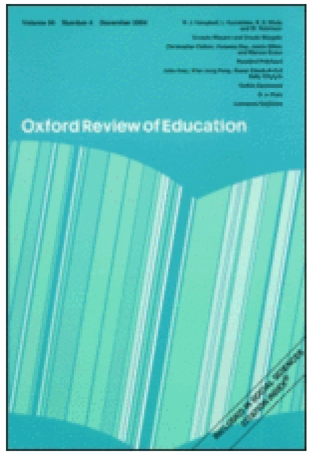

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Mixed Signals: Cognitive Skills, Qualifications and Earnings in an International Comparative Perspective

While it is well-established that education holds value in labour markets, the *reasons* that education is valued are a source of ongoing debate. Bryan Caplan addresses this debate in *The Case Against Education* by making the provocative argument that "there's way too much education" (Caplan, 2018, p. 1). He goes on to argue that the reason for this oversupply of education is labour market signalling: students pursue education mainly as a way to show potential employers that they are intelligent, hard-working, and obedient individuals, but *not* because it increases their ability to be productive employees.

Caplan resurfaces (but does not resolve) a long-standing debate in the literature on education and labour markets: the unique role of education as both an absolute and a positional good (Hirsch, 1976). The absolute benefits of education refer to increased productivity and work quality that accrue through education. In contrast, the positional aspect of education is used to differentiate among competitors in the labor market, even when there are no absolute gains in productivity. To use the metaphor of a pie that is divided among members of society, education functions as an absolute good by helping individuals to produce a larger pie, but as a positional good it also increases the size of an educated individual's own slice of the pie relative to the less educated. Caplan argues that the positional benefits of education dwarf its absolute benefits by a ratio of approximately four-to-one (i.e. 80% to 20%), and hence he cautions against increasing educational expenditure and attainment.

This paper takes Caplan's book as a point of departure to examine how formal educational qualifications and cognitive skills are related to adults' earnings in labour markets in middle- and high-income countries. Unpicking this relationship involves careful consideration, as the relationship between variables is complex with multiple possible causal directions; for example, higher cognitive skills are likely to increase the level of education an individual attains, just as higher levels education are likely to develop cognitive skills.

We undertake this analysis using data from the Programme for the International Assessment of Adult Competencies (PIAAC), a study run by the Organization for Economic Cooperation and Development (OECD) in 30 countries. We begin the paper by reviewing theoretical perspectives on skills, qualifications and the labour market, focusing on the distinction between human capital theory and signalling. We then discuss the PIAAC data and our methods of analysis, logistic regression of earnings at different levels based on cognitive skills, educational qualifications, and demographic control variables.

Our analysis shows that cognitive skills - primarily numeracy - and educational qualifications both contribute to higher earnings, but the relative share of these two contributions differs substantially across countries. While in some countries (including Caplan's USA) qualifications overshadow cognitive skills, in other cases the two contribute much more equally to earnings. Furthermore, the signalling power of qualifications appears to be highest in countries with *low* levels of higher education; in contrast, countries with more university graduates in the workforce tend to place greater value on cognitive skills. We conclude by discussing the implications of these findings for theories of education and the labour market and educational policy.

Perspectives on Skills, Qualifications and the Labor Market

The relationship between education and the labor market was first addressed as a distinct field of study in early work on human capital theory (Mincer, 1958), which established a framework for understanding variation in earnings for individuals with different levels of education. In its classical form, human capital theory views the higher earnings of more educated workers as a return on investment (Becker, 1994), similar to that which might be obtained through any form of investment (e.g. real estate, stocks). The time and labor that individuals invest in their education factor into the cost of their labour later in life, and thus result in *both* higher productivity and higher earnings. In his critique of human capital, Foucault (2004, p.226). thus argues that human capital theory makes every worker "an entrepreneur of himself...being for himself his own capital, being for himself his own producer, being for himself the source of his earnings."

Since its inception, human capital theory has gained widespread status as the *de facto* model to conceptualize education and the labour market. Through Rostow's (1960) modernization theory, it became a guiding force behind international development funding from the World Bank and other donors (Jones, 2004; Lauder, 2015). Human capital theory remains a focus of much research: contemporary work in the field has devoted particular attention to the topic of highly skilled labor, analyzing the "skills premium" that it demands in labour markets. For example, Autor (2014) argues that the skills premium is growing in most high-income countries, but points out that a growing return to skills in the labour market is an intrisic part of the growing levels of income inequality experienced in many countries.

However, in the years after the classical formulations of human capital theory, other ways of conceptualizing education in the labour market emerged. Signalling (Spence, 1973) and screening (Stiglitz, 1975) both posit that education has value in labor markets because it reduces uncertainty. According to signalling theory, potential employees use educational qualifications as a way to demonstrate their abilities to potential employers. These abilities include not only skills used in the performance of the job, but also their work-ethic, ability to follow instructions, and dedication to complete tasks. For university graduates, their success in competitive admissions processes can also work as a signal of their abilities relative to peers (Hoekstra, 2009). Screening theory takes a similar view of education as a demonstration of ability, but focuses more on the employers' role. According to screening theory, employers who are uncertain about job applicants' quality set "wage contracts," i.e. specifications for a salary matching a certain set of educational qualifications (Siglitz, 1975; Stiglitz and Weiss, 1990). In both signalling and screening theories, some value of education is attributed to its role in reducing uncertainty in the labor market rather than developing productive skills.

Both signalling and screening theory differ from human capital in that they view education as having both positional and absolute benefits, a concept first described by Hirsch (1976). The absolute benefits of education are very much akin to the increased productivity and corresponding salary premiums described by human capital theory; in other words, they refer to an absolute change in what an employee can do as a result of education. In contrast, positional benefits refer to the abilities of an educated employee relative to others who lack the same level of education. Particularly in terms of job market selection, an individual is likely to benefit from being the most educated applicant for a job (i.e. positionally ahead of competitors), even if the additional education one holds adds little or no absolute benefits.

To further illustrate the distinction between absolute and positional benefits, it is useful to imagine the aggregate output of all workers in a given country as a pie, which, after it has been baked, is divided up among all the workers who produced it. In this scenario, absolute benefits from education would enable an individual to make the overall pie bigger, regardless of how it is eventually divided. In contrast, positional benefits would increase the size of an individual's slice of the pie. Hirsch (1976) argues that education both enables individuals to make the pie bigger and also allows them to increase their slice of the pie. The balance between these two contributions is a key question for research on education and labour markets.

As signalling theory emphasizes the importance of qualifications in *getting* a job over the necessity of skills in *performing* a job, it opens a distinct possibility for graduate overeducation in labour markets, generally defined as the percentage of the workforce who hold a university degree but work in a job that does not require one (Chevalier, 2003). Many studies report some degree of graduate overeducation, but also suggest that the prevalence and severity of overeducation tend to vary across national contexts (Barone & Ortiz 2011; Cardoso, 2007; McGuinness 2006, Reisel 2013). Brown, Lauder and Ashton (2012) and Brown, Lauder and Cheung (2019) further argue that employers' ability to source skilled labour from low-income countries is leading to a long-term deterioration of the skills premium in high-income countries, as low-income, high-skills labour markets are able to undercut the cost of skills in high-income countries. In combination with other studies highlighting variation in returns to skills across countries (Hanushek et al, 2013), the literature therefore suggests that the balance between human capital and signalling may be largely shaped by national context, pointing to a need to study the issue in an international comparative perspective.

In many senses, Caplan's argument better reflects another critique of education in the labor market: credentialism. In essence, the literature on credentialism argues that educational qualifications largely function as an intentional effort of the educated elite to perpetuate class advantage by limiting access to desirable jobs (Collins 1979; Dore, 1976). The result is a process of degree inflation: as the provision of education has expanded each generation must obtain more credentials than the one that preceded it simply to maintain their class position. Collins warns of 'cycle of rising educational attainment and rising occupational requirements' that threatens to continue 'until janitors need PhDs' (Collins 2002, 25–29). Both the credentialist literature and Caplan emphasize possibilities for self-serving institutions that offer little useful education, epitomized in Caplan's critique of "the head-in-the-clouds Ivory Tower academic" (p. 11). Thus, although Caplan describes his critique in terms of signalling, in many senses he is actually describing credentialism.

Synopsis

The value of education in the labour market is addressed in debates regarding its absolute and positional benefits. On the one hand, human capital theory focuses on the absolute returns to skills; and on the other hand credentialist perspectives and Caplan's (2018) strong version of signalling theory argue the contrary. However, Bills (2003) rightly points out that these two perspectives are not necessarily oppositional since, absolute and positional benefits are not mutually exclusive; in fact, Hirsch shows that both benefits are usually present to some extent. Furthermore, it is clear that this dichotomy does not capture all the possible dimensions of the role of education in labour markets. For example, we have not considered how the absolute benefits of education are distributed. While classical human capital theory tends to assume they are retained by the individual, it is equally possible that they are retained by employers who seek to maximise profit (Brown et al, 2012), or shared in society more widely (Moretti, 2004).

