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Revisiting the effects of skills on economic inequality:
Within- and cross-country comparisons using PIAAC

Working paper for presentation at
"Taking the Next Step with PIAAC: A Research-to-Action Conference"

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Abstract:
Previous studies have examined relationships between skills and economic distributions within and across countries to mixed results that relate to both variation in empirical methods and to limited availabilities of consistent skill data separate from education histories. Using multifaceted and internationally comparable skill data from the newly-released Programme for the International Assessment of Adult Competencies (PIAAC), this study adds to the existing literature by examining how literacy, numeracy, and problem-solving skills of adults relate to wage inequality in an international context that is characterized by both economic forces of demand and supply and by institutions. Econometric decomposition, aimed at quantifying contributions of observable and unobservable factors to inequality, is conducted aggregately over all adults and separately by the specific demographic attribute of gender given gender's identified importance in previous literature on earnings inequality. Substantial inequality is documented across countries, skill measures, and gender, thus reinforcing previous findings that skill, even by the broader definition used here, is only a partial explanation for vast differences in economic inequality across countries. The paper concludes with a discussion of relationships to institutional differences within and across countries and of additional ongoing data needs to further understandings of inequality dynamics within and across nations.

Keywords: Skills, earnings inequality, labor markets, education, cross-country studies, gender, PIAAC, OECD

JEL Codes: J24, J31, I21, I24, O15

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Introduction

Correlations between skill levels and economic distributions have been hypothesized in academic literature and popular discussion alike. The newly-released first wave of the Organisation for Economic Co-operation and Development (OECD)'s Programme for the International Assessment of Adult Competencies (PIAAC) provides a distinctive opportunity to study how the levels and distributions of a wide variety of adult skills, in the areas of literacy, numeracy, and problem-solving, relate to wage (or earnings) inequality in an international context that is characterized by both economic forces of demand and supply and by institutions.[1] Figure 1, for example, illustrates negative cross-country correlations between means of select PIAAC skill variables and 90/10 ratios (i.e., ratios within country of incomes at the 90th percentile versus the 10th percentile) along with a linear trend line. 90/10 ratios are a common measure of income inequality used in the economics literature and in policy circles. The sample correlation coefficient between this measure of literacy skills and the 90/10 ratio (as reported by the Luxembourg Income Study (LIS))[2] is -0.399; that between numeracy and the 90/10 ratio is larger in absolute value, -0.616. These values are even more striking (-0.538 and -0.639 respectively) when the United States (a possible outlier) is excluded. Similar patterns are evident for other aggregate inequality measures (e.g., the "Gini" coefficient from economics which measures differences between cumulative population and income shares (Figure 2), and the often cited poverty rate (Figure 3)). These figures also reveal inverse relationships between average skill proficiency and economic inequality.

[Figures 1, 2, and 3 about here]

Academic examination of the relationship between skills and inequality in labor economics has been popular in recent decades. Katz and Murphy (1992), for example, in a seminal and well-cited paper, relate changes in the demand for skills (as measured in their case by college education) to changes in wage structures in the United States over time. This work has formed a theoretical basis for continued empirical studies of skills and inequality within economics. Due to a lack of reliable and comparable skill data across countries, early empirical work (e.g., Katz and Murphy, 1992; Blau and Kahn, 1996) focused on indicators of higher education, or combinations of education and experience variables as proxies for skill. These proxies, however, are imperfect at best, and this has been recognized in the literature. More recent work, while maintaining the hypothesis of significant relationships between skills and inequality, has critiqued the use of higher education as a skill measure, most especially when used across international contexts where educational and political institutions vary substantially (e.g., Leuven et al, 2004). As a result, academic literature in empirical economics in

[1] As a technical matter, wage inequality would refer to the spread of the wage distribution and earnings inequality would refer to that for the earnings distribution (where total earnings are a function of wages (e.g., hourly) and hours worked). The two terms, however, are used interchangeably in this paper to denote economic inequality overall since several wage and earnings measures are studied and contrasted in what follows. Income inequality, as illustrated in Figures 1 through 3, refers to inequality in earned and non-earned income within the population. While these aggregate patterns are demonstrated as background, the focus on this paper is on earned income since earned income is more likely directly related to skill than is income from other sources (e.g., inheritances).

[2] LIS is a harmonized microdata collection across countries identified in PIAAC and others. From these data, the country-level inequality measures (e.g., 90/10 ratio, Gini coefficient, poverty rate) that are shown here are calculated and published. Gottschalk and Joyce (1998) use LIS data to relate differences in supply shifts to earnings inequality across eight countries and find that relatively small overall increases in earnings inequality may reflect large but offsetting changes in returns to skills. The authors, however, use educational attainment adjusted for age as their skill measure in contrast to examining direct skill measures as in this paper.

this topic area has moved toward the use skill surveys such as predecessor surveys to PIAAC. While this literature finds evidence of some correlations between broadly-defined skills and wage inequality, bounding economic magnitudes and pinpointing specific policy importance in the current international context given the presence of new, more detailed and comprehensive skill measures is of continued academic and political interest.

The primary purpose of this paper is to revisit the quantification of the effect of skills (and its distribution) on economic inequality both within and across countries using PIAAC, which given its design, should be more reflective of modern skills in the present international economy than previous surveys. A major hypothesis is that previous estimates of the effect of skills on inequality may have suffered from bias due to unobserved skill dimensions that may be better captured by PIAAC. The paper documents the sensitivity (comparability and robustness) of earlier results in the literature to the new PIAAC skill definitions. This facilitates scholarly comparisons with the earlier work that may have been subject to statistical imprecision given the availability of only lesser developed skill measures at the time of the writings.

The paper also serves to update major analyses to the current time period which is most relevant for current educational, labor, and social policy discussions nationally and internationally, and provides a rich interpretation by exploiting data from PIAAC with special attention to differences that are correlated with demographic factors, especially gender which has been identified in the literature as an important factor by which earnings and inequality are determined both within and outside the United States (e.g., Blau and Kahn, 2005; Raudenbush and Kasim, 1998). The paper therefore is one of the first to examine relationships between PIAAC skill-levels and socioeconomic risk as interpreted in terms of wage inequality associated with skill groups which affects individuals across countries. This has implications for understanding primary and secondary effects of education and training programs and other policies affecting lifelong learning and the level and distribution of skills within and across countries.

The specific research questions are as follows:

- What are the relative contributions to economic inequality of (1) levels of observable variables such as skill and other indicators of human capital, (2) of labor market rates of returns to these variables, and (3) of unobservable factors such as institutional differences across countries?
- Do the newly-released PIAAC data confirm previous results in the academic literature on the effects of skills on wage and earnings inequality, or do these data provide different results?
- Are there any differences in findings when problem-solving skills (that were not identifiable in previous datasets but are identifiable in PIAAC) are included? Or are differences due to variable definitions, time period, variations in institutions across countries, and/or the scope of country coverage?

In order to provide answers to these questions, the paper proceeds as follows. The next section discusses relevant theoretical and empirical literature on skills and earnings inequality using data previous to PIAAC as well as new literature on wage determination which does use PIAAC and therefore has direct relations to this study. This is followed by a discussion of the primary PIAAC data used in this paper. Particularly, definitions of skill, other human capital, and earnings variables are presented along with their descriptive summary statistics. The empirical section of the paper then presents the major regression decomposition methodologies that are used here to isolate differences in economic distributions due to differences in the levels of skills and other human capital variables across countries, differences in the returns to these skills (e.g., how wages respond to specific variables), and differences in unexplained portions of the econometric model. The results section then focuses on the interpretation of the magnitudes of the observed and unobserved compositional elements that are found by implementing the empirical methodology in the primary specification. Both skill and non-skill determinants of wages are considered. The robustness tests section provides additional information on immigrants as a particular subgroup of interest, on the addition of informal training as a supplementary education variable, and on several alternative earnings measures included in PIAAC. These include hourly wages with bonuses added and monthly earnings (with and without bonuses and for the self-employed). The paper ends with a discussion and conclusions section in which institutional factor differences across countries (such as differences in union density, public sector employment, labor and product market regulations, and minimum wages) are considered using information from supplemental data sources, and limitations of the study and future data needs associated with PIAAC are noted.

Literature Review

This paper fits into a longer literature, the most relevant of which pertains to the use of other cross-country skill surveys. A newer, less extensive literature pertains to the use of PIAAC in labor economics studies specifically. Other interrelated literature from labor economics also is cited. Key findings from these literatures are documented below.

Previous Studies and Data on Skills and Earnings Inequality

Using the International Adult Literacy Survey (IALS) for 11 countries, Devroye and Freeman (2001) document positive (albeit small in magnitude, on the order of seven percent) correlations between skill inequality and earnings inequality.[3] The authors also find that earning inequality is more prevalent within, not across, skill groups, and that returns to skill as measured by skill premiums explain a greater proportion of cross country differences than does skill level and its distribution. Consistent with these findings and also using IALS, Blau and Kahn (2005) compare the United States to eight other OECD countries and argue that magnitudes of labor market returns to skills and differences in the distribution of residuals (or the remaining unexplained portions of their models) dominate the skill distribution itself as important determinants of wage inequality. They relate their findings in discussion to institutional explanations such as differences in collective bargaining arrangements across countries in addition to demand and supply factors, and suggest that feedback effects between these two types of explanations for wage inequality may be important for understanding equilibrium dynamics.

