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Functional Literacy, Heterogeneity and the Returns to Schooling

Multi-Country Evidence

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Abstract

Little is known about which of the skills that make up workers' human capital contribute to higher earnings. Past empirical evidence suggest that most of the return to schooling is generated by effects or correlates unrelated to the skills measured by the available tests. This paper uses the International Adult Literacy and the Adult Literacy and Life Skills surveys to obtain multi-country estimates of the components of the return to schooling. The results reveal considerable heterogeneity and a dichotomy between two groups of countries. For a subgroup of educationally advanced countries, nearly half of the return to schooling can be attributed to labor marker-relevant functional literacy skills associated with schooling, while for a subgroup of less educationally advanced countries, such skills account for just over 20 percent of the return to schooling, while the return to schooling mostly reflects the signaling value of schooling.

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FUNCTIONAL LITERACY, HETEROGENEITY AND THE RETURNS TO SCHOOLING: MULTI-COUNTRY EVIDENCE

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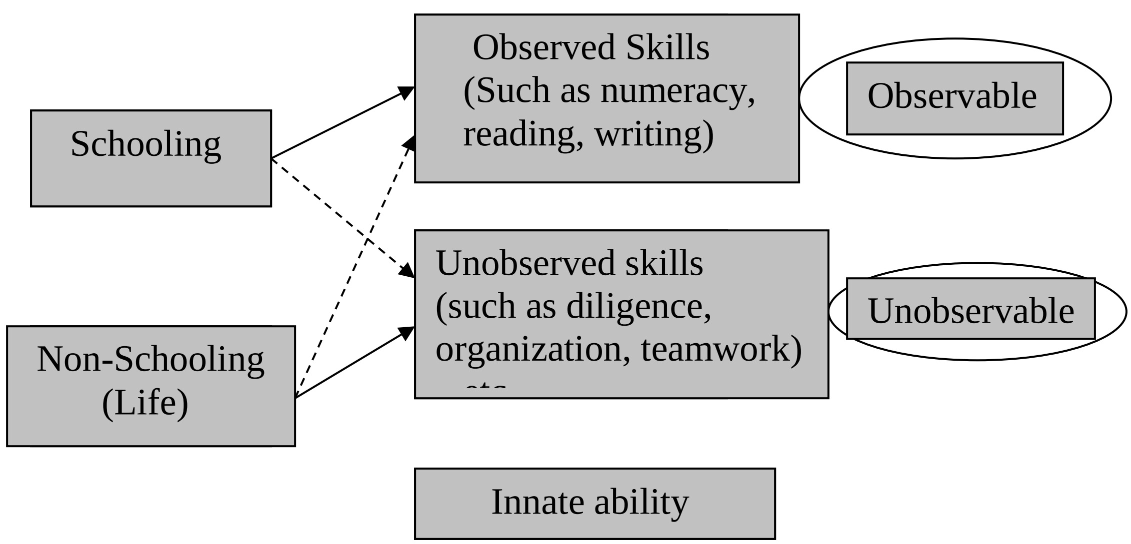
1. Introduction

The return to investing in education, based on past empirical studies, is known to differ between individuals. For example, evidence from the United States (see for example, Ingram and Neumann 2005) shows that over the past decades, individuals with college education but without specific skills experienced the lowest benefits from investing in education. Therefore, labor markets may favor individuals with a wide range of (cognitive or non-cognitive) skills; for such individuals, skills are expected to interact positively with education, resulting in higher benefits from education investments.

Figure 1: Observable versus Unobservable Skills



As highlighted in Figure 1, (observable) skills as well as (unobservable) skills, are generated through schooling as well as elsewhere in life (such as within the family). Other unobservables (innate ability) may be signaled via schooling. Ability is multidimensional. IQ has to be distinguished from what is measured by achievement tests, although it partly determines success on achievement tests. Non-observable skills have direct effects on wages (given schooling), schooling, achievement tests and social outcomes. Labor market relevant observable and unobservable skills affect socioeconomic success. Abilities and skills are both acquired. They are influenced both by genes, schooling and the environment.

When a true measure of ability is an omitted variable in the earnings equation, different approaches have been used in the empirical literature to capture the "true" return to education.[§] This paper uses achievement test scores measuring adult literacy skills (generally measures of capability to process and apply knowledge, particularly in the workplace), and employs them as additional controls in the earnings function. One should, however, keep in mind that both schooling and the test scores are generated by the same latent ability and, therefore, be aware of the joint causality between schooling and test scores (see Hansen *et. al.* 2003; Nordin 2005).

We use the International Adult Literacy Survey (IALS) and the Adult Literacy and Life Skills (ALL) data, which contain direct measures of adult literacy. The IALS and ALL data have been used in several studies. Blau and Khan (2001) examined the role of cognitive skills in explaining higher wage inequality in the United States. Leuven *et al*. (2004) used IALS data for 15 countries and explored the hypothesis that wage differentials between skill groups across countries are consistent with a demand and supply framework. They find that cognitive achievement is an important

[§] One approach uses twins, to arrive at a measure of the causal return to education. For example Ashenfelter and Rouse (1998) and Rouse (1997) using data from the US, have compared the earnings of twins with different educational levels, and reported an estimate of the return to education that is about 30 percent smaller than the OLS estimate. Another approach uses sources for exogenous variation in educational attainment, such as institutional changes in the schooling system in the form of changes in compulsory schooling laws, abolition of fees, etc., as well as other "natural variations" (i.e., school construction projects and other "natural experiments") affecting the schooling decision, to estimate a causal return to education effect using instrumental variable estimation.

determinant of earnings in all countries examined except Poland and Finland; they also find that about one-third of the variation in relative wages between skill groups across countries is explained by differences in net supply of skill groups. Green and Riddell (2003) used the measure of literacy in the IALS data set to examine the influence of observable and unobserved skills on earnings in Canada. They find that literacy skills contribute significantly to earnings and that their inclusion in earnings equations reduces the measured impact of schooling. They also find that schooling and literacy do not interact in influencing earnings. Their findings suggest that observed and unobserved skills are both productive but that having more of one skill does not enhance the other's productivity. Devroye and Freeman (2001) used the same data and found that skill inequality among advanced countries explains only about 7 percent of the cross-country differences in earnings inequality. They also find that the bulk of cross-country differences in earnings inequality occur within skill groups, not between them. Hanushek and Zhang (2006) use IALS data to control for the quality of education's impact on the returns to education. They construct quality-adjusted measures of schooling attained at different time periods and use these along with international literacy test information to estimate returns to skills for 13 countries. Their estimated returns to quality-adjusted education are considerably higher than the traditional estimate for most countries, but these are offset to varying degrees by selection biases on ability. The combined corrections alter significantly the pattern of returns to schooling estimated from Mincer wage equations.

