−1.711 (0.62)	−0.125 (0.05)	0.610 (0.22)	1.393 (0.61)	2.952 (1.36)	2.470 (1.24)
Parental education: upper secondary	−2.331 (1.16)	−2.922 (1.48)	−2.756 (1.40)	3.714 (2.93)**	1.747 (1.37)	1.482 (1.18)	−2.385 (0.90)	−2.560 (0.97)	−3.503 (1.33)	0.749 (0.62)	0.269 (0.22)	−0.411 (0.35)
Parental education: tertiary	1.991 (1.28)	1.206 (0.78)	1.404 (0.92)	4.753 (3.18)**	3.233 (2.20)*	2.844 (1.96)*	−5.741 (2.03)*	−6.087 (2.13)*	−5.601 (1.92)	4.516 (3.06)**	3.782 (2.57)*	3.093 (2.17)*
Years of schooling	1.147 (6.03)**	0.830 (4.27)**	0.662 (3.47)**	1.669 (8.77)**	1.136 (5.44)**	1.027 (4.90)**	0.702 (2.49)*	0.539 (1.88)	0.464 (1.58)	0.637 (4.95)**	0.431 (3.24)**	0.298 (2.35)*
Working hours	0.015 (16.07)**	0.015 (16.56)**	0.013 (14.90)**	0.011 (11.66)**	0.011 (11.16)**	0.010 (10.49)**	0.015 (10.96)**	0.015 (11.39)**	0.014 (10.31)**	0.011 (10.31)**	0.011 (10.24)**	0.010 (9.39)**
General cognitive skills		3.874 (5.61)**	3.170 (4.66)**		5.125 (6.38)**	4.735 (5.72)**		2.499 (3.21)**	2.325 (3.00)**		3.253 (5.33)**	2.135 (3.44)**
Sector: agric.	−3.278 (0.96)	−3.277 (1.01)	−3.077 (1.00)	−10.131 (2.62)**	−10.253 (2.65)**	−9.329 (2.56)*	−12.319 (2.11)*	−12.433 (2.16)*	−10.069 (1.69)	−8.494 (2.74)**	−8.041 (2.63)**	−6.329 (2.16)*
Sector: private tertiary	−5.600 (4.58)**	−5.264 (4.34)**	−4.893 (4.06)**	−6.137 (4.41)**	−6.055 (4.43)**	−6.281 (4.56)**	−0.796 (0.41)	−0.728 (0.38)	−0.017 (0.01)	−0.248 (0.19)	−0.459 (0.36)	−0.649 (0.51)

Table 3. *(Continued)*

Variable	Country											
	UK			US			Germany			Netherlands		
	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6
Sector: public service	–3.329 (2.66)**	–3.094 (2.49)*	–4.178 (3.38)**	–6.674 (4.65)**	–5.995 (4.22)**	–6.721 (4.71)**	1.026 (0.51)	1.002 (0.50)	1.456 (0.71)	–0.735 (0.54)	–0.770 (0.57)	–0.879 (0.64)
ISCO one-digit	2.719 (11.45)**	2.341 (9.58)**	1.647 (6.33)**	1.679 (5.95)**	1.270 (4.39)**	0.895 (2.99)**	1.984 (4.35)**	1.775 (3.92)**	1.282 (2.66)**	1.765 (6.87)**	1.466 (5.56)**	0.754 (2.69)**
Employment status: self-empl.	11.143 (1.49)	9.158 (1.21)	11.681 (1.65)	1.016 (0.41)	0.530 (0.21)	1.572 (0.64)	–2.417 (0.81)	–2.426 (0.82)	–2.515 (0.87)	–5.988 (3.41)**	–5.914 (3.43)**	–4.638 (2.75)**
Supervisory status: yes	6.653 (5.83)**	6.255 (5.56)**	5.349 (4.83)**	6.568 (5.90)**	6.562 (5.95)**	5.811 (5.23)**	8.854 (4.35)**	8.031 (3.95)**	6.885 (3.32)**	5.818 (5.15)**	5.999 (5.41)**	4.192 (3.78)**
Firm size	0.010 (5.32)**	0.009 (5.01)**	0.007 (3.83)**	0.015 (6.94)**	0.014 (6.96)**	0.012 (5.67)**	0.014 (4.60)**	0.014 (4.52)**	0.013 (4.35)**		– –	– –
Work-specific linguistic skills			5.393 (8.80)**			3.583 (5.55)**			2.716 (3.16)**			4.819 (7.57)**
Work-specific financial skills			0.649 (1.25)			–0.195 (0.39)			2.012 (2.51)*			1.866 (3.31)**
Work-specific manual skills			0.791 (1.73)			–0.142 (0.28)			0.864 (1.07)	–8.799 (0.36)	–5.949 (0.57)	0.181 (0.36)
N	1509	1509	1509	1313	1313	1313	655	655	655	1487	1487	1487