Both Devroye and Freeman (2001) and Blau and Kahn (2005) focus on regression decomposition techniques from econometrics to examine the importance of various observed and unobserved factors on different measures of earnings distributions. Devroye and Freeman (2001), for example, decompose cross-country differences in the spread of earnings (as measured by the standard deviation) while Blau and Kahn (2005) devote attention to decomposing 50-10 and 90-50 log wage differentials. These measures are similar to the 90/10 ratios previously discussed, but instead of ratios within country of incomes at certain percentiles of interest, the measures focus on differences between particular percentile points of the distribution of wages which have been converted into natural log form. The 50-10 log wage differential, for example, is the difference between the 50th percentile of log wages and the 10th percentile of log wages. Log wage differentials are used to measure inequality in the bottom (50-10) and top (90-50) wage distributions. They provide insight on how unequal wages

[3] The focus on skill inequality is in contrast to the *level* of skills documented in Figure 1. Both are considered here.

are between the poor and the average and between the rich and average earners, and thus are general indicators of inequality of the poor and of the rich respectively.

Leuven et al. (2004), on the other hand, use IALS (compared with other data sources) to show 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" (p. 466). In contrast to Devroye and Freeman (2001) and Blau and Kahn (2005) that use these same data, Leuven et al. (2004) use different economic modeling techniques to document this larger impact of traditional supply and demand factors. Specifically, the authors construct measures of net supply (i.e., of differences between supply and demand) to compare to differences in relative wage rates of income groups across countries.[4] This methodology, however, involves making a large number of assumptions about the demand and supply sides of the market which may not be realistic in all country contexts.

Previous Labor Market Research Using PIAAC

An important first entry in the labor economics field using PIAAC specifically is Hanushek et al. (2013) which documents high lifetime labor market returns to numeracy, literacy, and problem solving by estimating a series of Mincer (1974) type wage determination equations incorporating PIAAC skill measures in place of the more limited skill measures from earlier international skill surveys. The Mincerian framework involves modeling log wages as a function of education, experience, and experience squared to allow for nonlinearities in the impact of this variable.

In their base specifications, Hanushek et al. (2013) supply PIAAC skills in place of education in this framework. In robustness analysis, they include both skill levels and educational attainment. The authors report evidence of statistically and economically significant relationships between skill and wage levels across PIAAC countries. In discussion, they note that skill inequality in PIAAC does not appear related to differences in skill returns, although pinpointing causation and the systematic study of inequality is beyond the scope of their focus. They also caution readers to terms of interpreting their primary estimated coefficients as causal returns to skill because of the potential importance of unobserved non-cognitive skill as an omitted variable.

Whereas Hanushek et al. (2013) document labor market returns to numeracy, literacy, and problem solving skills expressed as levels, this paper in contrast highlights *variability* in labor market returns as it relates to both level and variability in these skill sets and therefore answers questions pertaining to equities in skills and in earnings within and across populations.

Other Related Work

As other notable literature describes the importance of demographic differences, available factors will be used for stratification and comparison. Raudenbush and Kasim (1998), for example, show that ethnic and gender inequality in employment and earnings cannot be fully attributed to skill differences using the U.S. National Adult Literacy Survey. While race and ethnicity are not reported in cross-country PIAAC public-use data, examination of gender and of immigrant status is straightforward.[5]

Heckman (2011) describes research by himself and others that finds that inequality in learning translates into inequality in ability, achievement, health, and adult success. Autor (2014) notes

[4] Arguably this method better deals with possible endogeneity of prices than do the decomposition methods used elsewhere in the literature. Prices are endogenous in economics if they are jointly determined by the demand and supply sides of the market (for example, in equilibrium).

[5] Schleicher (2008) mentions possible breakdowns by minority and non-minority status, though this pertains to the U.S. specific PIAAC data as opposed to all international surveys.

increasing skill premiums, citing Hanushek et al. (2013) and others, as being one driver of increases in inequality in the U.S. If effects on own wages (as estimated in Hanushek et al., 2013, for example) are considered primary effects, effects on wage distributions may be considered secondary effects of interest. A sometimes overlooked dimension is that if institutional and policy conditions are successful in diminishing the size of the at-risk population, depending on which part of the initial skill distribution receives educational "treatment," policy actions may simultaneously increase inequalities, thus having additional (unintended) effects on labor markets and society. Corak (2013), for example, documents decreased intergenerational mobility when more earnings inequality is present. The paper therefore is significant for understanding the relevance of specific targeting of skill improvement programs and policies for equity in the distribution of adult learning and economic outcomes.

Data

Description of major data and summary statistics are presented in turn. The focus is on skill measures, non-skill indicators of human capital, and the measurement of earnings.

Description of Skill Measures

Primary data come from the public-use PIAAC data files from all countries that were available at the time of this writing and which include relevant variables. The main aggregate dataset is based on 23 OECD countries which participated in the first round of PIAAC between 2008 and 2013.[6] These countries are Austria, Belgium (Flanders), Canada, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, South Korea, Netherlands, Norway, Poland, the Russian Federation[7], Slovak Republic, Spain, Sweden, the United Kingdom (England and Northern Ireland), and the United States. Further restrictions in some specifications are due to specific variable information availability and are indicated in what follows.

There are three primary skill measures available for analysis in PIAAC. These are based on literacy, numeracy, and problem solving skill categories.[8] The OECD (2013b) defines literacy as: "*'understanding, evaluating, using and engaging with written texts to participate in society, to achieve one's goals, and to develop one's knowledge and potential'* (OECD, 2012b). 'Literacy' in PIAAC does not include the ability to write or produce text, skills commonly falling within the definition of literacy...'literacy' is a broader construct than 'reading,' narrowly understood as a set of strategies for decoding written text. It is intended to encompass the range of cognitive strategies (including decoding) that adults must bring into play to respond appropriately to a variety of texts of different formats and types in the range of situations or contexts in which they read. A unique feature of the assessment of literacy in PIAAC is that it assessed adults' ability to read digital texts (e.g., texts containing hypertext and navigation features such as scrolling or clicking on links) as well as traditional print-based texts" (p. 3).

Numeracy then is: "*'the ability to access, use, interpret and communicate mathematical information and ideas, in order to engage in and manage the mathematical demands of a range of*

[6] PIAAC data were collected for 24 OECD countries in the first round. Data for 22 countries are included in the international public-use dataset from the OECD. Cyprus is available separately from the German GESIS Data Catalogue (Michaelidou-Evripidou et al., 2014). Australia is not used in the analysis here because that data has not been distributed as public access.

[7] The Russian Federation is included in what follows, though results for this country should be taken with caution due to questions regarding the validity of this country's preliminary data as noted in Hanushek et al. (2013) and other sources.

[8] The PIAAC plausible values variables PVLIT, PVNUM, and PVPSL are used.

situations in adult life' (OECD, 2012b). Numeracy is further specified through the definition of 'numerate behavior,' which involves managing a situation or solving a problem in a real context by responding to mathematical information and content represented in multiple ways…numeracy in PIAAC involves more than applying arithmetical skills to information embedded in text. In particular, numeracy relates to a wide range of skills and knowledge (not just arithmetic knowledge and computation), a range of responses (which may involve more than numbers), and responses to a range of representations (not just numbers in texts)" (OECD, 2013b, pp. 3-4).

While previously published skill surveys have included measures of literacy and numeracy, PIAAC adds a third skill category. Problem solving in technology-rich environments (PSTRE) is defined as: "*'using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks.'* The first wave of PIAAC focused 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'* (OECD, 2012b). The PSTRE domain of PIAAC covers the specific class of problems people deal with when using information and computer technology (ICT)…PSTRE represents a domain of competence which involves the intersection of the set of skills that are sometimes described as 'computer literacy' (i.e., the capacity to use ICT tools and applications) and the cognitive skills required to solve problems. Some knowledge of how to use basic ICT input devices (e.g., use of a keyboard and mouse and screen displays), file management tools, applications (word processing, email) and graphic interfaces is essential in order to be able undertake assessment tasks. However, the objective is not to test the use of ICT tools and applications in isolation, but rather to assess the capacity of adults to use these tools to access, process, evaluate and analyze information effectively" (OECD, 2013b, p.4).

Schleicher (2008) documents how the PIAAC skill measures have been developed with a goal of understanding a 21st century world. The author provides further motivation for extending beyond wage level effects to those on economic distribution. Regarding the potential use of PIAAC for the study of social inequality, for example, the author writes "The diffusion of ICT throughout the production process will have a marked impact on inequality in economic outcomes, most particularly as regards wages and employability...Wage disparity will grow rapidly as skilled workers reap some of the productivity gains associated with these technologies. Policy-makers worried about social inequality and exclusion have a need to know the size of these effects and which population sub-groups are most at risk." (p. 637).