In this paper we use a methodology previously used by Ishikawa and Ryan (2002); it is a two-step approach which splits skill by origin to generate estimates of the return to schooling-associated and non-schooling-associated labor marker relevant skills. We apply this approach to 14 countries or regions using the IALS and ALL datasets.[**] We show that: (1) skills acquired via schooling account for a larger part of the return to schooling, compared to what is implied by earlier methodologies (as summarized in Bowles et al. 2001) and (2) there is heterogeneity and a dichotomy between two groups of countries. For a subgroup of educationally advanced countries, the labor market predominantly rewards observable skills compared to non-observable. In the rest of the countries, only a small part of the reward can be attributed to skills acquired in school, as was the case when using earlier methodologies.

2. Methodology

In the basic Mincerian human-capital model (Mincer 1974), schooling is assumed to be independent of ability and the return from schooling investments is equal for all individuals. However, in the contemporary literature it is acknowledged that the return to schooling should differ for different skill levels. Intuitively, an estimate of the average return to schooling probably overestimates the return for less-skilled workers and underestimates the return to the highly skilled. One should, therefore allow skill to affect the rate of return to schooling investments.

Attempts to account for basic skills in earnings functions include, for low-income countries: Jolliffe (1998) for Ghana, Boissiere et al. (1985) for Kenya and Tanzania, Behrman et al. (1997) for Pakistan; for lower-middle-income countries: Psacharopoulos and Velez (1992) for Colombia, Angrist and Lavy (1997) for Morocco; for upper-middle-income countries, Case and Yogo (1999) and Moll (1998) for South Africa; Patrinos and Sakellariou (2011) for Chile; and for high-income countries, Finnie and Meng (2001) and Green and Riddell (2003) for Canada, Vignoles et al. (2011)

[**] These countries are, in IALS: Denmark, Norway, Finland, Czech Republic, Hungary, Slovenia and Chile; in ALL: Switzerland-German, Switzerland-French, Switzerland-Italian, Italy, Korea, Bermuda and the Mexican region of Nuevo Leon.

and McIntosh and Vignoles (2001) for the United Kingdom and Cawley, Heckman and Vytlacil (1998), Altonji and Dunn (1996b), Murnane et al. (2000), Murnane et al. (1995), Betts (1995) and Card and Krueger (1992) for the United States.

We use the adult literacy score as a measure of basic skill (adult functional literacy and numeracy)[††] to proxy for unobserved effects. We expect that the inclusion of a direct measure of such skills will reduce the estimated education coefficient, so that the coefficient on education then mostly captures the effect of schooling alone, having controlled for a range skills.

Given a distribution of wages, we assume that workers at different parts of the distribution benefit from different types of skills and abilities, including inherent unobserved ability. Less-skilled workers predominate in the lower quantiles of the distribution, while the highly skilled predominate in the upper quantiles of the distribution. However, it is hypothesized that adult literacy and numeracy (basic skills) are mostly relevant at lower parts of the earnings distribution, compared to the higher end of the distribution, where higher level skills are more relevant.

Consider the Mincerian wage function without and with controlling for basic skills (functional literacy):

$$W_i = \alpha_0 + \alpha_1 S_i + \alpha_2 X_i + \varepsilon_i$$

$$W_i = \beta_0 + \beta_1 S_i + \beta_2 L_i + \beta_3 X_i + \varepsilon_i$$

where W_i, S_i, X_i and L_i represent the hourly wage, years of schooling, other characteristics and the total literacy score (from the IALS and ALL datasets) of worker *i*. The traditional Mincerian wage

[††] Throughout this paper we will use the terms “adult skills”, “functional literacy” and “adult literacy” interchangeably.

function measures the total returns signaled by schooling. Once the total literacy skills score is added, β_2 is the coefficient on literacy regardless of where they are learned. Thus, β_1 should reflect the returns to those skills, not captured by usual literacy measurement assessments.

Previous estimates of the cognitive vs. non-cognitive components of the return to schooling (for example Gintis 1971; Bowles et al. 2001) are obtained as β_1/α_1 and $1 - (\beta_1/\alpha_1)$, respectively. Using this approach, the empirical evidence seems to favor the view that mostly non-cognitive skills are rewarded (or certain complex skills that are not captured in traditional surveys). Note, however, that when an aggregate score on skill is used, one cannot account for the origin of skill. For example the IALS and ALL scores capture a range of skills acquired by an individual, including skills acquired outside of school. The conventional approach (outlined above) assumes that all relevant skills are acquired (or signaled) via schooling.

In what follows, we explore an alternative methodology in obtaining additional information about the relative sizes of components of the return to schooling for a heterogeneous group of countries. Consider the following theoretical model (see Farber and Gibbons 1996; Ishikawa and Ryan 2002; Tyler 2004):

$$W_i = \alpha_0 + \alpha_1 S_i + \alpha_{2S} SL_i + \alpha_3 NSL_i + \alpha_4 NSNL_i + \alpha_5 F_i + \alpha_6 A_i + \alpha_7 X_i + \varepsilon_i \qquad (1)$$

where LS stands for skills associated with schooling, NSL for skills acquired elsewhere, NSNL for other – mostly unobservable – skills, F for family background variables and A for innate ability, while X is a vector of other controls (in our case years of potential labor market experience and its square). We distinguish, therefore between skills which can be acquired either through schooling or outside the school and other skills which, likewise may be acquired through schooling or outside the school.