Nevertheless, the debate between human capital and signalling theories is a useful entry point to better understand *why* education holds value in labour markets. In particular, different findings across contexts (Barone & Ortiz 2011; Cardoso, 2007; McGuinness 2006, Reisel 2013) suggest that an international comparative analysis may yield insights into whether education is of little economic value, as Caplan claims.

Data and Methods

To analyse the respective contributions of qualifications and skills to labour market outcomes, we use data from the Programme for International Assessment of Adult Competencies (PIAAC), an international study run by the OECD in 38 countries. PIAAC is intended to measure the skills of the adult population of participating countries on the basis that "provide a foundation for effective and successful participation in the social and economic life of advanced economies" (OECD, 2012, p. 10). Framed in the context of high-skills economies, PIAAC was administered to respondents on a laptop computer and included assessments of literacy, numeracy and problem solving in technology-rich environments. The last of these assessments, hereafter referred to as "problem solving," is defined by OECD (2012, p. 47) as

> using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks. The first PIAAC problem-solving survey focuses on the abilities to solve problems for personal, work and civic purposes by setting up appropriate goals and plans, and accessing and making use of information through computers and computer networks

In addition to the three assessments, respondents completed a questionnaire that included extensive information on their home life; social background and upbringing; and, where relevant, work, career and earnings

We analyze data from PIAAC rounds 1 and 2, which were conducted in 2008-13 and 2012-16, respectively (OECD, 2016, p. 20). Our analysis includes 27 different countries for which the relevant data on cognitive skills and earnings were collected, with an average sample size of 6,517 respondent per country. Responses are weighted to allow inferences about the national adult population, with bootstrapped variance estimates using a jackknife replication design (Mohadjer, Krenzke, & Van de Kerchove, 2013).

We analyze respondents between the ages of 25 and 64 who reported being in work at the time of data collection (we exclude respondents were in education *and* work), as respondents in this age group are likely to have completed most of their education.

Our analysis focuses on the contributions of cognitive skills and educational qualifications to earnings in the labour market across countries that participated in PIAAC. Conceptually, we understand PIAAC data on cognitive skills and qualifications to represent partial measures of human capital and signalling, respectively. However, we recognize that there are important parts of human capital and signalling that are not captured. Other aspects of human capital can include field-specific education, skills aquired through on-the-job training, and expertise accrued through experience. We assume that PIAAC scores measure an underlying construct – cognitive ability – which would contribute to earnings both in job selection and in post-selection job performance. Similarly, signalling also includes the status of educational institutions (Rivera, 2015) and other affiliations, activities and experience, which are not measured here.

Our focus is therefore on how the ratio of how these two components of human capital and signalling contirbute to earnings, and how this ratio varies across countries. Given the sample size of PIAAC and the variation in educational qualifications and cognitive skills in the populations studied, it is possible to disaggregate how these two variables are related to earnings. We do so using a logistic regression of the following form:

$$(1)\quad Y = \beta_0 + \beta_1 Num + \beta_2 Lit + \beta_3 PS + \beta_4 HE + \beta_5 Sec + \beta_{6\ldots K} X$$

Our primary outcome variable (Y) is the probability that an individual earns above a given decile in their country's earnings distribution, for example, the probability of earning above the 70th percentile (or more than 70% of other people in the country). We use a dichotomous outcome variable and logistic regression because of the way that income data are reported in PIAAC. While PIAAC does collect raw earnings data (i.e. earnings in dollars), these data are missing for seven countries. Countries with missing earnings data include the United States (the focus of Caplan's analysis) as well as countries with relatively important and unique models of skills in the labour market, for example, Germany and Singapore. Since all these countries include relative earnings in deciles, this outcome variable presents the best opportunity for international comparative study. However, the use of earnings percentiles also prevents cross-country analysis of differences in earnings.

We, therefore, use "premium" to denote an increased probability of attaining a given income level relative to the rest of the national population, rather than an increase measured in monetary terms. While the two approaches to measuring the returns to skills are conceptually similar, it is important to understand the distinction between an increased probability of relative earnings at a given level and an increase in absolute earnings.

The dependent variable Y is analyzed as an outcome of a series of variables from the PIAAC survey. These variables include the individual's scores on the PIAAC numeracy, literacy and problem-solving assessments (Num, Lit, PS, respectively), with the relation to earnings captured in coefficients β_1, β_2, and β_3, respectively. Additionally, the relationship between qualifications and earnings is analyzed through the dummy variables indicating whether the individual's highest qualification is a higher education degree (D) or a secondary school diploma (S), relative to a reference group who have not completed secondary school.

PIAAC reports respondents' highest level of completed formal education coded in six ordinal levels based on the International Standard Classification of Education:

1. Lower secondary or less (ISCED 1,2, 3C short or less)
2. Upper secondary (ISCED 3A-B, C long)
3. Post-secondary, non-tertiary (ISCED 4A-B-C)
4. Tertiary – professional degree (ISCED 5B)
5. Tertiary – bachelor degree (ISCED 5A)
6. Tertiary – master/research degree (ISCED 5A/6)

For the purposes of analysis we distinguish between three different levels of education: less than secondary school (level 1 in the PIAAC classification), completed secondary school (level 2) and "higher education" (levels 3 - 7). We use the term "higher education" loosely to encompass both tertiary and non-tertiary post-secondary education; while recognizing the formal distinction between the two categories, international differences in the structure of post-secondary education makes a combined consideration the most insightful approach (see Barakat and Shields, 2019 for further discussion on the amalgamation of these categories). All amalgamation of categories therefore occurs at the post-secondary level (i.e. ISCED levels 4 to 7). Without algamating ISCED levels, results become somewhat incomparable across countries due to the different nature of their post-secondary education systems. For example, in the United Kingdom, nontertiary post-secondary education (ICSED 4) has a significantly negative coefficient, as vocational qualifications are also regarded as second-tier in the labour market (Shields and Masardo, 2018). In countries with more coordinated economies, the value of a "professional degress" (ISCED 5B) is greater than or similar to a "bachelor's degree" (ISCED 5A, e.g. in Austria, Germany and the Czech Republic), while in liberal economies the bachelor's degree has a greater link to earnings (e.g. the UK, Ireland and New Zealand). Because of these differences in the nature of post-secondary education across countries, the analysis has the most coherency when all types of post-secondary education are considered together. The appendix shows a breakdown of the relationship between earnings and qualifications across all six levels of the qualification coding.

In order to disaggregate the skills and qualifications from other social characteristics, we control for confounding variables (represented in the matrix *X*) that may be associated with both cognitive skills and educational qualifications. Socioeconomic status is particularly important given the large literature on the reproduction of social status through education (Bourdieu and Passeron, 1990) and the strong relationship between socioeconomic status and educational outcomes (Jehangir, Glas and van der Berg, 2015). To control for socioeconomic status, our model includes parents' highest completed educational qualification using the same three-level coding (less than secondary, secondary, higher education) and we include an ordinal measure of the number of books respondents reported in their childhood home. We also use control for the earnings premiums associated with particular educational fields using a simple three-level coding: (1) business, law and social science (2), science, technology, engineering and mathematics (STEM) and (3) other fields. While this is a coarse analysis of complex and subtle differences between fields, it is the best available way to disaggregate educational qualification from fields of study. Finally, we include respondents' gender (using the binary coding employed in PIAAC) and age, measured in five-year intervals. The relationship between these variables and earnings is captured in the coefficients $\beta_{6...K}$.

We estimate model parameters (i.e. β_0 to β_k) in two ways. First, we perform the regression independently for each country in the PIAAC dataset, resulting in a different set of parameters for each country. We also use different income thresholds for the dichotomous outcome Y, ranging from earnings above the 20th percentile to the 90th percentile (in decile increments), and we perform the regression with every threshold for every country. These results are used for the visual presentation of results in Figures 1 to 4 below. Second, we perform the regression model across the entire PIAAC dataset using a random intercepts model (Pinheiro & Bates, 2000). This allows more general conclusions about the relationship between cognitive skills, qualifications and earnings, as well the ability to concisely report a complete set of results that include control variables.

Results

In using income deciles as an outcome, a preliminary question concerns how relationships in the model vary earnings across the income distribution. In other words, when the outcome Y is set to a different income threshold (e.g. the 80th percentile versus the 50th), do the parameters in the model change? If this were the case, the premiums of skills and qualifications would have to be considered at each point in the income distribution. However Figure 1 shows that returns to both qualifications and skills are relatively consistent across the earnings distribution from percentiles 20 to 90; however, the confidence interval becomes much larger at the 90th percentile. Thus, while education may allow individuals to attain higher levels of income, there is much less certainty around how it relates to the *highest* levels of income. Based on these results, we proceed to show results using an outcome of earning above the 70th percentile below; results for other income thresholds (presented in the appendix) are broadly similar.