Summary Statistics of Skill Distributions

Tables 1 and 2 show how skills as measured by PIAAC vary within and across countries. For each of these categories the tables show means and standard deviations (sd) as well as the 10th, 50th, and 90th percentiles of the skill level measures and the 50-10 and 90-50 constructed skill differentials. The 50-10 and 90-50 skill differentials are differences of the 50th and 10th and the 90th and 50th skill percentiles of the skill distribution respectively. These are tabulated separately for literacy, numeracy, and problem solving skills. A low differential for a skill gap by one of these measures corresponds to a case where there is limited inequality of skills in the lower or higher part of the skill distribution. Similarly, a high differential indicates that there is a substantial difference in the magnitude of skill levels between the median and either the bottom end of the distribution (as measured by the 10th percentile) or the upper part of the skill distribution (90th percentile). Furthermore, the differentials can be interpreted in terms of measuring inequality in the lower skill (50-10) and higher skill (90-50) populations of each country.

Summary statistics are presented aggregating over genders (Table 1) and disaggregated by gender (Table 2).[9] There is notable variation in skills by the literacy, numeracy, and problem solving measures across countries (as measured by means), within countries (as measured by standard deviations and percentile differentials), and as expected, across genders (as seen by comparing the two panels Table 2).

From Table 1, literacy skills vary from a low average of 250.5 skill points in Italy to an average high of 296.2 in Japan. Numeracy skills vary from a mean of 245.8 (Spain) to 288.2 (Japan). Problem solving skills, on the other hand, vary from 274.9 (Poland) to 294.0 (Japan).[10] These averages are indicative of midpoints of the distributions of skills in each country (in terms of skill levels), but they tell little about the extent and nature of inequality of skills within and across countries.

Standard deviations, on the other hand, summarize the spread of the distributions of skills within countries. For literacy skills, standard deviation varies from a low amount of inequality (39.7 skill points in Japan) to a high (50.7 skill points) in Finland. For numeracy, the lowest amount of inequality by this measure is found to be in the Russian Federation (42.0 skill points) and the highest is in the United States (57.0 skill points). For problem solving skills, the range is a low in the Slovak Republic (36.9 skill points) to a high in the Russian Federation (49.0 skill points). Thus, the dispersion of skills, as measured by standard deviation, indicates substantial differences in skill inequality within and across countries.

Substantial variation in skill distributions also is noticeable by examination of the percentiles and percentile distributions for literacy, numeracy, and problem solving skills. In contrast to the standard deviation of skill levels which gives an overall measure of dispersion around the mean of the skill distribution, the 50-10 and 90-50 skill differentials separately measure inequality of the lower skilled population and the higher skills population within each country. The literacy inequality in the lower skill populations (50-10 skill differential) varied between 55.3 skill points in the Czech Republic to 69.9 skill points in France. Meanwhile, the inequality among the higher skilled (90-50 skill differential) was 42.9 literacy skill points in the Slovak Republic, 56.2 skill points in Canada and 57.0 points in the United Kingdom and 57.1 in the United States.[11] In terms of numeracy skills, Canada, the United Kingdom, and the United States also stand out as having the highest inequality of skills in the upper parts of these country's skill distributions. Furthermore, in numeracy, both lower and upper skill inequality measures are higher than those in literacy for these countries. Canada, the U.K. and the U.S., however, are not outliers in terms of problem solving skills in technology rich environment domains. Instead, five other countries emerge by that skill measure as having higher upper skill inequality (Czech Republic, Estonia, Germany, Poland, and the Russian Federation).

Across all countries studied and across all three skill measures, it is found that those in the lower skill population differ more from the average than those in the upper skill population. This can be seen in terms of larger 50-10 differentials than 90-50 skill differentials across the board. Thus, the descriptive results suggest that low skill inequality is higher than upper skill inequality by these measures. Problem solving skills did not differ as much as the other two domains across the upper and lower skill inequalities on average. Only for Japan was there a larger difference between the 50-10 and 90-50 skill differentials for problem-solving skills than for both literacy and numeracy. The difference for problem solving skills was also higher than that for literacy (but not for numeracy) for Finland and

[9] All summary statistics are produced using STATA statistical software by implementing the PIAACTOOLS programs which have been developed in the specific context of PIAAC by adjusting for sampling design structure.
[10] Missing values in the problem solving panel relate to unavailability of data for this skill measure for some countries. Specifically, problem solving skills assessment was not administered in France, Italy, Spain, and Cyprus.
[11] Canada, the United Kingdom, and the United States have something in common in that all three have been specifically identified in previous literature as having both high skill and wage inequality (Devroye and Freeman, 2001).

the Russian Federation. The variation of magnitudes across skill measures demonstrates the extent to which the three PIAAC skill measures capture different aspects of skill strengths.

[Tables 1 and 2 about here]

Comparison of the two panels of Table 2 reveals that while skill differentials within countries are correlated across genders, there are still some notable differences.[12] This may be expected given different institutional attitudes toward women and wage employment across countries. The lower skill inequality (50-10) was higher for women in Sweden (by 4.5 skill points) and lower for women in Denmark (by 9.1 skill points). Meanwhile, the higher skill inequality (90-50) was higher for women in Japan (by 0.2 skill points) and lower for women in Italy (by 6.5 skill points). This suggests that for example, in Denmark, women in the lower literacy skill levels differ less from the average skilled woman in Denmark than do men in the lower literacy skills compared to the average Danish man. Similarly, Italian women in the higher literacy skills differ less from the average skilled Italian woman than do Italian men in the higher literacy skills from the average Italian man. Similar magnitude differences can be seen across genders for the other two skill categories though specific country outliers differ in those cases.

Relationships between Skill Measures and Other Human Capital Indicators

Some early literature suggested that years of schooling and/or experience (or a composite measure of these variables) could be used as a proxy for skill across countries (e.g., Blau and Kahn, 1996). Figure 4, however, graphs average years of schooling against average literacy, numeracy, and problem solving skill levels in its three panels respectively along with linear trend lines.[13] A positive correlation is readily noticeable for both literacy and numeracy skills, though this relationship is stronger for literacy skills alone. There is a lesser (and slightly negative as indicated by the linear trend line) relationship between PIAAC's problem solving skill levels and years of education by these summary statistics. Specifically, an R-squared correlation measure relating education to literacy skills is 0.30. For numeracy skills, it is 0.13. For problem solving skills, in contrast, it is only 0.01. It is important to note that digital problem solving was only assessed for a selected sample of the population of PIAAC respondents. Particularly, these questions were only asked to those who indicated that they had existing computer experience. The different sample therefore (which is positively selected based on education given the survey design) may relate the very limited slope between years of schooling and problem solving skill level in the third panel of the figure.

Overall the figure suggests that average years of education explain less than a third of the variation in the literacy skills across countries, while they explain approximately one tenth of variation across countries in numeracy skills and only one hundredth of variation in digital problem solving skills. Consistent with other literature as cited (e.g., Leuven et al., 2004; Hanushek et al., 2013), education levels alone appear to be limited for study of human capital using PIAAC. Furthermore, this indicates notable differences between what is captured by years of schooling and what is captured by the three PIAAC skill measures, and provides support for using each of these variables in the empirical modeling.

[Figure 4 about here]

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[12] Gender information is not available for Netherlands and the Russian Federation and therefore these countries are excluded from this and other gender analysis.
[13] Years of schooling is measured by the YRSQUAL_T variable from the public-use international PIAAC data.

Differences between what can be learned from education and experience alone and from direct skill measures such as those offered by PIAAC are further confirmed by Table A1 of the Appendices which gives coefficients and standard errors from regressions of skills (separately for literacy, numeracy, and problem solving) on the other human capital variables of years of education and experience, and their squares to allow for nonlinearity in relationships.[14] Education is statistically significantly positively related to skills across most countries and across the three skill measures. In most cases, the return to education is decreasing as seen by the coefficients for the quadratic terms and the statistical significance in many cases. In other words, the impact of education on skills is found to be increasing (with education) but at a decreasing rate. Relationships with experience vary across countries, as do magnitudes in the experiential returns. The results persist across genders (Tables A2-A3), though again magnitudes vary across genders within country. This again confirms that gender as an important demographic differential for the study of inequalities in skill and earnings.

Earnings Inequality

Aggregate earnings are difficult to use for empirical studies of inequalities in labor economics since these measures may represent differences in wages across economic agents, differences in hours worked, or both. The PIAAC data, however, includes a wage measure that is based on raw data of *hourly* earnings excluding bonuses for wage and salary earners, purchasing power parity (PPP) corrected to U.S. dollars.[15] It is this variable that forms the basis of the primary earnings measure used in this paper. The population within the PIAAC data that is studied in the major empirical analysis presented then is that of the employed (as opposed to all persons for whom skill was measured). This is because data on wages are not available for the unemployed by definition. Alternative earnings measures are contrasted in the Appendices for the major analysis.

Figures 5 and 6 illustrate log wage differentials based on 50-10 and 90-50 percentiles overall and for male and female subgroups respectively. As in the cited literature, the natural logarithm is used to scale wages. The 50-10 log wage differential describes wage inequality between the bottom 10 percent of earners and those earnings in the middle of the distribution (at the median), and the 90-50 log wage differential does the same for the top 90 percent of earners relative to the median earner. Just as the 50-10 and 90-50 skill differentials can be interpreted in terms of measuring inequality in the lower skill and higher skill populations, the 50-10 and 90-50 differentials for log wages can be interpreted as measuring "inequality of the poor" (defined as the lower half of the distribution) and "inequality of the rich" (for the upper half of the wage distribution). The figures therefore illustrate wage inequality within and across countries and across the demographic category of gender.