In this model, the coefficient α_1 is a measure of the pure return to schooling. Note that measures of innate ability and other unobservable skills are not usually available in data sets. If a measure of the component associated with school-generated functional skills (SL) can be acquired, the following equation could have been estimated:

$$W_i = \beta_0 + \beta_1 S_i + \beta_{2S} SL_i + \beta_3 F_i + \beta_4 X_i + \varepsilon_i \qquad (2)$$

and the coefficient β_1 would be a measure of the return to schooling which is not associated with basic skills.

As in Ishikawa and Ryan, first, the total literacy score (the IALS or ALL scores in our case) is regressed on education qualifications (SQ), that is, type of qualification (i.e., high school, university, etc.), as well as family background and other characteristics:

$$L_i = \gamma_0 + \gamma_1 SQ_i + \gamma_2 Z_i + \varepsilon_i \quad (3)$$

In our case vector Z includes information on father's and mother's education, age, location of residence, as well as additional information contained in the survey, such as having taken a training course during the past year, using libraries often, reading books at home often, attending plays, etc.

A measure of skill associated with schooling is obtained from equation (3) using the schooling coefficient γ_1 as follows:

$$SL = \gamma_1 SQ_i \quad (4)$$

Then,

$$NSL_i = SL_i - L_i \quad (5)$$

The equation to be estimated now becomes:

$$W_i = \delta_0 + \delta_1 S_i + \delta_2 SL_i + \delta_3 NSL_i + \delta_4 F_i + \delta_5 Xi + \varepsilon_i \quad (6)$$

where the sum of SL and NSL scores equals the total literacy score in equation 3. Now, the two components of the return to schooling can be estimated as:

$$NLR = \delta_1/\alpha_1 \text{ and } SLR = [(1 - (\delta_1/\alpha_1)]$$

If one goes as far as assuming that the gross literacy score captures all of the productivity enhancing basic skills acquired through schooling (along with skills acquired elsewhere), the estimated coefficient δ_1 would represent the market signaling value of an additional year of schooling (after controlling for skills acquired in school and elsewhere – but not natural ability), while δ_2 and δ_3 would represent respectively the returns to those skills acquired at school and elsewhere, respectively.

However, it is probably more realistic to assume that the literacy score does not capture *all* the labor market relevant skills acquired in school; therefore, S contains those productivity enhancing skills acquired in school and are not captured in the literacy score (see also Tyler 2004). The estimated coefficient δ_1 will then represent a mixture of returns to those skills acquired in school and not captured by the literacy score and the signaling value of schooling.

Ishikawa and Ryan (2002), using the 1992 American National Adult Literacy Survey, found that for the most part it is the substance of learning in school which predominantly affects wages. On the other hand, Gintis (1971) and Bowles *et al.* (2001), after surveying the literature over several decades, find that what is predominantly rewarded in the labor market is the (unobservable) non-cognitive component of schooling, rather than basic skills.

3. Data

The International Adult Literacy Survey (IALS) was carried out in 20 countries in the mid- to late 1990s, a project undertaken by the governments of the countries and three intergovernmental organizations.[‡‡] It is a carefully designed, innovative survey of adult populations, and goes beyond just measuring literacy capabilities to assessing how these capabilities are applied to everyday activities. The IALS was followed by an extensive quality review (see Murray *et al*. 1998) which, after comparing the distribution of the characteristics of the actual and weighted samples, concluded that the actual and weighted samples were comparable to the overall populations of the IALS countries. The questionnaire also included questions about labor market status, earnings, education as well as demographic characteristics.

[‡‡] OECD, European Union and UNESCO.

The Adult Literacy and Life Skills Survey (ALL) is a more recent (2003), large-scale cooperative effort undertaken by governments, national statistics agencies, research institutions and multilateral agencies. The ALL study builds on the International Adult Literacy Survey (IALS), the world's first internationally comparative survey of adult skills undertaken. The foundation skills measured in the ALL survey include prose literacy, document literacy, numeracy, and problem solving. Additional skills assessed indirectly include familiarity with and use of information and communication technologies.

Both data sets include three scales as measures of skill: prose literacy, document literacy and quantitative literacy, each in the 0-500 range. Prose literacy tests the understanding and use of texts such as editorials, news stories, fiction and poems. Document literacy tests skills required to locate and use information contained in a variety of formats, such as job applications, payroll forms, maps and tables. Quantitative literacy tests skills required in making calculations after locating numbers embedded in printed materials; examples of such calculations include determining the interest on a loan, calculating a tip and balancing a checkbook.

4. Results

The working sample in this multi-country study includes males employed for wages between the ages of 22 and 65. Empirical results are restricted to males, as earnings function estimates for females would hinge on the extent of selectivity bias[§§]. The dependent variable in the earnings regressions is the logarithm of the hourly wage, calculated using information on yearly earnings from wages, hours worked per week and weeks worked per year. In the estimation of earnings functions, gross

[§§] Potential selectivity could be serious, given that in some of the countries female labor force participation is low (for example, it is 57 % in Switzerland (It.), 58 % in Italy and only 36 % in Chile).

achievement scores were standardized. Therefore, the estimated coefficient of the standardized score measures the approximate percentage change in the hourly wage arising from a one standard deviation increase in the score.

In estimating equation 6, there is the possibility to encounter a multicollinearity problem due to the potential correlation between years of schooling and the derived schooling skills variable (SL). In our case, after measuring the variance inflation factors (VIF), no significant multicollinearity (that is over and above what is introduced by the correlation of experience and its square with years of schooling in a Mincerian equation) was encountered.