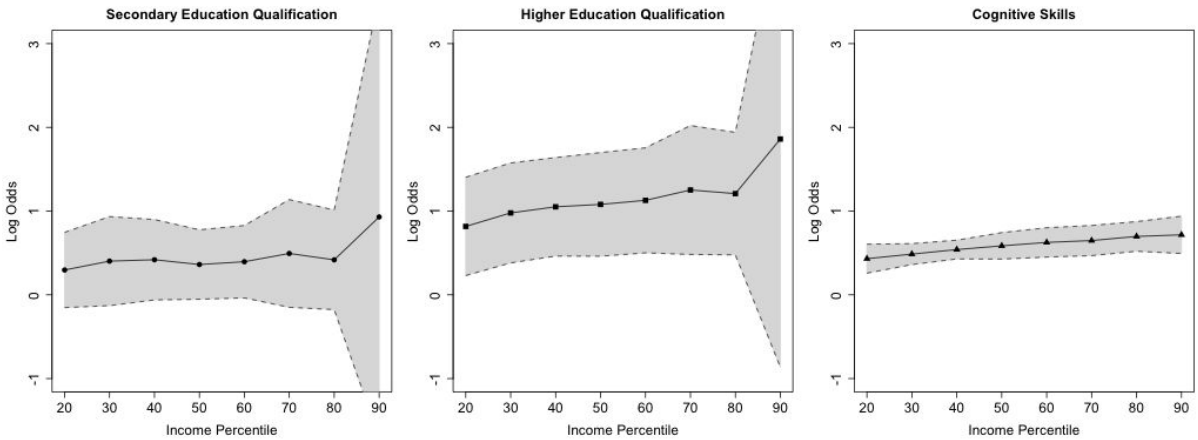

Figure 1: Relationship between secondary education qualifications, higher education qualifications and total skills and the probability of earning above income deciles 20 to 90. Results show that the premium from secondary education is constant across the income distribution, while higher education and cognitive skills increase slightly. The confidence interval around the 90th percentile is much wider than for lower earnings, suggestion that the relationship between education and very high earnings is uncertain.

The contributions of educational qualifications and cognitive skills can be analyzed in both absolute and relative terms. An analysis of the absolute contributions focuses on the size of the association between income and either (or both) factors. In some labour markets, the contributions of both factors may be high, while in others earnings may be largely unrelated to skill and qualifications. In contrast, assessing the relative contribution involves comparing the contribution of educational qualifications to the skills that it supposedly reflects: in other words, the relative contribution is the ratio of the qualifications contribution to the skills contribution.

	Model 1	Model 2
Intercept (β_0)	-1.040**	-0.810**
	(0.096)	(0.061)
Cognitive Skills		
Numeracy (β_1)	0.293**	0.263**
	(0.083)	(0.034)
Literacy (β_2)	0.100	0.013
	(0.085)	(0.037)
Problem Solving (β_3)	0.191**	0.244**
	(0.058)	(0.027)
Qualifications (Ref = "Less than Secondary")		
Secondary Education (β_4)	0.378**	0.218**
	(0.096)	(0.064)
Higher Education (β_5)	1.124**	0.890**
	(0.099)	(0.061)
Field of Study (Ref = "Other")		
Business, Law & Soc. Sci. (β_6)	0.394**	0.459**
	(0.082)	(0.032)
STEM (β_7)	0.246**	0.219**
	(0.069)	(0.030)
Parental Qualifications		
Parent: Secondary Education (β_8)	0.203**	0.085**
	(0.051)	(0.026)
Parent: Higher Education (β_9)	0.092	0.098**
	(0.061)	(0.036)
Gender = Female (β_{10})	-1.226**	-1.715**
	(0.057)	(0.120)
Age (5 Year Cohorts) (β_{11})	0.259**	0.191**
	(0.027)	(0.011)
Childhood Books at Home (β_{12})	0.060	0.045**
	(0.034)	(0.014)
Female × Secondary Education		0.272
		(0.138)
Female × Higher Education		0.670**
		(0.117)
N	58,937	58,937
Groups	27	27
Between Group Variation ($\sigma_{\beta 0}$)	0.323	0.319

Table 1: Results from the random intercepts model for all countries in the analysis. The dependent variable is the log odds ratio of earning above the 70th income percentile Regression coefficients for continuous variables (i.e. cognitive skills, age, and childhood books at home) are presented in standardized coefficients.

Table 1 shows the results from the parameter estimates across all countries, using a random intercepts model (Pinheiro and Bates, 2000); thus the relationship between qualifications, cognitive skills and earnings is assumed to be fixed across countries. Results show that across the 27 countries studied, the earnings power of higher education overshadows most other factors, including all cognitive skills combined. Sadly, the only stronger predictor of earning above the 70th percentile is gender, with females much less likely to receive these earnings than males. Among the control variables, another interesting finding is the strength of business and law, which has a greater earnings premium than STEM fields. While our international comparative analysis focuses on differences between countries, these results show that across all countries there is a tendency for qualifications to contribute more to earnings than cognitive skills. However, cross-country averages still allow for substantial differences between countries, particularly if the relationship between cognitive skills, qualifications and earnigns is moderated by national context.

Among cognitive skills, numeracy has the strongest earnings premium followed by problem-solving. While the premium from literacy skills is not distinguishable from zero across all countries (i.e. it is non-significant), it is nevertheless retained in the analysis of skills below because in some countries it is an important component of skills-related earnings. Overall, results from Model 1 support the notion that higher education has a strong signalling value across countries, because its earning premium is many times that associated with variation in skills. Comparing the coefficients of qualifications and cognitive skills is challenging because they are measured on different scales, however the normally distributed scaling of PIAAC cognitive scores provides a way to compare coefficients with respect to the larger population. For example, the average premium of a degree across countries (0.890 in Model 2) is of a similar magnitude to a 3.38 standard deviation increase in numeracy ($0.890 \div 0.263 = 3.38$). Thus, to equal the earnings power of a degree based on numeracy skills, an individual needs to outperform above the third standard deviation in numeracy, higher than 99.9% of the population! Further strategies for comparing cognitive skills scores and qualifications are employed in the cross-national analysis below.

Model 2 extends the analysis by adding an interaction term between gender and qualifications. This adds the important insight that across all 27 countries, the earnings premium of a degree is greater for females. Thus, signalling also has some benefit in that it signals equal ability and reduces unjust prejudice and discrimination.

However, Figure 2 goes into greater detail by showing the relationship between educational qualifications, skills and earnings premium across 27 countries in the PIAAC study. The association between higher education earnings (β_4) and secondary education and earnings (β_5) is shown as a solid circle and square, respectively, and countries are ordered from lowest to highest on their values for these two data points. They are connected by a dashed line to show the range of returns associated qualifications when controlling for cognitive skills and other social and demographic factors. These values, therefore, represent the closest measure of "signalling" that can be obtained from the data, as they are essentially the earnings value of qualifications when cognitive skills are removed.

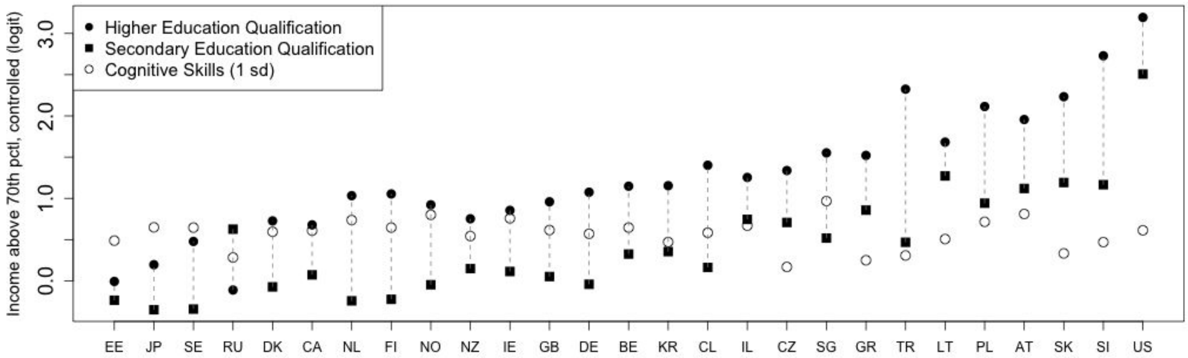

Figure 2: The probability of earning above the 70th income percentile as an outcome of higher education qualifications, secondary education qualifications, and one standard deviation of cognitive skills in 27 different countries. Results show that in some countries, the premium from qualifications is comparable to "typical" variation in cognitive skills (i.e. one standard deviation), while in other countries it is many times higher.