[Figures 5 and 6 about here]

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[14] Years of experience comes from the C_Q09_C variable in PIAAC. The squared variables are divided by 100 for the purpose of scaling coefficients to ease the interpretation of results and minimize leading zeros in the reporting these values.

[15] Hourly earnings by this variable, EARNHRPPP, are not available for the countries of Austria, Canada, Germany, Sweden, and the United States in the public-use dataset. Instead, the PIAAC data include wage quintiles for some of these countries. Quintile data, however, is not useful for studying overall wage distributions in the decomposition approach framework, because quintiles do not reveal the full earnings distribution but instead only show select points of the distribution. This represents a limitation of the analysis and further highlights the importance of future data releases incorporating more consistent information across countries. Again, gender information is not available for Netherlands and the Russian Federation further complicating and restricting analysis by this important demographic differential. Only 17 countries then are included in the wage analysis overall, and only 15 countries remain when tabulated by gender.

Substantial wage inequality within and across countries is evident. Across countries in Figure 5, wage inequality is highest in Korea, Japan, Estonia, and Cyprus at the top of the wage distributions with 90-50 differentials approaching or exceeding one (the point at which the 90th percentile earner would make 100 percent more than the median earner). Differentials by gender also are generally higher at the higher end of the wage distribution than the lower end for both men and for women. Exceptions are the Czech Republic and Norway (to a small extent) for women and Denmark for both genders (Figure 6). In general, wage inequality for men appears higher though there are clear exceptions with South Korea and Cyprus being primary outliers in the direction of heightened wage inequality as evident by the 90-50 log wage differential for women in those countries.

Unlike the skill inequality measures (as described in Tables 1 and 2) which had the feature that of more inequality at the bottom of the distribution than the top, wage inequality for the rich (the upper end of the wage distribution) is shown in Figure 5 to be higher than wage inequality for the poor (the lower end of the wage distribution) across most countries. This is also true in general for men and for women separately (Figure 6). Lower and higher wage inequality (as measured by the 50-10 and 90-50 log wage differentials respectively) among men is more similar than these inequality measures among women. This seems largely based on women in the higher wage categories earning a lot more than average women in some countries.

Empirical Methodology

Methodology to examine inequality using country-level microdata has differed in the economics literature. Devroye and Freeman (2001) and Blau and Kahn (2005), for example, use variance decomposition methods, statistical methods to separate components of the distribution of earnings and therefore quantify the extent of explained (by skills, for example) versus unexplained variance in earnings (that the authors express in natural log form). These papers depend on decompositions similar to Juhn et al. (1993) to separate out effects of observed skill levels, of prices (i.e., wage responses to variations in skill levels, or "returns to skill"), and of unobserved residual components across countries.

As opposed to decomposing contributions of these factors to the mean of a distribution, Devroye and Freeman (2001) decompose the spread of the distribution (standard deviation), aggregately across several countries. Blau and Kahn (2005), on the other hand, decompose the 90-50 and 50-10 log wage differentials across countries separately for men and for women as subgroups. Decomposing the 90-50 and 50-10 log wage differentials allow the authors to separate contributions to the inequality of the rich from those to the inequality of the poor.

The methodology here incorporates both of these papers' decomposition presentations as applied to the newer, more comprehensive PIAAC data in order to examine the extent to which differences in wage inequality across countries can be attributed to differences in observable factors (levels of and rates of return to skills and other demographics, for example) versus unobserved factors (which may be seen as including differences in the effects of underlying institutions on the wage distribution). Calculating decompositions separately for the lower (50-10 log wage differential) and the higher (90-50 log wage differential) parts of the wage distribution provides intuition about how differences in the effects of observable and unobservable components across countries vary *within* the overall wage distribution and whether differences are most concentrated among the poor or the rich across the locations studied.

Juhn et al. (1993) Decomposition

Decomposition methods can be used to separate the relative importance of (1) different levels of observable characteristics such as skill and other human capital differences across countries, (2) different returns to skill and other observable characteristics across countries, and (3) different unobservable factors (i.e., residuals) in the distribution of earnings across countries.

The decomposition technique starts with the estimation of a standard wage equation:

$$Y_{ij} = X_{ij}\beta_j + u_{ij} \tag{1}$$

where Y_{ij} is the natural log of hourly earnings of person *i* in country *j*, X_{ij} is a vector of regressors (observable variables included as independent or control variables in the multiple regression framework), and u_{ij} is an i.i.d. error term.

The idea of the decomposition is to divide the regression into the difference in inequality between country *j* and the baseline *b* due to differing quantities of observable characteristics, the marginal effect of changing "prices" (e.g., returns to skill and other observable characteristics), and the marginal effects due to differing unobservable factors (i.e., residuals). This allows for simulating counterfactual wage distributions due to varying each of these three factors independently and therefore allows for the separation of the effects of several differences which may exist simultaneously across countries. Separating the effects should provide intuition as to what are the drivers of differences in earnings inequality in the international context.

The methodology involves noticing that we can write the error term as the inverse cumulative distribution of residuals conditional on the regressors:

$$u_{ij} = F^{-1}\left(\theta_{ij}|X_{ij}\right) \tag{2}$$

We can then rewrite the wage equation relating the country *j* model to the model for the base country *b* as:

$$Y_{ij} = X_{ij}\beta_b + X_{ij}\left(\beta_j - \beta_b\right) + F_b^{-1}\left(\theta_{ij}|X_{ij}\right) + \left[F^{-1}\left(\theta_{ij}|X_{ij}\right) - F_b^{-1}\left(\theta_{ij}|X_{ij}\right)\right] \tag{3}$$

where it can be noted that this is a linear transformation or rearrangement of equation (1). Now, using equation (3) and as in Juhn et al. (1993)[16], we can write three components of differences in inequality between countries *j* and *b* for interpretation.

The first component ("Observable Quantities") is that due to differing quantities of skill levels and other independent variables across countries. This is formulated as the difference between the wage equation that allows the distribution of regressor quantities to vary in country *j* but holds observable returns and residuals at the base country levels *b* and the wage equation for the base country:

$$X_{ij}\beta_b + F_b^{-1}\left(\theta_{ij}|X_{ij}\right) - Y_{ib} \tag{4}$$

The second component ("Observable Returns") is due to differing returns to observable characteristics across countries and is constructed as the difference between the wage equation

[16] Juhn et al. (1993) compares over time for the U.S. (where the base is a time period) as opposed to using the methodology across countries. Blau and Kahn (1996) and (2005) are examples of cross country research using these methods.

allowing only observable quantities and returns to vary across countries and the difference forming the first component above:

$$X_{ij}\beta_j + F_b^{-1}(\theta_{ij}|X_{ij}) - [X_{ij}\beta_b + F_b^{-1}(\theta_{ij}|X_{ij}) - Y_{ib}] \quad (5)$$

The third component ("Unobservables") is due to differing residual errors (i.e., unobservable characteristics) across countries and is constructed by differencing the wage equation which allows simultaneous differences of quantities, returns, and unobservables and the second component above:

$$X_{ij}\beta_j + F^{-1}(\theta_{ij}|X_{ij}) - [X_{ij}\beta_j + F_b^{-1}(\theta_{ij}|X_{ij})] \quad (6)$$

The three components given in equations (4) through (6) sum to the original wage equation Y_{ij}. These three components are calculated and reported in each of the decomposition specification tables presented in the results and robustness tests sections. Instead of presenting decomposition results for means, the inequality indicators of standard deviation of log wages, of 90-50 log wage differentials, and of 50-10 log wage differentials are constructed in turn.

Choice of the Baseline Country

Coefficients and residuals from the United Kingdom specification are used as the benchmark reference prices and the residual distribution respectively since it is optimal to choose a baseline country to examine differences in distribution across countries.[17] Devroye and Freeman (2001) discuss particularly high skill and high wage inequality in the English speaking countries of Canada, the United Kingdom, and the United States. These patterns are also evident in PIAAC as documented above. Given data availability issues in PIAAC, the U.K. stands alone from this group as having all necessary variables in order to serve as the benchmark country for analysis (since the U.S. and Canada do not have continuous wage data in the public-use version of the data) and is chosen for this purpose since the literature supports this country as being an outlier in the direction of high inequality. This informs a prior expectation as to the directions of expected identified differences across the countries in the dataset and provides context for interpretation of results.