The earnings functions results for all countries along with the Variance Inflation Factors are presented in the Appendix. Column I presents the results from a standard Mincerian specification, while in column II, the gross standardized score enters the equation. In columns III and IV, the gross standardized score is replaced by the (standardized) SL and the SL along with the NSL measures, respectively.

Results are summarized in Table 1. The return to schooling estimates in column I (α_1, from equation 1) measure the full impact of schooling on earnings. This includes the effect of skills acquired at school as well as the signaling effect of schooling. The estimates vary from 3.3 percent (Norway) to 13.4 percent (Nuevo Leon). Once the independent effect of the gross literacy score (L) is accounted for (coefficient β_1 from equation 2, in column II), the return to an additional year of schooling, as expected, decreases with an average decline of about 18% (from 6.7% to 5.5%). Given that it is unlikely that all relevant skills are acquired at school (which is implicitly assumed in the column II estimation), in column III we control for those skills associated with schooling (SL). As a result, the years of schooling coefficient (δ_1, from equation 6) generally declines compared to column I, and this is more so for a subgroup of educationally advanced countries.

So, using the information from Table 1, the measure of the component of the return to schooling associated with functional literacy acquired through schooling is obtained as: SLR = 1- (β_1:α_1), while the non-schooling generated functional skills are estimated as: NLR = (β_1:α_1). On the other hand the corresponding two components derived using the coefficients from column III (using the coefficient δ_1 instead of β_1) are estimated as SLR = (1- δ_1:α_1) and NLR = (δ_1:α_1), respectively[***].

Table 1: Estimates of the components of the return to schooling by country

Country	**(I) Schooling coefficient (α_1)**	**(II) Schooling coefficient (β_1)**	**(III) Schooling coefficient (δ_1)**
Denmark[1]	4.8	4.5	2.7
Finland[1]	4.8	4.6	3.3
Norway[1]	3.3	2.5	1.2
Czech Republic[1]	6.2	5.5	4.1
Hungary[1]	8.4	7.0	5.5
Slovenia[1]	6.8	5.7	6.1
Switzerland-German[2]	6.0	4.8	3.1
Switzerland-French[2]	4.2	3.4	2.5

[***] In the Appendix tables 1-14, column (4) reports the results after the measure of skills acquired outside school (NSL) is added in the equation. The relative contribution of SL compared to NSL varies between countries. For more educationally advanced countries (such as Finland, Denmark and Switzerland-German), NSL are relatively unimportant; for most less educationally advanced countries (such as Italy, Slovenia, Switzerland-Italian, Nuevo Leon and Korea) the opposite is true, while they are of comparable magnitude to SL in the cases of Norway, Hungary, Bermuda and Chile.

Switzerland-Italian[2]	6.8	5.3	5.4
Italy[2]	4.7	3.4	4.0
Chile[1]	9.3	6.9	10.0
Nuevo Leon[1]	13.4	11.4	14.8
Korea[2]	7.2	6.5	6.9
Bermuda[2]	8.3	5.0	5.2
Mean	*6.7*	*5.5*	*5.3*

1: Using IALS

2. Using ALL

The two sets of estimates (using estimated coefficients β_1 and δ_1) suggest that the cross-country average of the component of the return to schooling associated with skills acquired outside school is about 70-80 percent of the gross return; that is, about 70-80 percent of what the labor market rewards in schooling is its non-literacy component (with the set of estimates associated with estimated coefficient δ_1, on average slightly lower); however, there is significant heterogeneity and a dichotomy between the two subgroups of countries – the educationally advanced and the less educationally advanced.

In Table 2, we divide the 14 countries in two groups of 7 after ranking the countries by average achievement score. We see that there is a strong negative association between country achievement score and dispersion of score. Chile, Slovenia and Italy rank at the bottom in average score and at the top in score dispersion; the opposite is the case for countries such as Norway, Finland, Denmark and Switzerland (German and French); that is in the best performing group of countries, not only quality of skill is higher on average, but skill is more evenly distributed.

The findings suggest that for the subgroup of better performers, the labor market reward for the component associated with functional literacy is substantial (on average nearly half of the gross return). In these countries, therefore, while schooling contributes to earnings, additional schooling must be accompanied by better functional literacy. In the subgroup of worse performers, on the other hand, predominantly schooling is rewarded independently of skill.

Table 2: Cognitive score and average years of schooling by country/region: Males, 22-65

Country/Region	IALS/ALL Score (rank)	Relative Mean Deviation (rank)	Years of Schooling (rank)	**$(1-\delta_1:\alpha_1)/(\delta_1:\alpha_1)$ (SLR/NLR)**
Norway*	302.5 (1)	0.056 (10)	13.5 (4)	64%/36%
Finland	298.3 (2)	0.059 (9)	13.1 (9)	31%/69%
Denmark	298.1 (3)	0.050 (13)	13.5 (4)	44%/56%
Switzerland-German	297.5 (4)	0.056 (11)	14.8 (1)	54%/46%
Czech Republic	291.6 (5)	0.063 (7)	13.4 (6)	34%/66%
Switzerland-French	285.4 (6)	0.054 (12)	14.2 (2)	41%/59%
Bermuda	280.9 (7)	0.078 (4)	14.1 (3)	37%/63%
Mean	***293.5***	***0.059***	***13.8***	***44%/56%***
Switzerland-Italian*	280.6 (8)	0.069 (6)	13.4 (6)	21%/79%
Korea	261.9 (9)	0.062 (8)	12.7 (8)	5%/%95
Hungary	259.7 (10)	0.071 (5)	12.2 (10)	35%/65%
Italy	250.6 (11)	0.083 (3)	11.8 (11)	15%/85%
Slovenia	240.6 (12)	0.104 (2)	11.5 (12)	10%/90%
Nuevo Leon**	-	-	10.6 (13)	0%/100%
Chile	204.2 (13)	0.126 (1)	8.9 (14)	0%/100%
Mean	***249.6***	***0.086***	***11.6***	***12%/88%***

* Average of IALS and ALL.