The total returns to skills are shown as an unfilled circle, which represents the sum of the coefficients for Numeracy, Literacy, and Problem Solving (i.e. $\beta_1 + \beta_2 + \beta_3$). Since the cognitive skills variables are standardized, this point represents the premium for an individual who is one standard deviation above average on numeracy, literacy, and problem solving within each country.

Several key findings emerge from this figure. First, the relationship between qualifications and earnings varies considerably between countries. In some countries such as Estonia (EE), Canada (CA) and Japan (JP) qualifications have a minimal relationship to earnings while in other countries such as the United States (US), Austria (AT), Turkey (TK) there is a strong relationship between qualifications and earnings. As one might expect, in nearly all countries, a higher education degree (filled circle) has a greater earnings premium than a secondary school qualification (filled square).

Second, the relative contributions of cognitive skills and qualifications also vary across countries. For example, in Denmark (DK), Canada (CA), Norway (NO), and Ireland (IE), the contributions of a one standard deviation increase in cognitive skills are comparable to those from higher education, and greater than those from secondary education. In other countries, the value of cognitive skills is comparable to higher education, for example in the United Kingdom (GB), Germany (DE) and Singapore (SG), the earnings associated with one standard deviation of cognitive skills are between those of secondary and higher education qualification. However, in countries such as the United States (US), Slovakia (SK) and Greece (GR), the contribution of skills is much less than qualifications. In these contexts, even an individual who was two standard deviations above average in their cognitive skills (i.e. more skilled than 97% of the population) would still have less chance of a high income than someone with a university degree. It is particularly noteworthy that in the United States, the focus of most of Caplan's analysis, the gap between cognitive skills and qualifications is the largest of all countries.

Third, the premium from cognitive skills is not associated with the qualifications premium. In other words, looking from left to right across the graph, the cognitive skills premium largely forms a flat line. While there is considerable variation from country to country, there is no trend such that the cognitive skills premium increases (or decreases) with the qualifications premium. Therefore, it also follows that the two types of premium are not at odds with one another; a higher premium on qualifications does not mean a lower premium on cognitive skills, and *vice versa*.

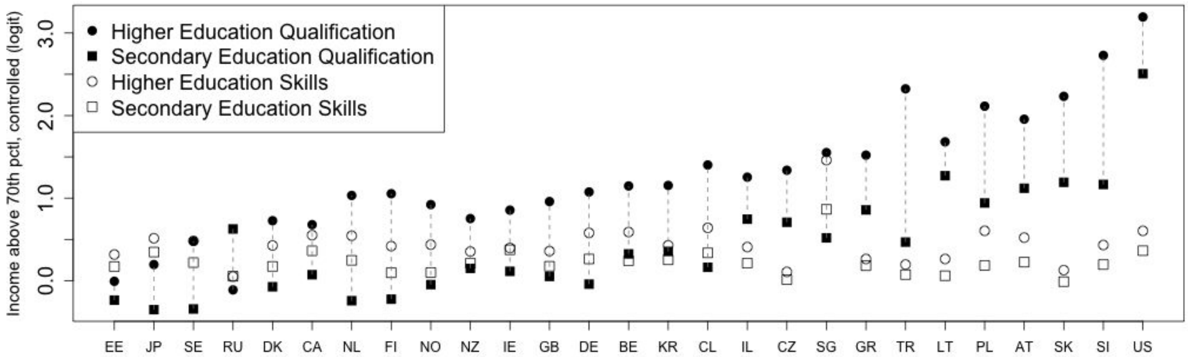

Figure 3: The probability of earning above the 70th income percentile as an outcome of higher education qualifications, secondary education qualifications, and the cognitive skills associated with these levels of education skills in 27 different countries. Results show that the contributions of skills and qualifications varies considerably across countries.

Figure 3 develops the analysis further by linking the cognitive skills to the averages obtained in each country's education system. Rather than the somewhat arbitrary measure of a one standard deviation increase in cognitive skills, the skills gain associated with each level of education is multiplied by benefits from skills to estimate *cognitive skills from education*, shown in a hollow square and circle for secondary and higher education, respectively. Caplan rightly warns of an "achievement bias," the assumption that cognitive gains are caused by education rather than individuals achieving to a level that matches their own intellectual ability. To address this concern, our estimates of the skills gained from education are conditioned on the same control variables (X) used in the analysis of earnings, such that the influences of factors such as home resources and socioeconomic status are mitigated.

Results show similar results to those in Figure 2, namely that there is considerable variation across countries in the relative contributions of qualifications and cognitive skills to earnings. Particularly at the level of secondary education (square point markers), the value of cognitive skills gained in education exceeds the value of the qualification itself in many countries. The value of cognitive skills from higher education is less clear. On the one hand, across most countries' university graduates have higher levels of cognitive skills than individuals with a secondary school qualification. However, since university graduates would also have completed secondary education, the value-added by cognitive skills from higher education is quite low (i.e. the gap between the outlined circle and the outlined square). There are two possible explanations for this result: the first is that higher education is generally not intended to develop the generic cognitive skills measured by PIAAC (i.e. numeracy, literacy and problem solving). Instead, it provides specialised, specific skills and perhaps other generic skills that are not measured by PIAAC, for example, critical thinking, intercultural communication and teamwork. The second explanation, in line with Caplan's argument, is that most of the value of higher education is due to signalling.

More important than the absolute ratio of "signal" to "skills," the analysis is important in showing variation in this ratio across countries. In particular, cross-national analysis shows that the high signalling value of higher education in the United States is not inevitable, but rather occurs by design (Hansen, 2011). Other countries show that it is possible to align education systems and labour markets such that the value of educational qualifications more closely matches generic cognitive skills; when one considers that these qualifications also "bundle" other benefits not measured in PIAAC's cognitive skills, including specialised skills and generic non-cognitive skills, the "case against education" is replaced with a recognition of its value for individuals and societies.

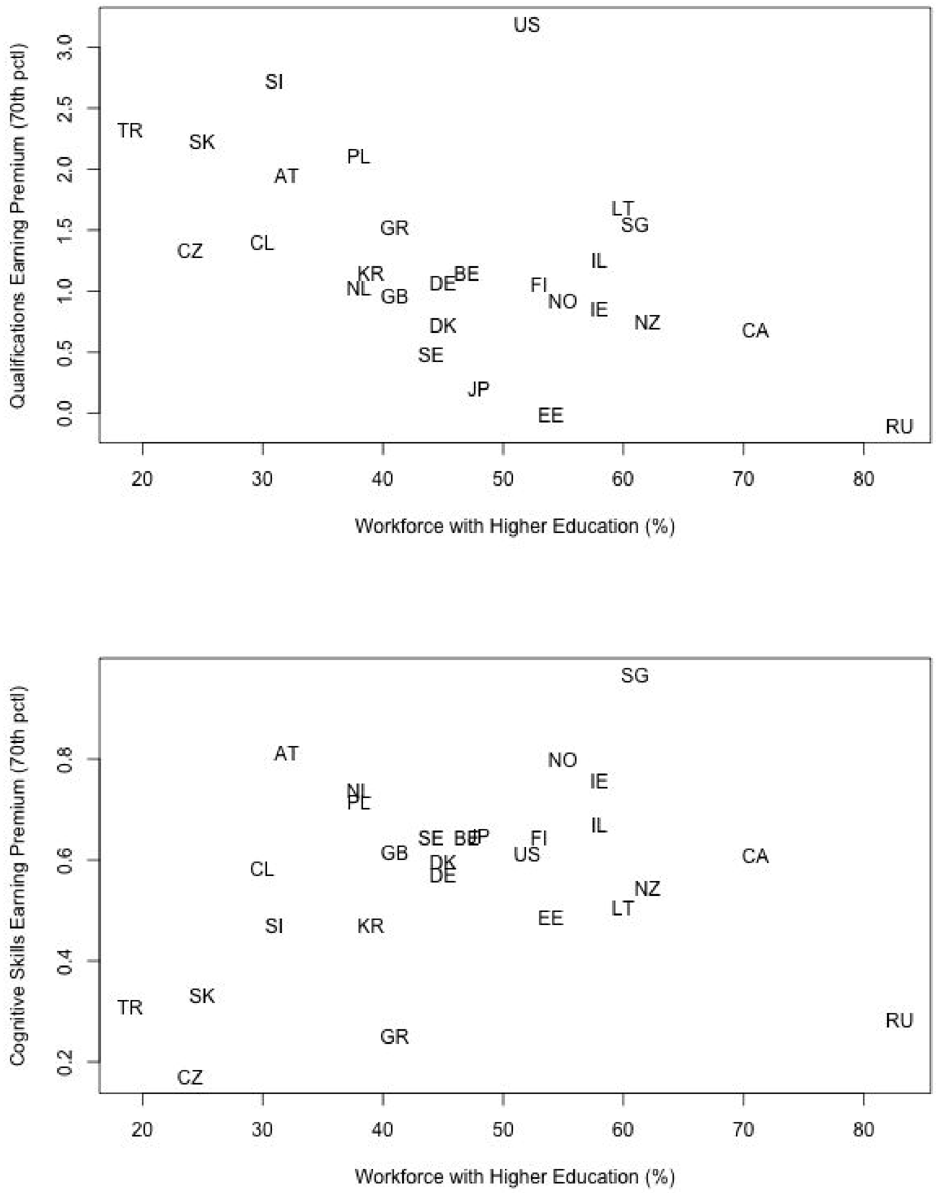

Figure 4: The higher education qualifications premium and cognitive skills premium in relation to the prevalence of higher education in 27 countries. Results show that countries with a greater share of the workforce who have completed higher education have a lower qualifications premium but a higher cognitive skills premium