Results

General determinants of log wages are estimated as in equation (1) and then used to compute the decomposition components (from equations (3) through (6)) for each of the three inequality statistics (standard deviation of log wages, 50-10 log wage differential, and 90-50 log wage differential) that are reported and interpreted in the decomposition tables that follow.[18] The primary specifications of the decomposition are presented with attention given to differences in the magnitudes of observable and

[17] Alternately, an "average" measure could serve as the baseline (as in some previous literature such as Blau and Kahn, 2005), but this is harder to interpret in terms of real world differences across countries when there is substantial variation across countries since all results would then be relative to a counterfactual country with unclear country characteristics.
[18] As noted, PIAACTOOLS procedures in STATA are used for all descriptive statistics and most results in this paper. For the decomposition, however, SVY commands with the jackknife option are utilized by incorporating the PIAAC public-use jackknife replication weights. This method follows Schnepf (2014)'s use of STATA SVY methods when analyzing PIAAC for more complicated estimation methods than those in PIAACTOOLS. Sensitivity analysis of the first stage regression (equation (1)) results using PIAACREG versus SVY with jackknife replication weights indicates only minor differences.

unobservable components of earnings inequality. Following these major results, the robustness tests section provides results from alternative specifications of interest.

Contribution of Skills to Economic Inequality

Major results from the decomposition approach for the impacts of skills alone are presented in Table 3. In these specifications, the vector X_{ij} (from equation (1)) includes only the three PIAAC skill variables as independent variables. Since decompositions are based on wage equations that control for all regressors included in X_{ij}, the sample is restricted to those countries for which all data (e.g., hourly wages and problem solving skill measures) are available.

[Table 3 about here]

Results are presented separately for each country relative to the base of the U.K.[19] The numbers in the first column of Panel A of Table 3 indicate how each country compares to the U.K. in terms of the total spread of log wages (total standard deviation). For example, a finding is that the Czech Republic has a spread of wages that is approximately six percent (0.06 log points) smaller than the U.K, while Estonia has a spread of wages that is approximately seven percent (0.07 log points) higher than the U.K. Overall, the spread of wages between the countries and the U.K. vary from being lower in Finland by about 15 percent (-0.15 log points) to higher in Russia by about 31 percent (0.31 points).

In this first specification, the only regressors are the three skill measurements for literacy, numeracy, and problem solving abilities and therefore the observable quantities component of the total difference across countries relative to the base country of the U.K. is interpreted in terms of the impacts of quantities (levels) of skills alone (apart from other demographic and work-related characteristics which are added in subsequent tables). For skills alone, this component is universally negative in terms of a contribution to total differences in the spread (standard deviation) of wages. Since several of the total differences are positive, however, this indicates that these negative observable quantities contributions are more than offset by positive components elsewhere. This suggests that many countries have less inequality due to the observable skill factors that are included in the model than does the base country of the U.K. Instead, these countries are characterized by large positive contributions of unobservable factors to inequality (e.g., institutions that are not controlled for in the model, other demographic factors that have been excluded, etc.). In some cases, however, this is partially offset by the *rates* at which skills contribute to total cross-country differences (as indicated by the observable returns component in the table).

[19] The first column of each panel indicates the total difference between each country *j* and the baseline country *b*, which as noted is set as the U.K. The total difference between the indicated country and the base country of the U.K. in each of the three panels is then decomposed into three major parts. The first is the portion of the difference that is due to observable quantities of skills. This is shown in the second column, and corresponds to the "Observable Quantities" equation (4) in the empirical methodology. The "Observable Returns" component then pertains to the portion of the difference across countries that is due to differing "prices" or returns to the various observable characteristics that are included as independent variables in the current specification. This corresponds to equation (5) in the empirical methodology. These returns are measured by the contributions of the regression coefficients to the cross-country differences in inequality, and are reported in the third column. Finally, the "Unobservables" component is that portion of the total difference across countries that is the remainder and thus is attributable to unobservable factors (equation (6)). This is shown in the fourth column of each table and may be interpreted as including differences in country-level institutions and cultural and social norms that are not reflected in the independent variables in the regressions that are being decomposed.

Overall, the importance of differences in unobservables in determining wage inequality across countries is found to be substantial. Unobservable components, for example, explain approximately two-thirds of the total difference in the spread of wages (-0.0372/-0.0564) between the Czech Republic and the U.K. while the levels of and returns to skills (observable factors in this model) explain only one-third. Unobservable components contribute even more and in some cases much more (average is 96 percent), to each of the other country-U.K. pairs. Skills, even when measured comprehensively as in PIAAC, are found to contribute little on their own to economic inequality across nations.

In all, eight countries show more wage inequality than the U.K. in terms of the spread of wages as indicated by the standard deviation, and only five show less wage inequality than the U.K. This measure, however, indicates overall spread of wages within country relative to that in the U.K. as opposed to separating the lower from the upper parts of the wage distribution in order to say something about inequality of the poor and the rich particularly.

The numbers in the first columns of Panels B and C show how each country compares to the U.K. in terms of inequality of the poor (50-10 wage gap) and inequality of the rich (90-50 wage gap). For the Czech Republic, for example, the inequality of the poor is approximately five percent lower than that for the U.K. and inequality of the rich is approximately 19 percent lower than that for the U.K. Similar to the overall spread of wages, inequality in the lower part of the wage distribution (50-10) is higher for eight countries and lower for five countries relative to the U.K. Unlike the overall spread of wages, however, wages in the upper part of the wage distribution (90-50) are higher for only six countries relative to the U.K. In the Netherlands and the Russian Federation, wage inequality of the rich is less than that in the U.K. while wage inequality of the poor is greater than that of the U.K. This type of pattern is not evident from the examination of standard deviation alone.

Again, the decomposition presents the portion of these gaps (the 50-10 and 90-50 log wage differentials) that are due to observable levels of independent variables in the model and rates of return of these variables, and due to unobservable factors that are not included in the model. Substantial variability in inequality across countries is seen in the range of total differentials reported in the first columns of these panels. In all country cases, the unobservable component portions of the total differences are large consistent with the results for the overall spread of the wage distribution in Panel A. This indicates that differences in the regression error terms across country models are critical for generating the total differences that are observed in the wage distributions and that this is true for both the lower and upper parts of the wage distribution in many countries. For inequality of the poor, unobservable factors contribute at least 50 percent (lower bound is Japan) to the total differences in inequality across countries. For inequality of the rich, unobservable factors contribute at least 49 percent (lower bound is the Czech Republic and therefore the same country as in the standard deviation of log wages results).

The finding of a large portion of the total difference between measures of inequality in many countries relative to the U.K. that is due to unobservable components, however, is perhaps unsurprising. Blau and Kahn (2005) concluded similarly using the IALS data, for example, and suggested in their concluding analysis that unobserved institutional factors are often of greater importance for understanding inequality than are the price and quantity effects standard in standard economic theory of supply and demand. Before repeating this conclusion here, however, it is worthwhile to examine the many other variables that have been identified as important in earning determination, several of which can be directly included in this study.

Including Contributions of Non-skill Determinants to Earnings Inequality

In the second major specification, the vector X_{ij} includes control variables that are drawn from age groupings (four dummy variables for categorical age ranges), education levels (in years), experience levels (in years), experience squared divided by 100, and skill measures for all three of literacy, numeracy, and problem solving. The age groupings are those defined by PIAAC in the international public-use data.[20] Specifically, binary variables are included for those 25-34, those 35-44, those 45-54, and those 55 plus. The excluded category corresponds to those 24 years or age or younger.[21] Experience squared is divided by 100 for the purpose of scaling the coefficients to ease in the interpretation of marginal effects. The regressors are combinations of those used in Blau and Kahn (2005) and Hanushek et al. (2013) and follow from the standard Mincerian tradition (Mincer, 1974) to be consistent with earlier theoretical and empirical modeling of wages in labor economics.

Summary statistics in the form of means and standard deviations for major control variables aside from skills are presented in Table 4. The first columns give the fraction of respondents in each country in each of the age groupings that are defined by a series of dummy variables. The age distribution is found to be roughly similar across countries by these measures. The same is found unsurprisingly for the gender distribution. Education, however, is more spread out. Average education varies from 10.5 years in Italy to 14.5 years in Ireland. Average work experience also varies, from 13.2 years in South Korea to 21.0 years in Denmark.

[Table 4 about here]

Table 5 repeats the decomposition approach for linear regressions in which the observable distributions of literacy, numeracy, and problem solving skills are examined alongside those associated with educational attainment measured by years of schooling, employment experience and its square, and of age (measured by the series of four categorical dummy variables for 25-34, 35-44, 45-54, and 55 plus, relative to the excluded category of 24 or less).[22] Given the previous descriptive results that skills and education levels are not perfectly correlated (and often characterized by low correlations), both types of regressors are included in this continued analysis, along with the other demographic and human capital variables noted above.[23] Gender is excluded in the primary specifications in order to

[20] The dummy variables are constructed from the categorical variable AGEG10LFS in the PIAAC public-use dataset.
[21] Variation in returns to skill by age in PIAAC is documented in Hanushek et al. (2013). Since the sample here maintains larger country-specific sample sizes by not restricted to prime-aged workers, controls for age are included as regressors.
[22] Differences in the returns to cognitive skills are illustrated via results from regressions in the style of equation (1) for this specification, which are similar to the regressions presented in previous work such as Hanushek et al. (2013). Results, for several countries separately, are shown in Tables A4 and A5 of the Appendices for reference. These tables give log wage effects of a 10 skill point increase in literacy, numeracy, and problem solving skills respectively. Table A4 shows results aggregately, and Table A5 presents results by gender sub-group. Many of the individual skill categories are not found to be statistically significant in the determination of wages by these specifications. This, however, may not be surprising. The sample correlation between average literacy and numeracy is 0.88, and that between literacy and problem solving skills is 0.84. The sample correlation between numeracy and problem solving is lower, but still relatively high, at 0.78. In contrast, correlations between each of the three skill measures (literacy, numeracy, and problem solving respectively) with years of education are 0.38, 0.37, and 0.30, and there are even smaller correlations with years of work experience. The presence of imperfect multicollinearity (a close to linear relationship among independent variables) would increase the estimated standard errors and make it less likely to find statistical significance. The goal of the primary analysis, however, is to decompose inequality differentials within and across countries to say something about inequalities in the wage distribution as opposed to estimating returns to skill alone. Since the decomposition method does not rely on the standard errors (lessening the importance of the threat of imperfect multicollinearity), all three skill measures are included in the specifications in order to exploit the comprehensiveness of the PIAAC skill data beyond that used in the previous literature.
[23] Aside from these country restrictions as previously mentioned, Finland is also excluded here due to missing years of education data, as are Austria and Germany.

maintain the largest sample of countries possible. This is then contrasted with the inclusion of gender for robustness in the Appendices. In the presence of these added control variables, the observable quantities component now refers to the effects of the levels of all demographic and work-related characteristics that are included in the regressions underlying the decomposition and the observable returns component is based on the rates of returns of each of these observable factors.