Notes: Reference categories: gender: male; immigrant status: native; parental education: primary or lower secondary; sector: industry; employment status: employee; supervisory status: no. Robust z statistics in parentheses. * = significant at 5 percent; ** = significant at 1 percent.

including work-specific cognitive skills further reduces the direct effect of schooling, leading to a cognitive component of schooling of between 34 and 53 percent.

Also, similar to our analyses without structural variables, the reduction of the education effect after only controlling for general cognitive ability is smallest in Germany, and of similar size in the other three countries. This supports hypothesis 2, which expected a stronger reduction in the US and the UK. The Netherlands falls less evidently on the German side than expected, perhaps because of the school-based orientation of vocational education (relative to the much larger dual apprenticeship system in Germany). Such a school-based system may induce employers more strongly to reward schooling on the basis of general cognitive skills than a country where the dual system allows more detailed understanding on the part of employers of the different skills and other traits available in their applicants and apprentices.

To what extent does the relative balance of general and work-specific cognitive skills for the explanation of the education effect vary across countries? As our aim is to examine the extent to which adding variables reduces the direct effect of education, a comparison of fit statistics and of the impacts of various dimensions of skills does not provide the necessary information. To illustrate the relative importance of work-specific and general cognitive abilities in explaining away the education effect, we calculated a 'reduction ratio' that indicates the extent to which the work-specific cognitive skills model (models 3 and 6) reduces the strength of the education effect more than the general cognitive skills model (models 2 and 5).

Let us comment on these reduction ratios for the four countries for two sets of models separately (one without controls for allocative mechanisms as in Table 2, and one with controls for allocative mechanisms as in Table 3). Unsurprisingly, all ratios are larger than 1, which indicates that the extended model (including general and work-specific cognitive abilities) reduces the education effect more strongly than a model that only includes general cognitive ability. More interesting are the comparisons across countries. In the models without allocative variables it appears that the work-specific cognitive skills model reduces the education effect by a factor of 2.2 relative to the general cognitive skills model, whereas it is only 1.5 in the US. Clearly, in Germany the additional insight obtained by adding work-specific cognitive skills is much stronger than in the US. Also for the Netherlands the reduction ratio indicates that the work-specific cognitive skills model reduces the education effect almost twice as much as the general cognitive skills model. In the UK, the reduction ratio is 1.7. These findings are in line with hypothesis 3, that states that the work-specific components of cognitive skills are relatively important in the explanation of the education effect in Germany and the Netherlands, compared to the US and the UK. Furthermore, the differences across countries in the reduction ratios are smaller in the models that control for allocative variables related to the labour market (sector, occupational level, employment status, supervisory status and firm size). Although the Netherlands still has a relatively high reduction ratio (1.7), and the US a relatively low one (1.2), the reduction ratio in Germany has decreased and has the same level as in the UK (1.5).

How can we explain this drop in the reduction ratio for Germany once we control for allocative variables? We assume that this results from the relatively strong regulation/credentialization of access to occupations in Germany. Credentialization assumes that access to occupations is regulated through formal qualification demands, which in

Germany strongly correlate to work-specific skills. This means that education more strongly affects the likelihood that people get the chance to *use* particular skills (rather than just have them). As the IALS measure of work-specific skills is based on whether people use particular skills in their occupation, this translates into a relatively low explanatory power of work-specific skills once we include variables into the model that are related to allocation. Further research needs to be done to substantiate this explanation.