If signalling occurs by design rather than as an inevitable consequence of education systems, then a key question is concerns the reasons that particular education systems and labour markets produce high signalling values. One explanation is shown in Figure 4, which plots the prevalence of qualifications and skills within a country against the premium associated with qualifications and skills. In both the top and bottom panels, the horizontal axis represents the percentage of the labour force who hold a higher education qualification. In the top panel, the vertical axis represents the earnings premiums for higher education qualifications (β_4); results show that, on average, as degree prevalence increases the qualifications premium decreases. Thus, as the prevalence of a degree goes up, the earnings premium associated with the degree goes down. What Autor (2014, p. 847) refers to as "remarkable explanatory power" of the "simple supply-demand framework" may apply not only to skills, but also to signalling; as the number of workers with degrees increases, the signalling power of degrees must decline. In the bottom panel, the vertical axis corresponds to the premium from cognitive skills ($\beta_1 + \beta_2 + \beta_3$); results show that in countries with higher degree prevalence, the value of cognitive skills in the labour market actually increases.

Combined, both panels show that the systems that Caplan might view as most desirable, i.e. a low return to qualifications (signalling) but a high return to skills, are actually those with *greater* access to higher education. While one might well disregard Russia as an anomalous case, countries such as Canada (CA), Ireland (IE), Norway (NO), New Zealand (NZ) and Singapore (SO) show that education systems that allow wider access to higher education also provide a high return to cognitive skills and place a low signalling value on higher education. Rather than a tradeoff between access to higher education and an earnings premium for skills, the two variables go hand-in-hand. Countries that value knowledge, or that have economies that require knowledgeable employees, are likely to reward these skills in the labour market *and* have more of a comparatively large share of the population who complete higher education. Thus, the results show that expanded access to higher education is also compatible (and associated) with an economic value placed on knowledge rather than on qualifications.

Thus, the supply of qualifications and their value in the labour market provides one explanation of the differences observed between countries in Figure 4. However supply and demand framework are only part of a bigger picture (Lauder, Brown and Cheung 2018), which likely includes labour market institutions, the regulatory environment, the composition of the national economy, and historical and geographical contexts. The many possible combinations of these factors ultimately exceeds the small the number of countries for which we have data, and we thus have only a partial picture of a much larger set of processes. However, with particular respect to the argument that access to education should be reduced due to high levels of signalling, a simple examination of supply and demand is incisive.

Discussion

Our analysis uses international comparative data to problematize Caplan's argument that "there's way too much education" (Caplan, 2018, p. 1). Variation across countries in the relationships between educational qualifications, cognitive skills, and earnings shows that a high "signalling" value of qualifications is not inevitable; on the contrary, the disproportionate influence of qualifications over cognitive skills in determining incomes appears to be mainly a peculiarity of the United States. In many other countries, the benefits cognitive skills are broadly comparable with qualifications, this pattern holds whether we consider cognitive skills as in terms of variation within the population (i.e. being one standard deviation above normal) or as an outcome of the education systems of these countries. Particularly at the level of secondary education, the economic value of the skills from education is on par with the value of the qualification itself in many countries.

Caplan has a stronger point in making a case against *higher education in some countries.*

Ironically, the countries where the signalling value of higher education is strongest are those countries with *less education*, not *more.* The signalling value of higher education is strongest in countries where access is lowest, and countries with higher levels of access to higher education tend to place more emphasis on cognitive skills rather than degrees.

While some of the earnings premium for university degrees may be related to the job-specific skills that are not included in the analysis (in contrast to general cognitive skills), the significant cross-national *variation* in the relative contributions of cognitive skills and qualifications makes it improbable that all of the degree premium is related to specific skills. Some of these international differences might be explained by the quality of the education systems, with the argument that higher quality systems producer greater skills and higher qualifications earning premiums. However, the lack of corresponding differences in economic output or productivity makes the case for differences in the skills content of higher education improbable. Rather, international variation suggests some degree of signalling is found in all most countries in the analysis, with particularly high levels in several countries.

The analysis above supports an approach to educational policy that provides widespread access to higher education. This sharply contrasts with Caplan's (2018, p.6) recommendation that "we would be better off if education were less affordable," as to achieve widespread access to higher education affordable access is a requisite. Given that elite universities and highly stratified systems are likely to lead to higher levels of signalling (Brown et al, 2012; Hoekstra, 2009), a relatively homogenous system with minimal status competition is the most likely way to reduce signalling. Even given these objectives, international evidence shows that different approaches are possible; countries such as Canada, New Zealand, Norway and Ireland all achieve high levels of access to higher education and low levels of signalling, but they have very different approaches to higher education policy and funding.

Limitations

In many sense, our analysis tends to overestimate signalling, as it attributes most of the earnings associated with a degree to signalling from qualifications rather than field-specific skills. Because our model includes only the basic cognitive skills measured by PIAAC and a very broad dummy variable for subject specification, we do not capture the specific and non-cognitive skills that are important outcomes of education, particularly higher education. Instead, these are aggregated into the qualifications earning a premium, which actually bundles many benefits from education, including some degree of job market signalling.

A second limitation relates to the attribution of cognitive skills to education: as mentioned above, there is some assumption that these skills result from the given level of education. It is also possible that an individual's ultimate educational attainment is partially determined by their cognitive skills. Our analysis accounts for this problem in attributing the source of cognitive skills by controlling for social background in estimating the cognitive skills gain from secondary and higher education. Thus, advantages in cognitive skills that come from home background are not attributed to education, but it is still possible that the development of cognitive skills from sources other than education (home, social environment, etc) are mis-attributed to education.

In the context of a comparative analysis of the contributions of qualifications and cognitive skills to earnings, these two limitations are somewhat complementary. The first tends to overestimate signalling by discounting all the other benefits of a degree such as specialized skills; the other tends to underestimate signalling by attributing cognitive skills to schools.

Conclusion

These limitations notwithstanding, our analysis is useful in illustrating cross-national variation in the relative contributions of qualifications and cognitive skills to earnings. We show that this variation is substantial and that any claim that education is either primarily about human capital or skills should be limited to a particular context rather than made universally. This finding also helps to explain and reconcile previous studies that yield differing results regarding the relationship between human capital and signalling (or the extent of overeducation), as these divergent results may be due to differences in the context of the study. Finally, our analysis provides a counter-intuitive approach to limiting signalling in labour markets: by making access to higher education more widely available.

A useful endeavour for future research would be to develop a more complete measure of the skills that result from higher education, including not only the general measures of cognitive skills analysed here but also specialised technical skills and non-cognitive skills such as intercultural communication and teamwork. Such a measurement would provide a more robust empirical framework for comparing human capital (in its entirety) and signalling in the labour market, rather than the analysis of cognitive skills (an important part of human capital theory) undertaken here. Developing a more complete picture of the bundle of skills and abilities imparted through higher education would lead to a more informed debate of the relative contributions of signalling and skills to labour market outcomes.

References

Autor, David H. (2014). "Skills, Education, and the Rise of Earnings Inequality Among the 'Other 99 Percent.'" *Science*, 344(6186), 843-851. DOI: 10.1126/science.1251936

Barakat, B., & Shields, R. (2019). Just another level? Comparing quantitative patterns of global expansion of school and higher education attainment. *Demography*, Forthcoming.

Barone, C., & Ortiz, L. (2011). Overeducation among European university graduates: A comparative analysis of its incidence and the importance of higher education differentiation. *Higher Education* 61(3), 325–37.

Becker, G. S. (1994). *Human capital: A theoretical and empirical analysis with special reference to education* (3rd Edition). Chicago, IL: The University of Chicago Press.