[Table 5 about here]

In 11 out of 12 country pair cases in Panel A for the standard deviation of log earnings (Czech Republic being the exception[24]), unobservable factors are found to be of greater importance than are observable quantities (e.g., of skill, of other schooling, etc.) and returns to these factors (e.g., wages as functions of these observable skill, etc.). This same pattern is also evident for nine out of 12 country pairs in Panel B for differences in the 50-10 log wage differential, and for eight out of 12 country pairs in Panel C for differences in the 90-50 log wage differential.

Tables 6 and 7 reproduce the results once again but now are formed based on the subsamples of men and of women respectively for countries for which gender information in addition to the other variables is available. In some cases the orderings relative to the benchmark of the U.K. changes across genders. This is true for Japan in terms of the overall spread of wages between the country and the U.K. (standard deviation of log wages) where the male differences in greater than the U.K. but the female difference is lesser. Exactly half of the total differences in the gap between the wages of the average and the poor (50-10 log wage differentials) switch directions relative to the U.K. across the male and female subsample tables. This indicates substantial heterogeneity across genders in the lower part of the wage distribution for the countries studied. Specifically, inequality of the poor is higher in the U.K. for men and lower in the U.K. for women than in the Czech Republic, Denmark, Ireland, and the Slovak Republic. The opposite is true for Japan. In contrast, none of the measured gaps between the rich and the average (90-50 differentials) reveal qualitatively different results across genders. Furthermore, the unobservable component remains large across both genders.

[Tables 6 and 7 about here]

For men, the importance of unobservable factors is greater than that of observable factors for eight out of 10 pairwise country comparisons for the standard deviation of log wages. A more equal balance of the importance of observable relative to unobservable factors is found for the other measures of inequality. In only three out of 10 cases for the 50-10 log wage differential, but six out of 10 cases for the 90-50 log wage differential, are the effects of unobservables found to be of highest importance in the determination of earnings inequality in the labor market for men. For women, unobservable factors have greater importance than observable ones for six out of 10 pairwise country comparisons for the standard deviation of log wages, four out of 10 cases for the 50-10 log wage differential, and five out of 10 cases for the 90-50 log wage differential. These results re-confirm the importance of gender in the determination of the spread of earnings in the labor market.[25] The results

[24] Unobservables only account for 23 percent of the total difference between the Czech Republic and the U.K. in the standard deviation of earnings. This is compared, however, to an average unobservables contribution of approximately 89 percent across the countries studied relative the U.K. This later number is roughly similar to the findings in the previous literature using decomposition approaches to study economic inequality, though slightly lower due to the treatment of problem solving skills as observable in this study.

[25] Results in Table A6 of the Appendices reproduce the findings in Table 5 while incorporating a gender control variable (as opposed to examining results for separate subsamples of men and of women). Like in Tables 6 and 7, this restriction,

also re-confirm, however, that much of the observed economic inequality across countries is still left unattributable to the observable economic equilibrium factors related to demand and supply dynamics that are measured in this framework.

Robustness Tests

Variations to the primary specifications are contrasted below for robustness and in order to derive further conclusions about subpopulations of potential interest, and about whether the major results are robust to the inclusion or exclusion of certain independent variables of interest. Changes to the definition of the dependent variable (log hourly wages) also are considered.

Immigrants and Non-immigrants as Subgroups

One direction for a robustness check of the specification presented in Table 5 is to consider wage inequality relationships for immigrants as a subgroup separately from the rest of the population. Some earlier literature (e.g., Devroye and Freeman, 2001; Leuven, 2004) suggests that immigrants may not respond to skill tests in the same way as do natives because the test is administered in national languages. These observations motivate the separate treatment of immigrants and non-immigrants in a similar fashion to how gender was disaggregated in the previous tables.

[Tables 8 and 9 about here]

The subsample of immigrants is considered in Table 8 and that for non-immigrants is considered in Table 9. For immigrants, the overall sample drops from 152,514 total observations in the full dataset (before any country restrictions) to only 19,264 immigrants by this definition.[26] Unobservable factors are found to outweigh observables in seven out of 10 pairwise country comparisons for the standard deviation of log wages, in four out of 10 cases for the 50-10 log wage differential, and in five out of 10 cases for the 90-50 log wage differential for immigrants. For non-immigrants, unobservable differences outweigh observable differences for eight of the pairwise combinations for standard deviation, for six of the combinations for the 50-10 ratio and for seven of those for the 90-50 ratio. Therefore, substantial unobservable factors still play an important part of the story even once immigrant status has been considered.

Alternative Independent Variables

The education variable used throughout this paper is based on years of formal education or training. It is possible, however, that non-formal education also is a significant determinant of earnings in some countries in the sample and is correlated with other included control variables. If this is the case, the observation of this information as a variable may change the results regarding the importance of unobservable components relative of observable components in the decomposition because otherwise

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however, necessitates the removal of two countries (the Netherlands and Russian Federation) due to data availability of the gender variable. Results for countries that are included in both Tables A6 and 5, however, are qualitatively similar. As expected due to the same underlying estimation samples, the total effects are equivalent across the two models but the three decomposition components vary.

[26] The PIAAC variable IMGEN (First and second generation immigrants (derived)) is used to separate the sample. Immigrant status is defined inclusive of both first and second generation immigrants in order to maintain a larger sample size for the analysis. Non-immigrants with one foreign-born parent are excluded from the sample.

the underlying regression coefficients (and also the decomposition components which are functions of these coefficients) suffer from omitted variables bias.

Table A7 in the Appendix presents the decomposition results with same independent variables as in Table 5 but the additional inclusion of a variable to control for non-formal education.[27] While the unobservable component in the decomposition does decrease in many cases, the results are qualitatively similar to the previously reported ones.

Robustness to the exclusion of the age group control variables is also tested. Mincer (1974) regression typically do not include age when education and experience are included due to possible collinearity or linear relationship among the regressors. Recognizing that returns to skill may vary with age, however, Hanushek et al. (2013) restricts to prime-aged workers between the ages of 35 and 54 in their primary specifications. Since this type of restriction is not used here in order to maintain maximum sample size, variables for age were included as separate independent variables in the main models. Table A8 in the Appendix relaxes this assumption and presents qualitatively similar results in the absence of the age variables. This indicates that the presence of the age dummy variables is not driving the major results of the paper.

Alternative Earnings Measures

Several alternative earnings measures are presented in final specifications for the purpose of documenting robustness of the major results. Table A9 provides a first robustness check pertaining to the dependent variable. Instead of gross hourly earnings in PPP terms (the variable that is used throughout the preceding decomposition analysis), gross hourly earnings *including* bonus payments in PPP terms is used as the dependent variable. In terms of total differences between countries and the benchmark country of the U.K., only two differences change sign in comparison to the results in Table 5. These differences correspond to the 50-10 log wage differential for the Slovak Republic (which is positive when bonuses are included and negative otherwise) and the 90-50 log wage differential for Ireland (which is negative when bonuses are included and positive otherwise). For the case of the difference in the Slovak Republic result, the greatest difference across Tables A9 and 5 appears in the unobservables component. This indicates that for this country the inclusion of bonuses actually detracts from providing evidence of relationships to the observable components. For the case of Ireland, the difference appears in terms of the observable quantities component, thus indicating that the demographic and work-related characteristics that are included in this study are better related to wages including bonuses for this country than to wages without bonuses.

Aside from these minor exceptions, the overall patterns across Tables A9 and 5 are strikingly similar with unobservable factors remaining highly significant in terms of their importance in the determination of differences across countries in terms of inequality statistics and within countries when these inequality statistics are compared with each other. Differences, however, could be hypothesized to emerge in the presence of an overall earnings measure instead of a wage measure since earnings are a function of both wage and time worked. To test this, Tables A10 through A12 present results from decompositions using the dependent variables of monthly earnings, monthly earnings including bonuses, and monthly earnings for the self-employed respectively. Each dependent variable used is reported and used in PPP terms to maintain comparability across countries for the purpose of

[27] The specific variable used is NFEHRS, the derived number of hours of participation in non-formal education in the PIAAC public-use international data.

interpretation.[28] The result is again few notable differences over the primary results presented in the main specifications.