Conclusions and discussion

In this article we examined to what extent education is rewarded on the labour market through the mechanism of the cognitive skills it indicates; whether there are cross-national differences in this process, and how we can explain these cross-national differences. Following neoclassical economic theory as well as its sociological allies in modernization and meritocratization theories, we would expect cognitive skills be the main mechanism through which educational qualifications are rewarded. Contesting this assumption, Bowles and Gintis (2000, 2002; Bowles et al., 2001) argue that only a small fraction of the education effect on wages is cognitive. We used data from the International Adult Literacy Survey (IALS) for the US, the UK, Germany and the Netherlands to examine the size of the cognitive component of schooling. In order to give the cognitive explanation a fair chance, we extended the types of cognitive skills that are incorporated, and distinguished between general cognitive ability and three types of work-specific cognitive abilities (literacy, financial, technical). Our results indicated that a larger fraction of the education effect is cognitive than shown by previous research. When looking at general cognitive ability alone, our estimate is that the cognitive component varies between 24 and 36.6 percent, depending on the country that is analysed. If we include the structural variables in the models (Table 3), this value varies between 23 and 32 percent. If we extend the conceptualization of cognitive skills, the cognitive component of schooling rises to between 50.8 and 63.1 percent, depending on the country of study. If we include the structural variables in the models, the percentage reduction is between 34 and 53 percent. This shows that, once properly measured, cognitive skills mediate to a considerable extent the relationship between education and earnings, in line with human capital theory. As already discussed, skills that are rewarded on the labour market are not necessarily cognitive in nature. This suggests that our results may still underestimate the importance of human capital.

Importantly, we showed that the relative importance of general vs work-specific cognitive abilities varies systematically between countries, with a larger fraction of the schooling effect being captured by the work-specific component in Germany and the Netherlands than in the US and the UK. This can be explained by the different role of schooling between countries. However, in many cases the UK and the Netherlands were less easily placed in the same corner as the US and Germany, respectively. Moreover, clearly the US and Germany are contrasting countries with regard to the role of schooling on the labour market. In the US the cognitive explanation for the impact of schooling on work outcomes is, with regard to *work-relevant* cognitive skills, rather weak. However, in Germany the *general* cognitive skills explanation fares poorly relative to the US.

German employers reward schooling clearly not primarily for the general cognitive skill level it indicates, but rather use other criteria.

Independent of how we operationalize cognitive skills, it must be noted that a substantial fraction of the education effect remains unexplained and could thus be non-cognitive, calling for other explanations for the education effect, such as Bowles and Gintis's model of incentive-enhancing preferences. To the extent that these are related to schooling, they could potentially explain part of the remainder of the schooling effect. However, it could very well be that these traits are productive, something that Bowles and Gintis are unclear about. On the one hand, a productivity argument may be read in their statement that these traits are 'profitable to employers but are not the sort of "skills" that appear as arguments in a production function' (Bowles and Gintis, 2000: 118). On the other hand, however, to the extent that incentive-enhancing preferences can be seen as 'rents' that distort market functioning, which is clearly the point taken in their study with Osborne (Bowles et al., 2001), these traits may be seen as non-productive.

A limitation of our analysis is that the available information to control for selection processes was not optimal, particularly as far as characteristics at the firm level are concerned. This is a critical point if we consider that self-reported items regarding how often workers perform specific tasks on the job can be taken only as a proxy of work-specific cognitive abilities (not least because it is inappropriate to assume that workers do not have a skill if they do not report using it). Yet, it is worth mentioning that, in spite of these limitations, our structural variables referring to occupational position and location in the labour market exert a strong influence on earnings, even after controlling extensively for cognitive skills – a finding that may shed light on the limitations of human capital theory.

More generally, our results illustrate the complementarity between human capital and alternative perspectives. On one hand, it is true that: (1) controlling for formal schooling, work-specific skills influence earnings; and (2) work-specific skills mediate a relevant portion of the influence of *general* cognitive skills on earnings; findings that support human capital theory. On the other hand, it is still the case that: (3) controlling for work-specific skills, formal schooling has an effect on earnings; and (4) the influence of general skills on earnings is never fully explained out by work-specific skills, indicating support for theories of credentialism and screening.