**The literacy score derived from the Nuevo Leon data is not comparable to the scores in the rest of the surveys, as the scale is different.

Another observation from looking at column 4 in the Appendix tables 1-14, is that for the first group of countries, generally, the coefficient of SL (δ_2) is clearly larger than the coefficient of NSL (δ_3). In the second group of countries, however, the opposite is true. This may have to do with signaling and whether better educated workers, after entering the labor market can obtain jobs which are a better match to their skill quality. With incomplete information, employers cannot observe workers' real productivity and have to pay them their expected marginal product, conditional on a noisy signal and some easily observable characteristic such as education. There is evidence (see Arcidiacono et al. 2010) that college attendance specifically plays a much more direct role in revealing ability in the United States labor market in early careers; ability is observed nearly perfectly for college graduates, but is revealed much more gradually for high school graduates.

Overall (that is, taking the average estimates over the entire group of countries examined), the evidence given in this paper does suggest that functional literacy skills account for a larger part of the return to schooling, compared to what is implied when accounting for the gross literacy score in the earnings function – but not by much (about 30 percent versus 20 percent on average). However, the main result is that there is considerable heterogeneity and a dichotomy between two groups of countries.[†††]

The heterogeneity of the results with respect to the two groups of countries suggests that the labor market reward varies with the quality of skill the education system can generate in each country. In the first group of countries, the market rewards functional literacy substantially. On the other hand, in the second group of countries, the market overwhelmingly rewards skills acquired outside the school. In the educationally advanced group of countries, the quality of skill generated is such that the labor market recognizes its value and rewards it. In other words, there is something about the skills being taught in schools in these countries that make them more relevant to the needs of employers. In the less educationally advanced group of countries, the skill quality generated is low and more dispersed;

[†††] Note also the difference in the pattern between Switzerland-German and Switzerland-French on the one hand and Switzerland-Italian on the other.

given asymmetric information in the labor market, the returns to schooling reflects their signaling value.

The findings, therefore, can be placed within the labor market signaling theory. Consider two hypothetical countries (labor markets) which are polar opposites: in the first, assume that due to the high quality of skill generated by the education system, workers possess a high quality of labor-market-relevant literacy skills which are equally distributed among workers; in the second, assume not only that skill quality is low, but also very dispersed between workers. Hence, in the first case, there is less of a reason for employers (who are interested in hiring productive workers) to rely on signaling, as they face a certain prospect, rather than a lottery; the opposite is true in the second case, where employers face a lottery and are expected to rely much more on signaling through education, which is taken to predict worker productivity.

The evidence in this paper confirms that labor markets are effective in distinguishing and rewarding highly skilled workers. In labor markets schooling serves to increase the cognitive skills of individuals and to signal high ability. In the second group of countries in this paper, most of the schooling value is due to signaling.

A number of questions arise from the findings which could be the focus of further research. For example, when education systems develop, does the share of the labor market return to functional literacy associated with schooling increase? Furthermore, is it possible that given a certain level of literacy, the labor market turns to reward other skills – or skills not measured by standardized tests (such as teamwork) – which may also be learned in schools? Finally, should efforts be directed in developing assessments of non-literacy labor market relevant skills?

5. Conclusion

Past evidence suggests that a very large part of the returns to schooling are generated by effects or correlates unrelated to literacy skills measured by the available tests. Using an approach which splits the measure of cognitive skills available between those acquired through schooling vs. those acquired elsewhere, and using data from the International Adult Literacy Surveys (IALS) and the Adult Literacy and Life Skills surveys (ALL), we obtain multi-country estimates of the components of the return to schooling.

It is found that there is large heterogeneity between countries. For a subgroup of countries with effective education systems, which produce workers well-endowed in labor market relevant functional skills, the labor market rewards these skills substantially, along with other, more difficult to measure skills. On the other hand, for countries with less effective education systems, only a very small part of the reward can be attributed to literacy skills; the coefficient of years of schooling largely reflects the signaling value of schooling. These results seem to suggest that, at least for the latter group of countries, a substantial component of the returns to schooling is generated by effects which are unrelated to skills measured by available tests. Correspondingly, the contribution of more literacy skills to earnings is substantially independent of schooling.

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Appendix

Table A1: Employed Males 22-65, Denmark-IALS

	(1)	(2)	(3)	(4)
Years of schooling	0.048	0.045	0.027	0.027
	(9.5)	(8.3)	(3.0)	(3.0)
Experience	0.041	0.041	0.039	0.039
	(7.8)	(7.7)	(7.5)	(7.5)
Experience-squared	-0.0007	-0.0007	-0.0006	-0.0006
	(6.1)	(6.0)	(5.8)	(5.7)
Stand. score	-	0.021	-	-
		(1.3)		
Stand. SL	-	-	0.078	0.078
			(2.7)	(2.7)
Stand. NSL	-	-	-	0.013
				(0.8)
Constant	3.74	3.77	4.02	4.03
	(42.3)	(41.0)	(29.1)	(29.1)
R^2 adj.	0.143	0.144	0.149	0.148
N	1,004	1,004	1,004	1,004

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A2: Male Employees 22-65, Finland-IALS

	(1)	(2)	(3)	(4)
Years of schooling	0.048	0.046	0.033	0.032
	(5.4)	(4.9)	(3.2)	(3.1)
Experience	0.021	0.021	0.017	0.017
	(2.9)	(2.9)	(2.3)	(2.3)
Experience-squared	-0.0001	-0.0001	-0.0000	-0.0000
	(0.7)	(0.6)	(0.1)	(0.1)
Stand. score	-	0.036	-	-
		(1.2)		
Stand. SL	-	-	0.161	0.164
			(3.0)	(3.0)
Stand. NSL	-	-	-	0.020
				(0.8)
Constant	3.15	3.18	3.41	3.42
	(20.7)	(20.6)	(19.4)	(19.4)
R^2 adj.	0.096	0.097	0.113	0.105
N	762	762	762	762