Discussion and Conclusions

The concluding section focuses on summarizing major findings and contributions to the existing literature, on implications of the study for public policy within and across nations, and on further research and ongoing data needs for continued study in this subject area.

Major Findings and Relationship of the Study to Previous Literature

Substantial inequality is documented in the paper across countries, skill measures, and gender, thus reinforcing previous findings that skill by itself is only a partial explanation for vast differences in observed patterns of wage and earnings inequality across countries. The recent release of cross-country PIAAC data, with more comprehensive skill measures overall and the availability of three unique measures (fore literacy, numeracy, and problem solving abilities respectively) allowed for analysis of the effects of broadly-defined modern skills in the current international economy on inequality both within and across countries.

Summary statistics suggest that both skills and wages differ substantially within and across countries in the PIAAC dataset. Skills tend to be more variable in the lower parts of the skill distributions. Wages, on the other hand, tend to be more variable in the upper parts of the wage distribution. Econometric modeling was used to examine the importance of differences in levels of skills and other determinants of wages, in rates of return to these levels of skills, and in unobservable (unmodeled) features for understanding the sources of economic inequality across countries.

Major results parallel those of previous studies of cognitive skills and inequality, which were based on surveys such as IALS. This paper illustrates that demand and supply factors, and to a greater extent, unobservable factors such as labor and product market institutions matter. The addition of new problem solving skill measures does not substantially reduce the importance of unobservable factors when results are compared to previous literature. This, by itself, is an important result since it suggests that missing human capital variables in previous datasets, such as IALS, are not in fact primary drivers of the large unobservable factor component noted in previous literature. In all, skills are still only a small part of the story of cross-country differences in economic inequality. One caveat, also noted in Hanushek et al. (2013), however, is that unmeasured non-cognitive skill may still be an important omitted variable. Type of job, not controlled for here, also may matter since returns to skill and other observable characteristics plausibly vary across job categories especially in cases where employer-specific human capital is of importance.

Throughout the major analysis, the specific demographic characteristic of gender is given particular attention given its importance as a determining factor of wages in international literature within labor economics. Some overall sample results are found to be sensitive to gender as wage inequality tends to be higher for women in some contexts. Unobservable factors, however, continue to be of substantial significance for men and for women alike.

Further robustness tests show that there are fewer notable differences across immigration status categories, another characteristic suggested in the literature to be important for wage determination generally. Major results are also robust to alternative measures of education (to include non-formal

[28] The specific PIAAC variables are EARNHRBONUSPPP, EARNMTHPPP, EARNMTHBONUSPPP, and EARNMTHSELFPPP.

education particularly), and to the use of alternative wage measures (hourly wages with bonuses, monthly wages, monthly wages with bonuses, and monthly wages of the self-employed).

Relevance for Policy and Practice and Discussion of Institutional Factors

While the decomposition results do reveal substantial differences in the extent and determining factors of inequality within and across countries, the importance of institutions above and beyond supply and demand factors in many country cases is revealed to be consistent with earlier literature.

Although it is beyond the scope of this paper to determine which institutional factors are causally related to wage inequality across nations, it is possible to consider some institutional factors more generally for discussion. Hanushek et al. (2013) identifies several indicators available from the OECD that in their case are related to returns to skill. It is reasonable that these same factors also may be related to wage inequality. Furthermore, Blau and Kahn (2005) hypothesize that their similar results may be related to differences in collective bargaining arrangements across countries. Therefore, labor market regulations may be particularly important.

Table 10 summarizes some major indicators for the subset of countries that overlap with the major decomposition results. Particularly, the table presents summary statistics for trade union density as a percentage of employees, percentage of employment in general government and public corporations, an index variable for protection of permanent workers against individual and collective dismissals which range from a low of zero to a high of six (i.e., a composite measure of employment protection legislation), presence of statutory minimum wage legislation, and a product market regulation index that incorporates information on state control, barriers to entrepreneurship, and barriers to trade and investment. These data are publicly available from the OECD and are presented here as supplemental information for context only (as they do not appear in the formal models that are estimated and presented in this paper).

[Table 10 about here]

The table indicates substantial differences across countries for each of the identified institutional characteristics. Union density, for example, varies from only 8.1 percent in Estonia (a country with relatively high earnings inequality as documented in Figure 5) to 68.8 percent in Denmark (a country with relatively low earnings inequality documented in the same figure). Public sector employment varies from 5.7 percent in Korea (another country with high earnings inequality) to 29.3 percent in Norway (a country with low earnings inequality). While most countries in this sample do have minimum wage coverage, the generosity and extent of coverage may vary across countries. The two indices for worker protection and for product market regulation also reveal substantial differences across countries. This paper thus re-confirms that institutional characteristics still may have an extensive role in determining economic inequality in addition to what is the result of market forces of demand and of supply. Together, the statistics detailed in Table 10 point to the complexity of understanding *how* particular institutions matter and provides confirmation that additional research is warranted to pinpoint more of these details.

A major finding of this paper is that while individuals who participate in human capital improvement programs may themselves experience labor market rewards associated with skill, skill by itself is not found to be a major determinant of wage *inequality* outcomes within and across countries. It is important to stress that these findings are not in opposition to each other. Instead, average returns to skill overall may be shifting while the distribution of returns to skill around this average stays relatively constant. This means that individuals may be doing better (in comparison to say being in poverty by some absolute definition) but these same individuals may find themselves in the same position of the overall wage distribution.

Since skill measures, even those as comprehensive as those offered by PIAAC, by themselves are not found to be a substantial component of observed differentials in earnings inequality across countries, the paper suggests that there are limits in terms of the use of education and training opportunities that focus on increasing skills for the purpose of reducing wage inequality across subgroups if this is a policy goal. The same can be said in terms of investments targeting the improvement of returns to skills. This is not to say, however, that education and training opportunities are totally unimportant for the determination of inequality.[29] Instead, educational opportunity differences themselves within and across countries may be part of the sizeable unobservable component in the decompositions presented in this paper that have real effects on the overall shape of the wage distribution (alongside non-cognitive skill and other unobservable factors at the individual and country levels) and may not be perfectly reflected in observable skill and education levels. This indicates that while cognitive skills themselves are limited in terms of translating into wage inequality, institutions in general, as opposed to supply and demand factors alone, may be major contributors to the wage structure and distribution within and across economies. These institutions may include, but are certainly not limited to, those related to education and training and this presents a worthwhile direction for future research.

Future Research using PIAAC and the Importance of Further Information

Literature review suggests significant interest in quantifying relationships between skill distributions of various types and economic outcomes including those related to poverty and to inequality. This paper is a first to introduce PIAAC data, the latest in cross-country skill measurement, to this topical area in a systematic analysis. Continued interest therefore is anticipated to follow.

Specific future research (incorporating future releases of PIAAC, for example) can examine how economic risk, as measured by inequality statistics, changes over time within and across countries. Macro-level analysis using aggregated statistics from the microdata is naturally limited for the current PIAAC release by the small sample size of the cross-section. This will be eased with further data releases as longitudinal/panel data methodologies then will be available tools for analysis in the presence of additional data years as they become available. Other future research may extend this work by considering differences in inequality outcomes by race and ethnicity (indicators unavailable across countries in PIAAC but available for the U.S. case) or may provide a more detailed examinations of immigrants versus natives within or across countries.

In terms of methodology, some recent literature suggests the use of quantile regression for the study of the effects of education on inequality. This literature may be relevant for extensions to PIAAC skills, and for comparison with methods here. In addition, as noted, adding external indicators of institutional factors may provide value-added if comparability across countries of these data can be established and if full data series of information such as that reported in Table 10 can be constructed and merged to PIAAC.

A disadvantage of the decomposition approach generally that is discussed in some literature is that it discounts differences in the supply and demand factors that themselves affect wages, and thus may produce incomplete estimates of the true effect of skill distribution changes because of a lack of allowance for prices to depend on the net supply conditions that are detailed as important in classic papers such as Katz and Murphy (1992). Leuven et al. (2004), for example, responds to these critiques

[29] Furthermore, the social goals of these types of investments may be very different from those discussed here.

using methods by constructing demand and supply indices for low, middle, and high skilled groups and running econometric regressions (relating wage and skill differences) on pairwise combinations across countries. These authors find that their model is successful in explaining how much of the variation in relative wages between skill groups across countries is related to differences in net supply of skill groups, especially those differences for the low-skill population. An advantage of supply and demand analysis such as this is that it allows for an analysis of the relative contributions of differences in underlying economic factors related to supply and demand and institutional factors pertaining to labor markets and their regulation or lack thereof across countries. The Leuven et al. (2004) work, however, has been noted to use one composite skill measure (necessary in their view due to the presence of high observable correlations between skill types) which may not be desirable in all circumstances. There is little reason, however, why types of skills cannot be taken in turn for analysis instead of using an average skill across categories. This is especially true when correlations across skill categories are weaker, as in the case of the PIAAC digital problem solving measure in relation to the other two measures of skills that are available in PIAAC. This topic therefore is promising for future work.