At the same time, it should be recognized that, although we improved considerably upon the standard measures of cognitive ability, there are many productive skills that could be thought of that lead to higher levels of productivity, which are not included in our models. For instance, our data did not contain information on skills acquired through on-the-job training or task-specific manual skills that may be weakly related to cognitive skills. We would hold these work-relevant skills as important individual skills in the true 'human capital' sense of the word. Future research should make an effort in improving the measurement of work-relevant skills, which have been indirectly proxied in our analyses by the frequency of their mobilization in a number of specific job tasks. Furthermore, it would be highly useful to disentangle the role of specific non-cognitive skills as determinants of earnings. We regard these two research developments as complementary. We would maintain, however, that the previous observations do not dismiss our crucial claims, namely that cognitive resources can be highly rewarding in the labour market, that they explain a relevant portion of the effect of education on earnings and that their role is likely to vary across countries.

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Notes

1. The data for Britain were collected in 1996.
2. It depends whether we consider the average or the median of their meta-analysis.
3. Bowles et al. (2001: 1151–6) claim that results based on this simple measure (a short vocabulary test) are not substantially affected by measurement problems. They also re-run their models excluding cases based on this measure. Interestingly, to support their claim, they cite a study by Taber (1997) using a more detailed measure of general cognitive ability available for three time-points, and derive the following estimates of the cognitive component of schooling: 35 percent, 29 percent and 18 percent for 1982–4, 1985–7 and 1988–90 respectively. The first two estimates point to a substantially higher relevance of the cognitive component than suggested by Bowles et al. (2001). They are indeed rather close to the ones that will be presented in this article. Bowles et al. (2001: 1156) briefly comment also on a control analysis suggesting that using more comprehensive measures of general cognitive ability yields estimates about 10 percent larger than the narrower measures, another finding that is in accordance with ours.
4. It should be clear from the previous arguments why we selected these four countries to assess the role of educational systems: the US and Germany may be described as the 'extreme cases', but we include also the 'mixed cases' of the Netherlands and the UK moving to the one side or the other.
5. We have also run a factor analysis for these variables to test for multidimensionality. There was one underlying factor, which suggests that a one-dimensional representation of (general) cognitive skills is accurate (Devroye and Freeman, 2001; Green, 2001).
6. Although such items may be reflecting more strongly whether people *use* particular skills than whether they *possess* those skills, it is not uncommon to make inferences on the skill level of individuals based on the content of occupations. For instance, the American Dictionary of Occupational Titles has been used to operationalize different sorts of skills that explain gender inequalities in the labour market from a human capital perspective (Kilbourne et al., 1994a, 1994b).
7. The results of this factor analysis can be obtained from the authors upon request.
8. For some IALS countries, the standard variable of hourly wages used in Mincer equations is available: control analyses indicate that results concerning both the importance of schooling and the role of cognitive skills are basically unaffected by the way income is measured (Harmon et al., 2003).
9. For some countries it is possible to carry out additional analyses with a more extensive list of controls (e.g. temporary contract, part-time contract), but this extended specification does not affect our conclusions.

References

Arrow KJ (1973) Higher education as a filter. *Journal of Public Economics* 2: 193–216.

Beck EM, Horan PM and Tolbert CM II (1978) Stratification in a dual economy: A sectoral model of earnings determination. *American Sociological Review* 43: 704–720.