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A3: Employed Males 22-65, Norway-IALS

	(1)	(2)	(3)	(4)
Years of schooling	0.033	0.025	0.012	0.007
	(4.2)	(3.0)	(0.7)	(0.4)
Experience	0.034	0.033	0.035	0.034
	(5.2)	(5.0)	(5.3)	(5.1)
Experience-squared	-0.0005	-0.0005	-0.0006	-0.0005
	(4.0)	(3.8)	(4.2)	(3.9)
Stand. score	-	0.077	-	-
		(3.0)		
Stand. SL	-	-	0.074	0.084
			(1.5)	(1.7)
Stand. NSL	-	-	-	0.067
				(2.9)
Constant	3.89	3.99	4.15	4.21
	(31.1)	(30.9)	(19.2)	(19.5)
R^2 adj.	0.046	0.054	0.047	0.054
N	1,005	1,005	1,005	1,005

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A4: Male Employees 22-65, Czech Republic-IALS

	(1)	(2)	(3)	(4)
Years of schooling	0.062	0.055	0.041	0.039
	(7.0)	(5.8)	(2.9)	(2.8)
Experience	0.011	0.012	0.014	0.015
	(1.3)	(1.4)	(1.7)	(1.7)
Experience-squared	-0.0002	-0.0002	-0.0002	-0.0002
	(0.9)	(1.0)	(1.3)	(1.3)
Stand. score	-	0.051	-	-
		(2.1)		
Stand. SL	-	-	0.079	0.080
			(2.0)	(2.0)
Stand. NSL	-	-	-	0.037
				(1.6)
Constant	2.98	3.05	3.23	3.25
	(21.9)	(21.7)	(17.2)	(17.2)
R^2 adj.	0.092	0.097	0.097	0.099
N	569	569	569	569

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A5: Male Employees 22-65, Hungary-IALS

	(1)	(2)	(3)	(4)
Years of schooling	0.084	0.070	0.055	0.048
	(6.7)	(5.3)	(2.7)	(2.3)
Experience	0.032	0.033	0.031	0.032
	(2.3)	(2.4)	(2.2)	(2.3)
Experience-squared	-0.0002	-0.0002	-0.0002	-0.0002
	(0.9)	(0.8)	(0.7)	(0.7)
Stand. score	-	0.133	-	-
		(3.0)		
Stand. SL	-	-	0.118	0.137
			(1.8)	(2.1)
Stand. NSL	-	-	-	0.115
				(2.8)
Constant	3.91	4.02	4.24	4.27
	(19.2)	(19.6)	(15.4)	(15.6)
R^2 adj.	0.155	0.171	0.159	0.173
N	444	444	444	444

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A6: Male Employees 22-65, Slovenia-IALS

	(1)	(2)	(3)	(4)
Years of schooling	0.068	0.057	0.061	0.054
	(7.9)	(5.8)	(4.0)	(3.4)
Experience	0.008	0.009	0.007	0.008
	(0.9)	(1.0)	(0.8)	(0.9)
Experience-squared	0.0001	0.0001	0.0001	0.0001
	(0.5)	(0.5)	(0.5)	(0.6)
Stand. score	-	0.077	-	-
		(2.5)		
Stand. SL	-	-	0.026	0.047
			(0.6)	(1.0)
Stand. NSL	-	-	-	0.065
				(2.4)
Constant	5.23	5.34	5.31	5.38
	(37.0)	(36.1)	(25.6)	(25.8)
R^2 adj.	0.165	0.174	0.164	0.173
N	469	469	469	469

Note: Additional controls are: father’s and mother’s education; t-values in parentheses. Sample weights included.

Table A7: Male Employees 22-65, Chile-IALS

	(1)	(2)	(3)	(4)
Years of schooling	0.093	0.069	0.100	0.086
	(8.6)	(5.1)	(3.7)	(3.1)
Experience	0.001	0.0005	-0.0008	0.0000
	(0.1)	(0.1)	(0.1)	(0.0)
Experience-squared	0.0002	0.0002	0.0002	0.0002
	(1.2)	(1.1)	(1.2)	(1.1)
Stand. score	-	0.146	-	-
		(2.9)		
Stand. SL	-	-	-0.036	0.011
			(0.3)	(0.1)
Stand. NSL	-	-	-	0.104
				(2.9)
Constant	5.37	5.58	5.31	5.44
	(29.7)	(28.8)	(19.0)	(19.4)
R^2 adj.	0.173	0.183	0.172	0.183
N	588	588	588	588

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A8: Return to Schooling and Skills, Male Employees – Nuevo Leon-IALS

	(1)	(2)	(3)	(4)
Years of schooling	0.134	0.114	0.148	0.137
	(6.9)	(5.1)	(4.3)	(3.9)
Tenure*	0.047	0.043	0.047	0.042
	(1.7)	(1.5)	(1.7)	(1.5)
Tenure-squared	-0.001	-0.001	-0.001	-0.001
	(1.4)	(1.2)	(1.40)	(1.2)
Stand. score	-	0.160	-	-
		(1.7)		
Stand. SL	-	-	-0.067	-0.036
			(0.5)	(0.3)
Stand. NSL	-	-	-	0.146
				(1.8)
Constant	5.70	5.90	5.55	5.69
	(24.4)	(22.5)	(14.6)	(14.7)
R^2 adj.	0.074	0.076	0.081	0.076
N	701	701	701	701

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

* Information on tenure at current job was available, while information on age is incomplete.