Bills, D B. (2003). Credentials, signals, and screens: Explaining the relationship between schooling and job assignment. *Review of Educational Research,* 73 (4): 441–49.

Bourdieu, Pierre, and Jean-Claude Passeron. 1990. *Reproduction in Education, Society and Culture*. Second edition, translated by Richard Nice. London, Sage.

Brown, P., Lauder,, H. & Ashton, D. (2012). *The Global Auction*. *The Broken Promises of Education, Jobs, and Incomes*. Oxford University Press.

Brown,P., Lauder, H., and Cheung, S.Y. (2019) The Death of Human Capital? New York, Oxford University Press.

Caplan, B. (2018). *The Case Against Education: Why the Education System is a Waste of Time and Money*. Princeton, NJ: Princeton University Press.

Cardoso, A. (2007). Jobs for young university graduates. *Economics Letters*, 94(2), 271–77.

Chevalier, A. (2003). Measuring over-education. *Economica*, *70*(279), 509-531.

Collins, R. (1979). *The Credential Society: An Historical Sociology of Education and Stratification*. New York: Academic Press.

Collins, R. (2002). "Credential Inflation and the Future of Universities." *The Future of the City of Intellect: The Changing American University*, 23–46.

Foucault, M. (2004). *The Birth of Biopolitics: Lectures at the Collège de France, 1978-1979*. Translated by Graham Burchell. New York: Palgrave MacMillan.

Groot, W., & Van Den Brink, H. M. (2000). Overeducation in the labor market: a meta-analysis. *Economics of education review*, *19*(2), 149-158.

Hansen, H., (2011), Rethinking Certification Theory and the Educational development of the United States and Germany, *Research in Social Stratification and Mobility*, 29,1, 31-55.

Hanushek, E.A., Schwerdt, G., Wiederhold, S. and Woessmann, L., (2013). Returns to skills around the world: Evidence from PIAAC. *OECD Education Working Papers*, No. 101, OECD Publishing, Paris.

Hoekstra, M. (2009). The effect of attending the flagship state university on earnings: A discontinuity-based approach. *The Review of Economics and Statistics*, *91*(4), 717-724.

Hirsch, F. (1976). *Social Limits to Growth*. Cambridge, MA: Harvard University Press.

Jehangir, K., Glas, C. A., & van den Berg, S. (2015). Exploring the relation between socio-economic status and reading achievement in PISA 2009 through an intercepts-and-slopes-as-outcomes paradigm. *International Journal of Educational Research*, *71*, 1-15.

Jones, P.W. (2004). Taking the credit: financing and policy linkages in the education portfolio of the World Bank. In G. Steiner-Khamsi (ed.), *The Global Politics of Educational Borrowing and Lending*. New York: Teachers College Press, pp. 188-200.

Lauder, H. (2015). Human capital theory, the power of transnational companies and a political response in relation to education and economic development.*Compare: A Journal of Comparative and International Education*, 45(3), 490-493.

Lauder, H, Brown, P., and Cheung, S.Y, (2018) Fractures in the education–economy relationship: the end of the skill bias technological change research programme? *Oxford Review of Economic Policy,* Volume 34, Number 3, 2018, pp. 495–515

McGuinness, S. (2006). Overeducation in the labour market. *Journal of Economic Surveys*, 20(3), 387–418.

Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of Political Economy*. 66, 281-302.

Moretti, E. (2004). Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data. *Journal of Econometrics*, *121*(1-2), 175-212.

Oliveira, M. M. de, M C Santos, and B F Kiker. (2000). “The role of human capital and technological change in overeducation.” *Economics of Education Review* 19 (2): 199–206.

OECD. (2012). Literacy, Numeracy and Problem Solving in Technology-Rich Environments: Framework for the OECD Survey of Adult Skills. Paris: OECD Publishing.

Mohadjer, L., Krenzke, T., & Van de Kerchove, W. (2013) Survey Weighting and Variance Estimation. In *Technical Report of the Survey of Adult Skills (PIAAC)*. Paris: OECD

OECD (2016). *Skills Matter: Further Results from the Survey of Adult Skills*. Paris: OECD Publishing.

Pinheiro, J.C., and Bates, D.M. (2000). *Mixed Effects Models in S and S-Plus*. New York: Springer.

Reisel, L. (2013). Is more always better? Early career returns to education in the United States and Norway. *Research in Social Stratification and Mobility,* 31, 49–68.

Rivera, L.A. (2015). *Pedigree: How Elite Students Get Elite Jobs*. Princeton, NJ: Princeton University Press.

Rostow, W.W. (1960). *The Stages of Economic Growth: A Non-Communist Manifesto*. Cambridge: Cambridge University Press.

Shields, R., & Masardo, A. (2018). False equivalence? Differences in the post-16 qualifications market and outcomes in higher education. *Educational Review*, *70*(2), 149-166.

Spence, M. (1973). Job Market Signaling. *Quarterly Journal of Economics*, 87(3), 355–374

Stiglitz, J. E. (1975). The theory of “screening,” education, and the distribution of income. *American Economic Review*, 65(3), 283

Stiglitz, J. & Weiss, A. (1990). Sorting out the differences between signaling and screening models. National Bureau of Economic Research Paper Series. 93, 1-41. Retrieved from https://www.nber.org/papers/t0093.pdf

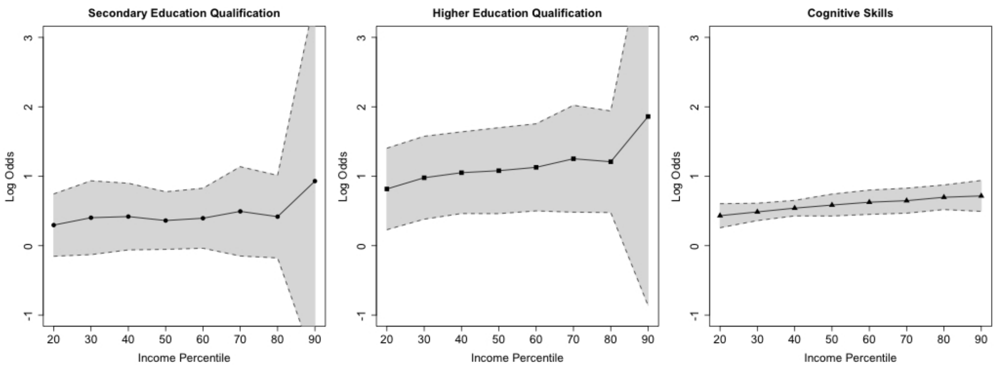

Figure 1

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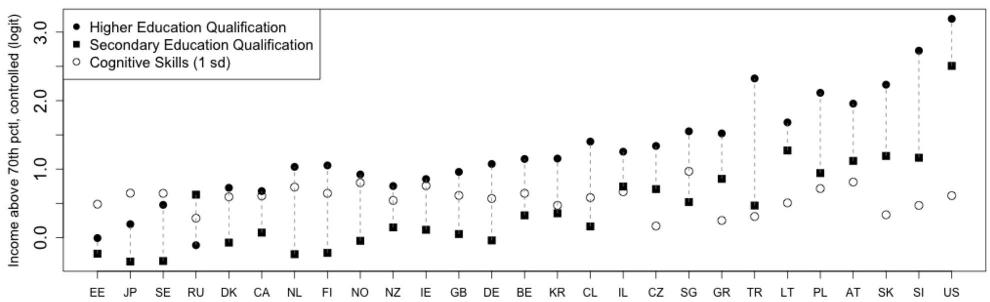

Figure 2

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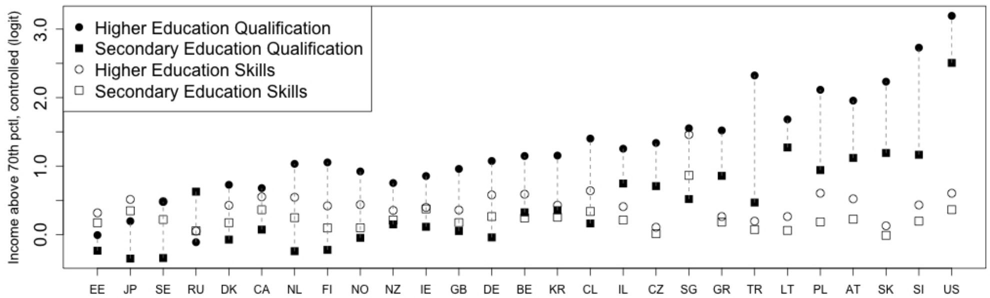