Becker GS (1962) Investment in human capital: A theoretical analysis. *The Journal of Political Economy* 70: 9–49.
Becker GS (1976) *Investment in Human Capital: A Theoretical and Empirical Analysis*. Grafenau: Lexika-Verlag .
Blau PM and Duncan OD (1967) *The American Occupational Structure*. New York and London: Wiley.
Bourdieu P and Passeron JC (1999 [1977]) *Reproduction in Education, Society, and Culture*. London and Newbury Park, CA: Sage in association with Theory Culture and Society Dept of Administrative and Social Studies Teesside Polytechnic.
Bowles S and Gintis H (2000) Does schooling raise earnings by making people smarter? In: Arrow K, Bowles S and Durlauf S (eds) *Meritocracy and Economic Inequality*. Princeton, NJ: Princeton University Press, 118–136.
Bowles S and Gintis H (2002) Schooling in capitalist America revisited. *Sociology of Education* 75: 1–18.
Bowles S, Gintis H and Osborne M (2001) Incentive-enhancing preferences: Personality, behavior, and earnings. *American Economic Association Papers and Proceedings* 91: 155–158.
Breen R and Jonsson JO (2000) Analyzing educational careers: A multinomial transition model. *American Sociological Review* 65: 754–772.
Brown DK (1995) *Degrees of Control: A Sociology of Educational Expansion and Occupational Credentialism*. New York: Teachers College Press.
Carbonaro W (2006) Cross-national differences in the skills-earnings relationship: The role of labor market institutions. *Social Forces* 84: 1819–1842.
Carbonaro W (2007) The effects of education and cognitive skill on earnings: How much do occupations and jobs matter? *Research in Social Stratification and Mobility* 25: 57–71.
Carroll GR and Mayer KU (1986) Job-shift patterns in the Federal Republic of Germany: The effects of social class, industrial sector, and organizational size. *American Sociological Review* 51: 323–341.
Collins R (1974) Where are educational requirements for employment highest? *Sociology of Education* 47: 419–442.
Collins R (1979) *The Credential Society: An Historical Sociology of Education and Stratification*. New York: Academic Press.
Davis K and Moore WE (1945) Some principles of stratification. *American Sociological Review* 10: 242–249.
Denny K and Harmon C (2001) Testing for sheepskin effects in earnings equations: Evidence for 5 countries. *Applied Economics Letters* 8(9): 635–637.
Denny K, Harmon C and Sullivan V (2004) *Education, Earnings and Skills: A Multi-Country Comparison.* Available at: www.ifs.org.uk/wps/wp0408.pdf
Devroye D and Freeman R (2001) Does inequality in skills explain inequality of earnings across advanced countries? NBER Working Paper No. 8140, Cambridge.
DiPrete TA and Grusky DB (1990) Structure and trend in the process of stratification for American men and women. *American Journal of Sociology* 96: 107–143.
Doeringer PB, Piore MJ and US Dept of Labor, Manpower Administration (1971) *Internal labor Markets and Manpower Analysis*. Lexington, MA: Heath.
Duncan O, Duncan B and Featherman D (1972) *Socioeconomic Background and Achievement*. New York: Seminar Press.
Farkas J (1996) *Human Capital or Cultural Capital?* New York: University of Columbia Press.
Green D (2001) *Literacy Skills, Non-Cognitive Skills and Earnings: An Economist's Perspective*. Available at: qed.econ.queensu.ca/pub/jdi/deutsch/edu_conf/Green.pdf

Harmon C, Walker I and Westergård-Nielsen NC (2003) *Education and Earnings in Europe: A Cross Country Analysis of the Returns to Education*. Cheltenham: Elgar.

Jencks C (ed.) (1972) *Inequality: A Reassessment of the Effect of Family and Schooling in America*. New York: Basic Books.

Kalleberg AL and Berg I (1994) Work structures and markets: An analytical framework. In: Farkas G and England P (eds) *Industries, Firms, and Jobs: Sociological and Economic Approaches. Expanded Edition.* New York: Aldine de Gruyter, 3–17.

Kalleberg AL and Van Buren ME (1996) Is bigger better? Explaining the relationship between organization size and job rewards. *American Sociological Review* 61: 47–66.

Kerckhoff A, Raudenbush S and Glennie E (2001) Education, cognitive skill, and labor force outcomes. *Sociology of Education* 74: 1–24.

Kilbourne B, England P and Beron K (1994a) Effects of individual, occupational, and industrial characteristics on earnings: Intersections of race and gender. *Social Forces* 72: 1149–1176.

Kilbourne BS, England P, Farkas G, Beron K and Weir D (1994b) Returns to skill, compensating differentials, and gender bias: Effects of occupational characteristics on the wages of white women and men. *American Journal of Sociology* 100: 689–719.

Leuven E, Oosterbeek H and Van Ophem H (2004) Explaining international differences in male skill wage differentials by differences in demand and supply of skill. *The Economic Journal* 114: 466–486.