Table A9: Return to Schooling and Skills Male Employees 22-65, Switzerland German-ALL

	(1)	(2)	(3)	(4)
Years of schooling	0.060	0.048	0.031	0.023
	(11.1)	(8.5)	(4.1)	(3.1)
Experience	0.043	0.044	0.039	0.041
	(4.9)	(8.5)	(7.4)	(7.8)
Experience-squared	-0.0006	-0.0006	-0.0006	-0.0006
	(5.5)	(5.6)	(5.0)	(5.1)
Stand. score	-	0.098	-	-
		(5.8)		
Stand. SL	-	-	0.131	0.143
			(5.2)	(5.8)
Stand. NSL	-	-	-	0.083
				(5.4)
Constant	2.26	2.42	2.75	2.83
	(22.4)	(23.7)	(20.2)	(21.2)
R^2 adj.	0.267	0.305	0.298	0.329
N	601	601	601	601

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A10: Return to Schooling and Skills Male Employees 22-65, Switzerland French-ALL

	(1)	(2)	(3)	(4)
Years of schooling	0.042	0.034	0.025	0.021
	(7.4)	(5.4)	(3.0)	(2.5)
Experience	0.042	0.044	0.041	0.042
	(6.4)	(6.9)	(6.4)	(6.7)
Experience-squared	-0.0006	-0.0006	-0.0006	-0.0006
	(4.4)	(4.5)	(4.2)	(4.3)
Stand. score	-	0.067	-	-
		(2.8)		
Stand. SL	-	-	0.085	0.092
			(2.7)	(2.9)
Stand. NSL	-	-	-	0.051
				(2.4)
Constant	2.43	2.52	2.70	2.71
	(21.1)	(21.3)	(18.0)	(18.1)
R^2 adj.	0.200	0.213	0.212	0.220
N	432	432	432	432

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A11: Return to Schooling and Skills Male Employees 22-65, Switzerland Italian-ALL

	(1)	(2)	(3)	(4)
Years of schooling	0.068	0.053	0.054	0.048
	(7.3)	(5.2)	(4.1)	(3.6)
Experience	0.031	0.030	0.029	0.030
	(3.6)	(3.6)	(3.4)	(3.5)
Experience-squared	-0.0002	-0.0002	-0.0002	-0.0002
	(1.5)	(1.3)	(1.2)	(1.2)
Stand. score	-	0.104	-	-
		(3.4)		
Stand. SL	-	-	0.064	0.067
			(1.5)	(1.6)
Stand. NSL	-	-	-	0.084
				(3.2)
Constant	2.09	2.29	2.30	2.35
	(12.4)	(13.0)	(10.5)	(10.8)
R^2 adj.	0.182	0.207	0.185	0.205
N	355	355	355	355

Note: Additional controls are: father’s and mother’s education; t-values in parentheses. Sample weights included.

Table A12: Return to Schooling and Skills Employed Males 22-65, Italy-ALL

	(1)	(2)	(3)	(4)
Years of schooling	0.047	0.034	0.040	0.032
	(9.7)	(6.3)	(5.8)	(4.6)
Experience	0.032	0.030	0.032	0.030
	(6.6)	(6.2)	(6.6)	(6.2)
Experience-squared	-0.0004	-0.0004	-0.0004	-0.0004
	(4.6)	(4.2)	(4.6)	(4.2)
Stand. score	-	0.101	-	-
		(5.5)		
Stand. SL	-	-	0.034	0.045
			(1.4)	(1.8)
Stand. NSL	-	-	-	0.085
				(5.3)
Constant	1.20	1.37	1.28	1.40
	(13.1)	(14.3)	(11.9)	(12.9)
R^2 adj.	0.103	0.129	0.104	0.128
N	999	999	999	999

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A13: Return to Schooling and Skills Employed Males 22-65, Bermuda-ALL

	(1)	(2)	(3)	(4)
Years of schooling	0.083	0.050	0.052	0.032
	(13.8)	(7.5)	(6.0)	(3.7)
Experience	0.018	0.019	0.016	0.018
	(3.7)	(4.3)	(3.3)	(3.9)
Experience-squared	-0.0001	-0.0002	-0.0001	-0.0001
	(1.4)	(1.6)	(0.8)	(1.2)
Stand. score	-	0.210	-	-
		(9.4)		
Stand. SL	-	-	0.163	0.195
			(4.9)	(6.1)
Stand. NSL	-	-	-	0.151
				(8.6)
Constant	1.73	2.17	2.18	2.45
	(16.2)	(19.5)	(15.6)	(17.9)
R^2 adj.	0.234	0.315	0.257	0.325
N	739	739	739	739

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A14: Return to Schooling and Skills, Male Employees – Korea

	(1)	(2)	(3)	(4)
Years of schooling	0.083	0.075	0.085	0.079
	(11.9)	(10.5)	(6.2)	(5.8)
Experience	0.075	0.074	0.081	0.079
	(15.6)	(15.5)	(16.2)	(15.9)
Experience-squared	-0.0013	-0.0013	-0.0014	-0.0014
	(13.8)	(13.4)	(14.1)	(13.7)
Stand. score	-	0.085	-	-
		(5.0)		
Stand. SL	-	-	0.013	0.037
			(0.3)	(0.8)
Stand. NSL	-	-	-	0.072
				(4.7)
Constant	7.20	7.30	7.12	7.20
	(65.8)	(66.3)	(38.1)	(38.7)
R^2 adj.	0.298	0.313	0.310	0.323
N	1,138	1,138	1,138	1,138

Note: Additional controls are: father's and mother's education; t-values in parentheses. Sample weights included.