Figure 3

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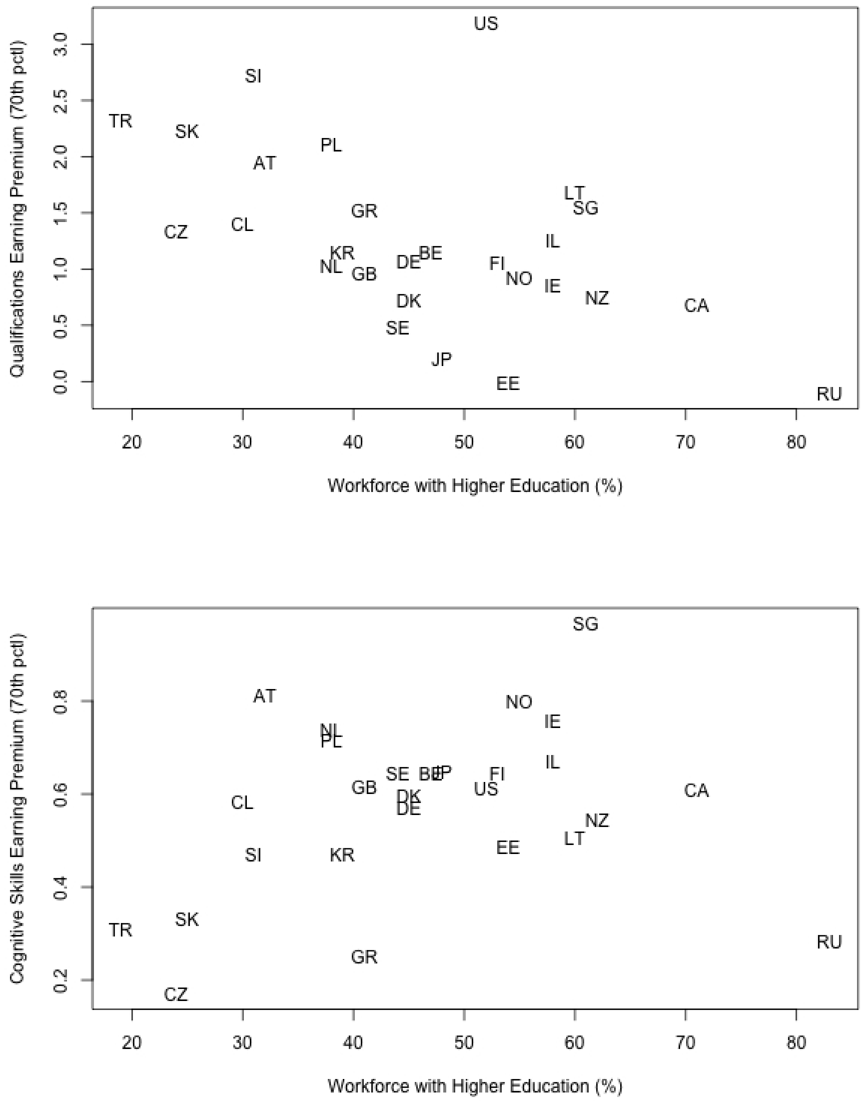


Figure 4

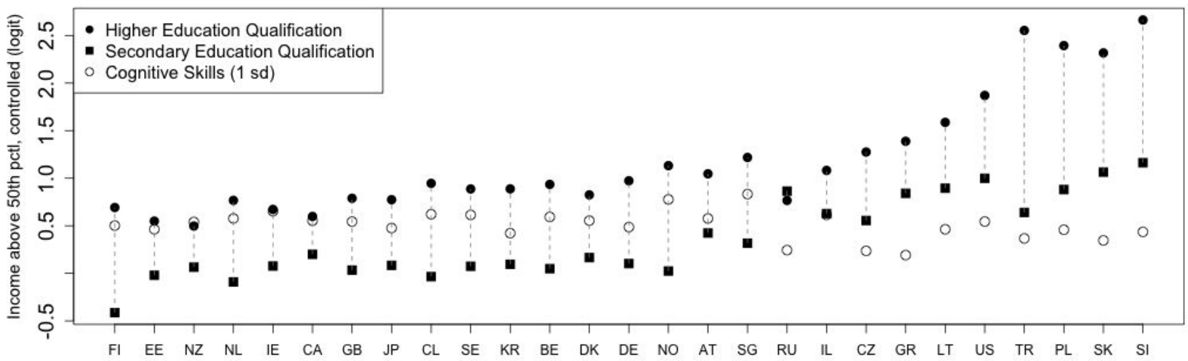
211x282mm (72 x 72 DPI)

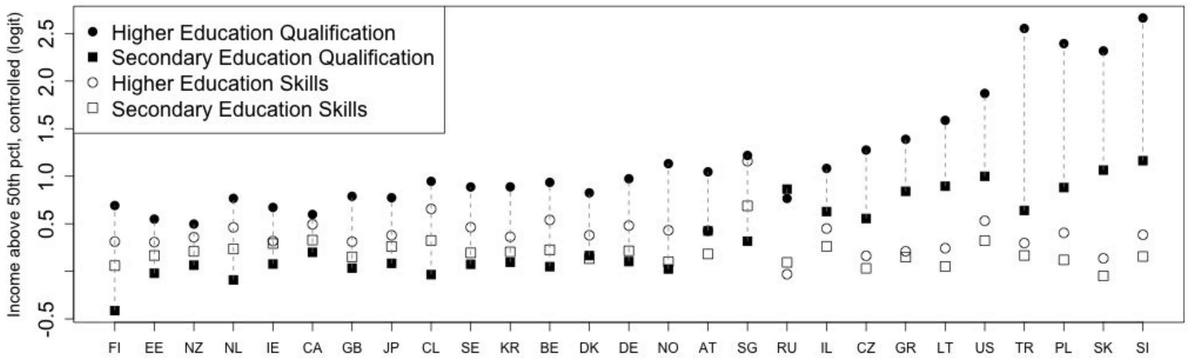
	Model 1	Model 2
Intercept (β_0)	-1.040**	-0.810**
	(0.096)	(0.061)
Cognitive Skills		
Numeracy (β_1)	0.293**	0.263**
	(0.083)	(0.034)
Literacy (β_2)	0.100	0.013
	(0.085)	(0.037)
Problem Solving (β_3)	0.191**	0.244**
	(0.058)	(0.027)
Qualifications (Ref = "Less than Secondary")		
Secondary Education (β_4)	0.378**	0.218**
	(0.096)	(0.064)
Higher Education (β_5)	1.124**	0.890**
	(0.099)	(0.061)
Field of Study (Ref = "Other")		
Business, Law & Soc. Sci. (β_6)	0.394**	0.459**
	(0.082)	(0.032)
STEM (β_7)	0.246**	0.219**
	(0.069)	(0.030)
Parental Qualifications		
Parent: Secondary Education (β_8)	0.203**	0.085**
	(0.051)	(0.026)
Parent: Higher Education (β_9)	0.092	0.098**
	(0.061)	(0.036)
Gender = Female (β_{10})	-1.226**	-1.715**
	(0.057)	(0.120)
Age (5 Year Cohorts) (β_{11})	0.259**	0.191**
	(0.027)	(0.011)
Childhood Books at Home (β_{12})	0.060	0.045**
	(0.034)	(0.014)
Female × Secondary Education		0.272
		(0.138)
Female × Higher Education		0.670**
		(0.117)
N	58,937	58,937
Groups	27	27
Between Group Variation ($\sigma_{\beta 0}$)	0.323	0.319

Appendix

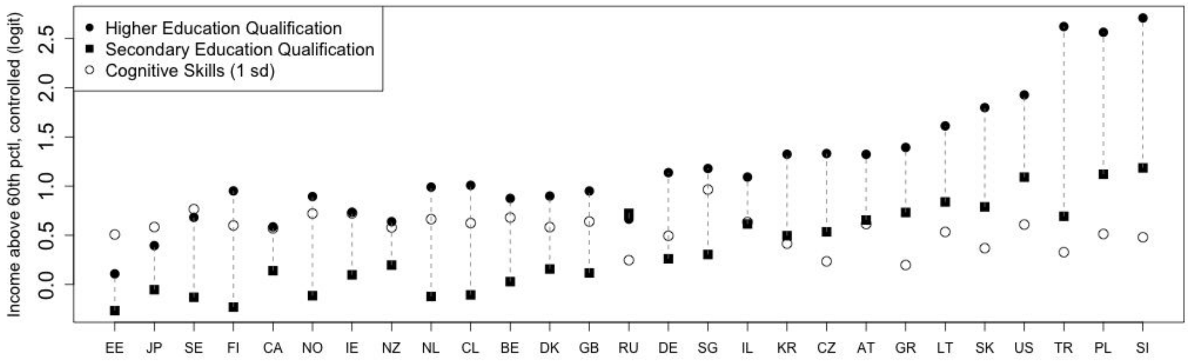
This appendix reproduces Figures 2 and 3 using earnings thresholds set at different levels. It illustrates that the results are conceptually similar regardless of the earnings threshold used in the regression analysis.