McKelvey RD and Zavoina W (1975) A statistical model for the analysis of ordinal level dependent variables. *Journal of Mathematical Sociology* 4: 103–120.

NCES (National Center for Education Statistics) (1998) Technical report on the first IALS. Canada.

OECD. (2000) *Literacy in the Information Age*. Paris: OECD.

Park H and Kyiei P (2007) The literacy gap between those with high levels and low levels of educational attainment among older adults: A comparative study of 20 countries. Paper presented at the spring meeting of the ISA RC 28 committee, Brno, Czech Republic.

Shavit Y and Müller W (eds) (1998) *From School to Work: A Comparative Study of Educational Qualifications and Occupational Destinations*. Oxford: Clarendon Press.

Spence M (1973) Job market signaling. *Quarterly Journal of Economics* 87: 355–374.

Stewart M (1983) On least squares estimation when the dependent variable is grouped. *Review of Economic Studies* 14: 737–753.

Stinchcombe AL (1979) Social mobility in industrial labor markets. *Acta Sociologica* 22: 217–245.

Taber CR (1997) The rising college premium in the eighties: Return to college or return to ability? Economics Department/Institute Policy Research, Northwestern University.

Thurow L (1975) *Generating Inequality*. New York: Basic Books.

Treiman DJ (1970) Industrialization and social stratification. In: Laumann EO (ed.) *Social Stratification Research and Theory for the 1970s*. Indianapolis, IN: Bobbs-Merrill, 207–234.

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Résumé

A partir des données de l'enquête IALS pour les Etats-Unis, la Grande-Bretagne et les Pays-Bas, le présent article analyse la manière dont le niveau d'éducation sert d'indicateur de compétences cognitives, donnant lieu à une récompense salariale. En opérant une distinction empirique entre des compétences cognitives générales et des compétences cognitives spécifiques aux situations professionnelles, nous démontrons que la composante cognitive de l'éducation scolaire est plus importante que celle attendue par Bowles et Gintis (2000, 2002). Au lieu de trouver qu'environ 20% des compétences cognitives sont déterminées par l'effet d'éducation, nos résultats indiquent que cette part varie entre 32% et 63%, selon le contexte sociétal et le mode d'opérationnalisation des compétences cognitives. De plus, nous montrons que l'importance relative des compétences générales et des compétences spécifiques varie systématiquement entre les pays. Une part plus importante de l'effet d'éducation se manifeste du côté des compétences spécifiques en Allemagne et aux Pays-Bas qu'aux Etats-Unis et en Grande-Bretagne. Cet écart s'explique par le rôle différent joué par le système scolaire dans les différents pays. Les effets de secteur, d'organisation et d'emploi occupé ont été particulièrement significatifs en Allemagne; ce qui confirme l'idée que ce pays est bien celui où les qualifications formelles ont des effets les plus marqués.

Mots clés: Capital humain, compétences cognitives, éducation, revenues

Resumen

Este artículo investiga hasta qué punto la educación es recompensada en el mercado de trabajo por las habilidades cognitivas que implica, usando datos de IALS para Estados Unidos, Reino Unido, Alemania y Holanda. A partir de la distinción empírica entre habilidades cognitivas generales y habilidades cognitivas específicas para el trabajo, mostramos que el componente cognitivo de la educación es mayor de lo anticipado por Bowles y Gintis (2000; 2002). En lugar de hallar que alrededor del 20 % del efecto de la educación sea cognitivo, nuestros resultados indican que entre el 32 % y el 63 % del efecto de la educación es cognitivo, dependiendo del país y la operacionalización de las habilidades cognitivas. Además se muestra que la importancia relativa de las habilidades generales frente a las habilidades laborales específicas varía sistemáticamente entre países, con una mayor porción del efecto de la educación capturado por las habilidades laborales específicas en Alemania y Holanda que en Estados Unidos y Reino Unido. Esto se explica por el diferente papel de la educación entre países. Resulta igualmente importante que, controlando por procesos de asignación relativos a la industria, la organización y la ocupación del empleo, la educación resulta particularmente significativa en Alemania, lo cual indica que en este país las credenciales son más importantes.

Palabras clave: Capital humano, educación, habilidades cognitivas, ingresos