Table A15: Variance Inflator Factors (VIF), Denmark-IALS

	(1)	(2)	(3)	(4)
Years of schooling	1.3	1.5	4.1	4.1
Experience	16.2	16.2	16.4	16.4
Experience sq.	16.5	16.5	16.7	16.7
Stand. score	-	1.3	-	-
Stand. SL	-	-	4.0	4.0
Stand. NSL	-	-	-	1.0
Mean VIF	7.2	6.3	7.2	6.4

Table A16: Variance Inflator Factors (VIF), Finland-IALS

	(1)	(2)	(3)	(4)
Years of schooling	2.0	2.2	2.8	2.8
Experience	13.8	13.8	14.7	14.7
Experience sq.	13.3	13.3	13.8	13.8
Stand. score	-	1.4	-	-
Stand. SL	-	-	5.6	5.6
Stand. NSL	-	-	-	1.1
Mean VIF	6.3	5.5	7.0	6.2

Table A17: Variance Inflator Factors (VIF), Norway-IALS

	(1)	(2)	(3)	(4)
Years of schooling	1.2	1.4	5.2	5.2
Experience	16.0	16.0	16.0	16.1
Experience sq.	15.9	16.0	16.1	16.3
Stand. score	-	1.3	-	-
Stand. SL	-	-	4.7	4.7
Stand. NSL	-	-	-	1.1
Mean VIF	7.1	6.2	7.4	6.6

Table A18: Variance Inflator Factors (VIF), Czech Republic-IALS

	(1)	(2)	(3)	(4)
Years of schooling	1.2	1.3	2.9	2.9
Experience	18.5	18.6	19.2	19.2
Experience sq.	18.5	18.5	19.1	19.1
Stand. score	-	1.2	-	-
Stand. SL	-	-	2.8	2.8
Stand. NSL	-	-	-	1.0
Mean VIF	8.1	7.0	7.8	6.8

Table A19: Variance Inflator Factors (VIF), Hungary-IALS

	(1)	(2)	(3)	(4)
Years of schooling	1.1	1.3	3.1	3.1
Experience	16.9	16.9	16.9	17.0
Experience sq.	15.5	15.5	15.5	15.5
Stand. score	-	1.3	-	-
Stand. SCL	-	-	3.0	3.1
Stand. NSL	-	-	-	1.1
Mean VIF	7.3	6.3	7.0	6.1

Table A20: Variance Inflator Factors (VIF), Slovenia-IALS

	(1)	(2)	(3)	(4)
Years of schooling	1.2	1.7	4.2	4.4
Experience	15.4	15.5	15.8	15.9
Experience sq.	15.2	15.2	15.6	15.6
Stand. score	-	1.7	-	-
Stand. SL	-	-	4.0	4.2
Stand. NSL	-	-	-	1.2
Mean VIF	6.9	6.1	7.1	6.3

Table A21: Variance Inflator Factors (VIF), Chile-IALS

	(1)	(2)	(3)	(4)
Years of schooling	1.8	2.9	11.9	12.2
Experience	13.5	13.5	13.5	13.6
Experience sq	12.7	12.7	12.7	12.7
Stand. score	-	2.1	-	-
Stand. SL	-	-	11.2	11.4
Stand. NSL	-	-	-	1.9
Mean VIF	6.4	5.8	8.9	7.8

Table A22: Variance Inflator Factors (VIF) – Nuevo Leon

	(1)	(2)	(3)	(4)
Years of schooling	1.2	1.6	3.7	3.8
Tenure	7.6	7.7	7.6	7.7
Tenure sq.	7.5	7.6	7.5	7.6
Stand. score	-	1.5	-	-
Stand. SL	-	-	3.5	3.6
Stand. NSL	-	-	-	1.1
Mean VIF	3.8	3.5	4.2	3.8

Table A23: Variance Inflator Factors (VIF), Switzerland German-ALL

	(1)	(2)	(3)	(4)
Years of schooling	1.2	1.4	2.5	2.6
Experience	15.8	15.9	16.2	16.2
Experience sq.	15.5	15.5	15.7	15.7
Stand. score	-	1.3	-	-
Stand. SL	-	-	2.3	2.3
Stand. NSL	-	-	-	1.2
Mean VIF	7.0	6.1	6.5	5.8

Table A24: Variance Inflator Factors (VIF), Switzerland French-ALL

	(1)	(2)	(3)	(4)
Years of schooling	1.2	1.5	2.7	2.8
Experience	14.3	14.4	14.4	14.6
Experience sq	13.9	13.9	14.0	14.0
Stand. score	-	1.5	-	-
Stand. SL	-	-	2.5	2.5
Stand. NSL	-	-	-	1.2
Mean VIF	6.3	5.6	5.9	5.3

Table A25: Variance Inflator Factors (VIF), Switzerland Italian-ALL

	(1)	(2)	(3)	(4)
Years of schooling	1.5	1.8	2.9	3.0
Experience	16.7	16.7	17.1	17.1
Experience sq.	16.7	16.7	17.0	17.0
Stand. score	-	1.5	-	-
Stand. SL	-	-	2.5	2.5
Stand. NSL	-	-	-	1.2
Mean VIF	7.4	6.5	7.0	6.2

Table A26: Variance Inflator Factors (VIF), Italy-ALL

	(1)	(2)	(3)	(4)
Years of schooling	1.4	1.7	2.8	3.0
Experience	14.2	14.3	14.2	14.3
Experience sq.	13.6	13.7	13.6	13.7
Stand. score	-	1.4	-	-
Stand. SL	-	-	2.5	2.5
Stand. NSL	-	-	-	1.1
Mean VIF	6.3	5.6	5.9	5.3

Table A27: Variance Inflator Factors (VIF), Bermuda-ALL

	(1)	(2)	(3)	(4)
Years of schooling	1.4	2.0	3.1	3.3
Experience	12.1	12.1	12.3	12.3
Experience sq.	11.9	11.9	12.0	12.0
Stand. score	-	1.7	-	-
Stand. SL	-	-	3.0	3.0
Stand. NSL	-	-	-	1.0
Mean VIF	5.5	5.0	5.4	4.9

Table A28: Variance Inflator Factors (VIF) – Korea

	(1)	(2)	(3)	(4)
Years of schooling	1.7	1.8	6.1	6.2
Experience	13.5	13.5	14.1	14.2
Experience sq.	14.6	14.7	15.7	15.9
Stand. score	-	1.2	-	-
Stand. SL	-	-	7.0	7.1
Stand. NSL	-	-	-	1.0
Mean VIF	6.4	5.6	7.5	6.4