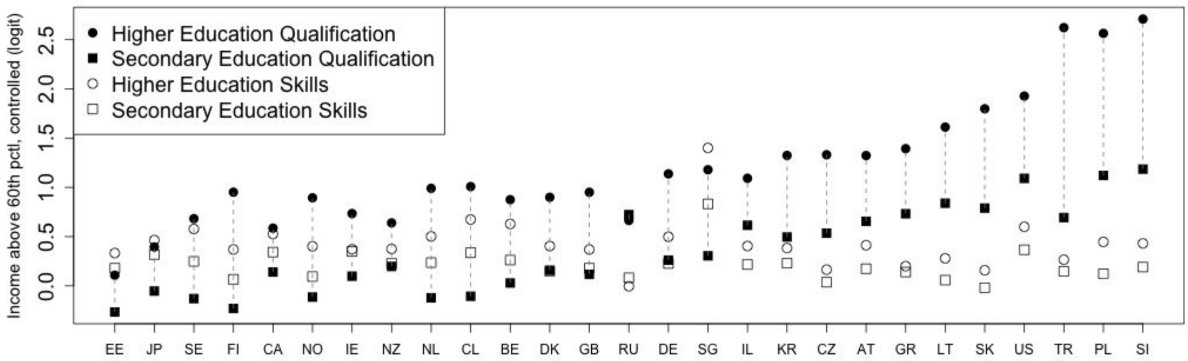
50th Percentile



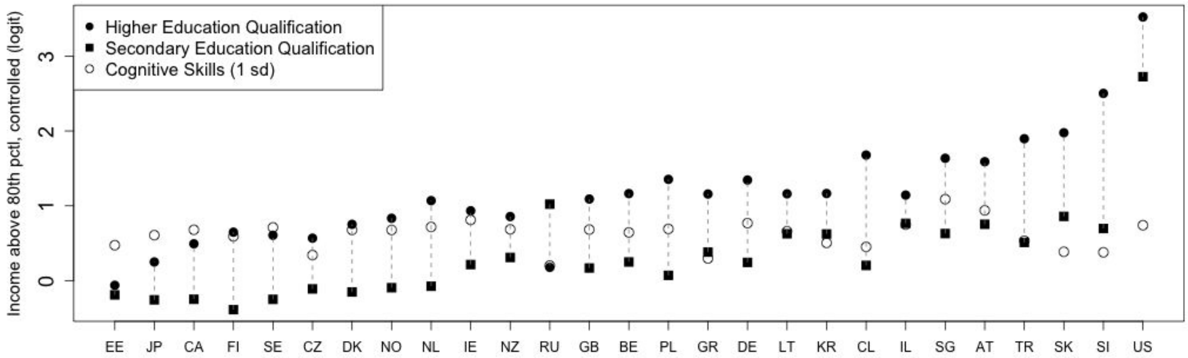


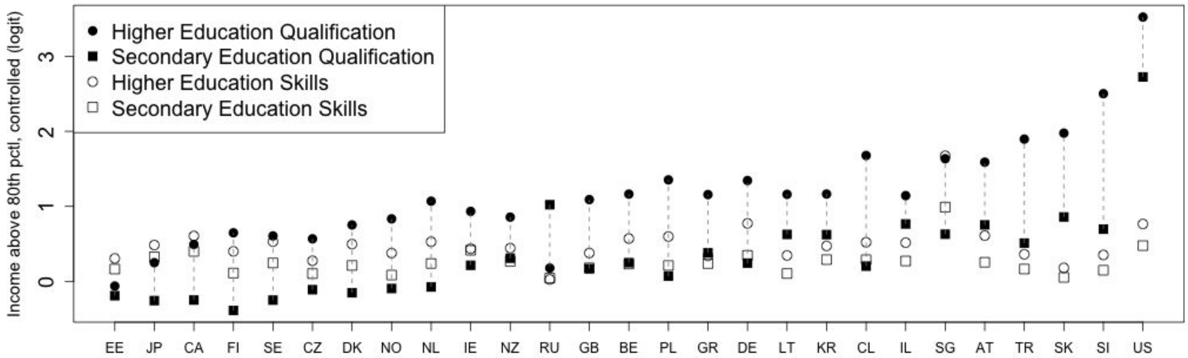
60th Percentile





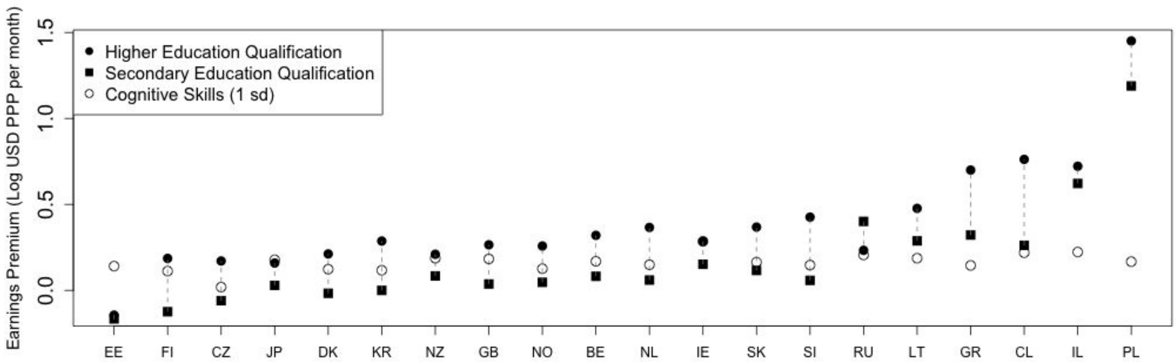
80th Percentile





Results for Monthly Earnings

As explained in the paper text, our analysis uses logistic regression analysis of the probability of attaining a given earnings percentile due to the limited coverage of raw earnings data. The plot below shows results from an ordinary least squares (OLS) regression for countries that report raw earnings data, using earnings per month in US Dollars, Purchasing Power Parity (USD PPP) as the dependent variable. The analysis includes the same set of control variables as Figure 2 in the paper text. This shows that our choice of earnings deciles as an outcome variable do not meaningfully alter our findings.



Earnings Across All Qualifications

The table below shows regression coefficients for all six levels of the ISCED qualification levels as coded in the PIAAC EDCAT6 variable. Coefficients are based on a logistic regression model using earning at the 70th percentile as the dependent variable, and the same set of control variables used in Table 1 and Figure 2 of the main body.

	Lower Secondary (Reference Category)	Upper Secondary (ISCED 3)	Post-Secondary (ISCED 4)	Professional Degree (ISCED 5B)	Bachelor's Degree (ISCED 5A)	Masters/Research Degree (ISCED 5A/6)
Austria	(0.00)	0.783	1.157	1.436	1.073	2.235
Belgium	(0.00)	0.384	0.405	0.981	1.472	2.046
Canada	(0.00)	-0.174	-0.041	0.373	0.933	1.510
Chile	(0.00)	0.243	1.219	2.60	2.922	0.110
Czech Rep.	(0.00)	-0.116	0.306	0.754	0.31	0.621
Germany	(0.00)	0.177	0.226	1.061	1.194	1.947
Denmark	(0.00)	-0.078	-0.034	0.415	1.127	1.602
Estonia	(0.00)	-0.106	-0.405	-0.429	-0.045	0.412
Finland	(0.00)	-0.373	0.435	0.150	0.506	1.686
UK	(0.00)	0.196	-13.538	0.553	1.41	0.044
Greece	(0.00)	0.425	0.522	0.803	1.565	1.728
Ireland	(0.00)	0.413	0.139	0.806	1.945	2.246
Israel	(0.00)	0.802	0.668	1.301	1.709	0.224
Japan	(0.00)	-0.225	-0.127	-0.239	0.466	1.259
Korea	(0.00)	0.635	0.822	1.344	1.88	0.312
Lithuania	(0.00)	0.684	0.760	0.962	1.536	2.036
Netherlands	(0.00)	-0.030	0.476	1.078	1.518	0.236
Norway	(0.00)	-0.116	0.267	0.858	0.828	1.515
N. Zealand	(0.00)	0.374	0.273	0.585	1.138	1.497
Poland	(0.00)	0.051	0.713	0.904	1.522	0.110
Russian Fed.	(0.00)	0.998	0.838	-0.256	-1.163	0.194
Singapore	(0.00)	0.804	0.64	1.601	2.393	3.082
Slovak Rep.	(0.00)	0.874	0.66	1.253	2.112	0.056
Slovenia	(0.00)	0.725	2.091	2.869	3.629	0.265
Sweden	(0.00)	-0.238	0.231	0.465	0.562	1.207
Turkey	(0.00)	0.593	1.00	2.382	2.438	0.252
USA	(0.00)	2.827	2.614	3.133	3.792	4.325