This paper presented here overall points out some major limitations in the current public-use PIAAC data for the study of wage and earnings inequality across countries. Complete analysis is not possible, for example, for several countries due to data limitations in terms of problem solving skills, in terms of wages, and in terms of basic demographics such as gender and years of education. Since specific variable availability differs across countries, several countries were necessarily dropped for certain parts of the analysis. As a result, the final results are not perfectly comparable with previous studies which focused on different sets of countries but are applicable to some countries with similar characteristics in the most recent time period. As new data becomes available, some of these gaps may be filled and may allow for further cross-country comparisons. This also suggests that future skill surveys (including future releases of PIAAC) should be especially attentive to the availability of comprehensive, comparable data across countries.

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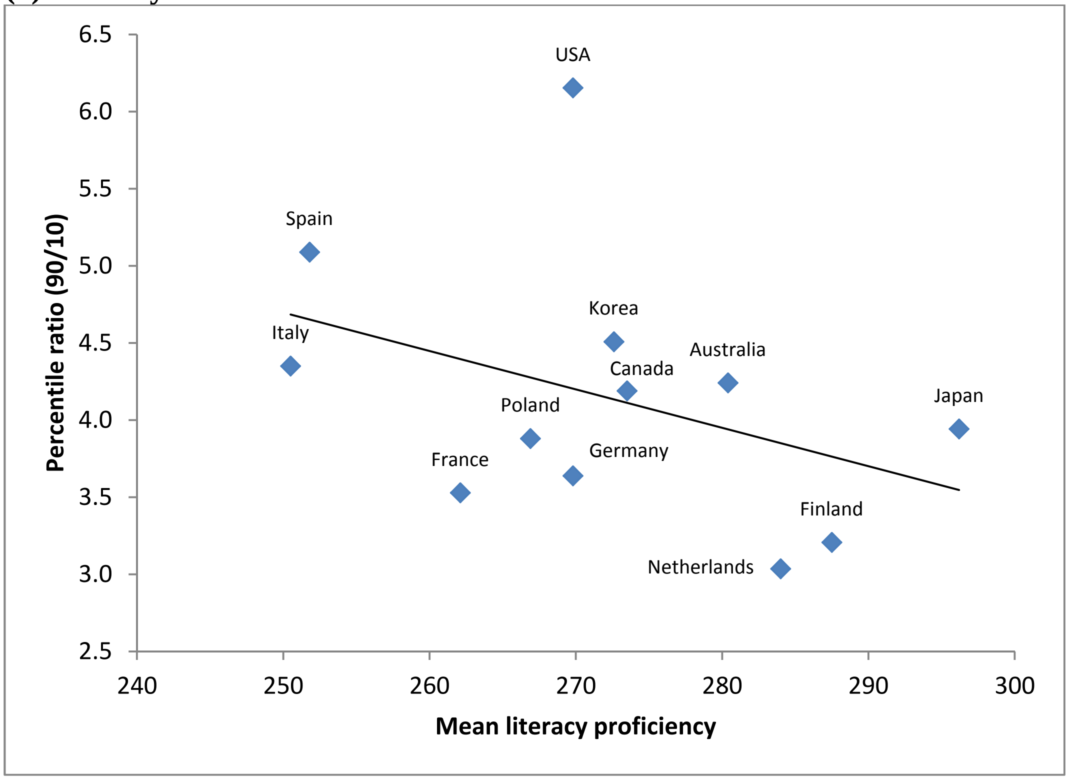
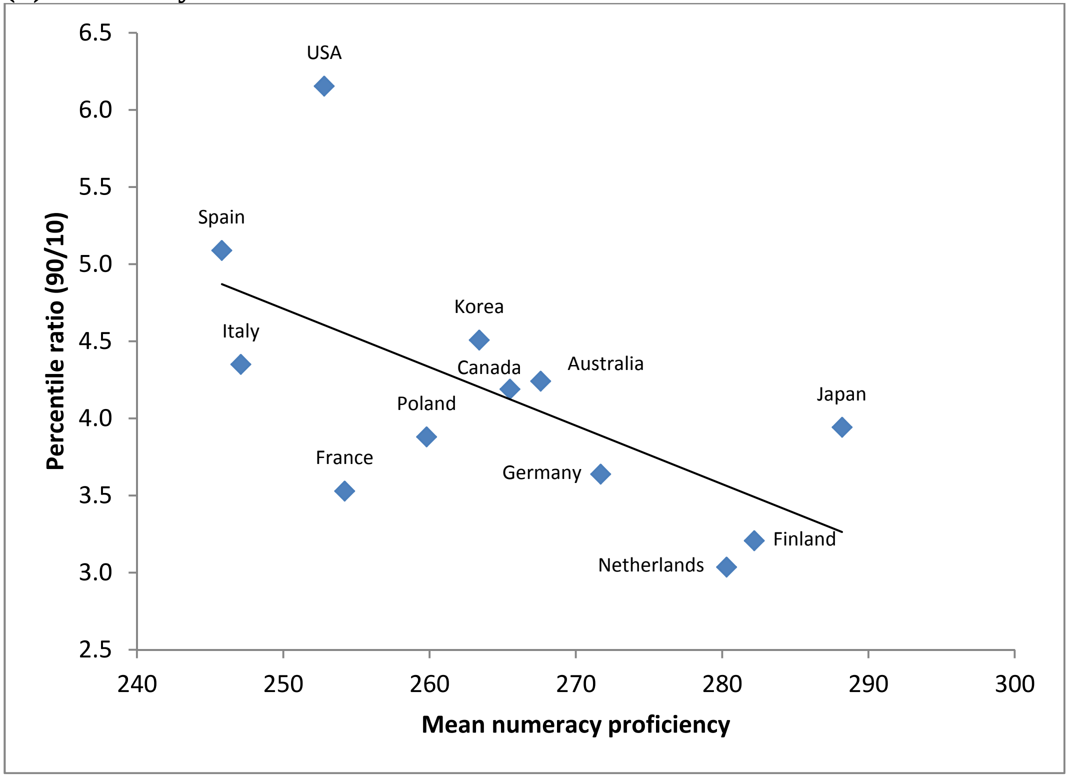
Figures and Tables

Figure 1: Skill proficiencies and income inequality, percentile ratio (90/10), with linear trend line

(a) Literacy



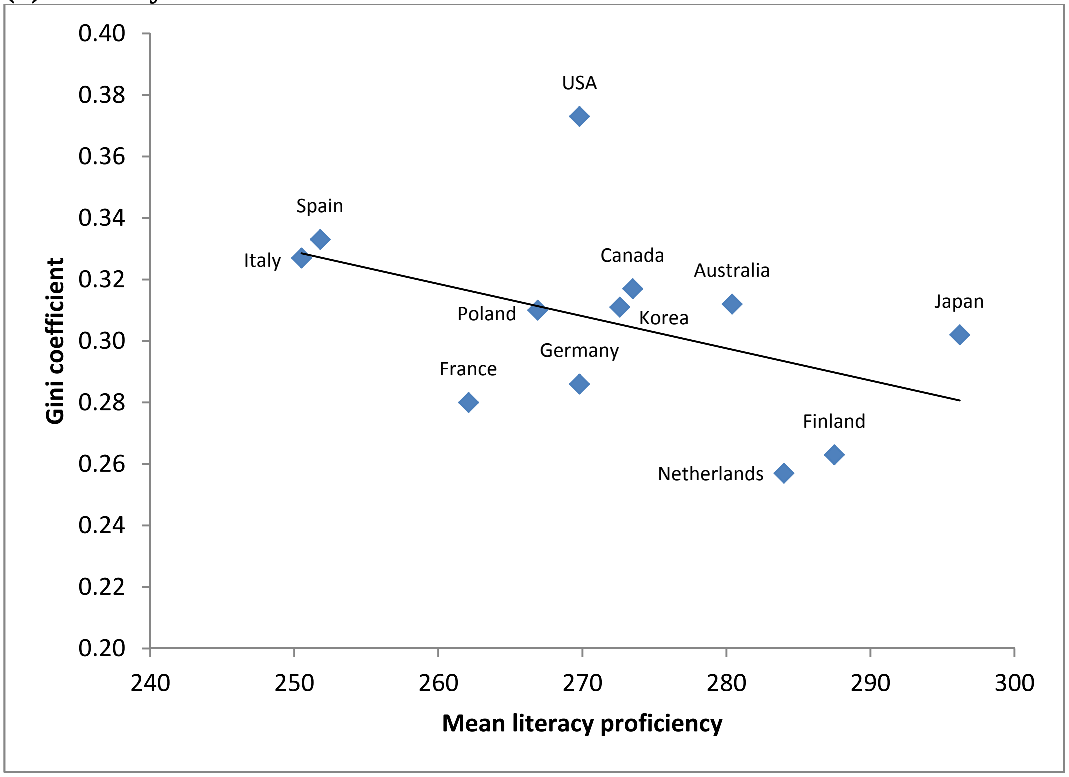
(b) Numeracy



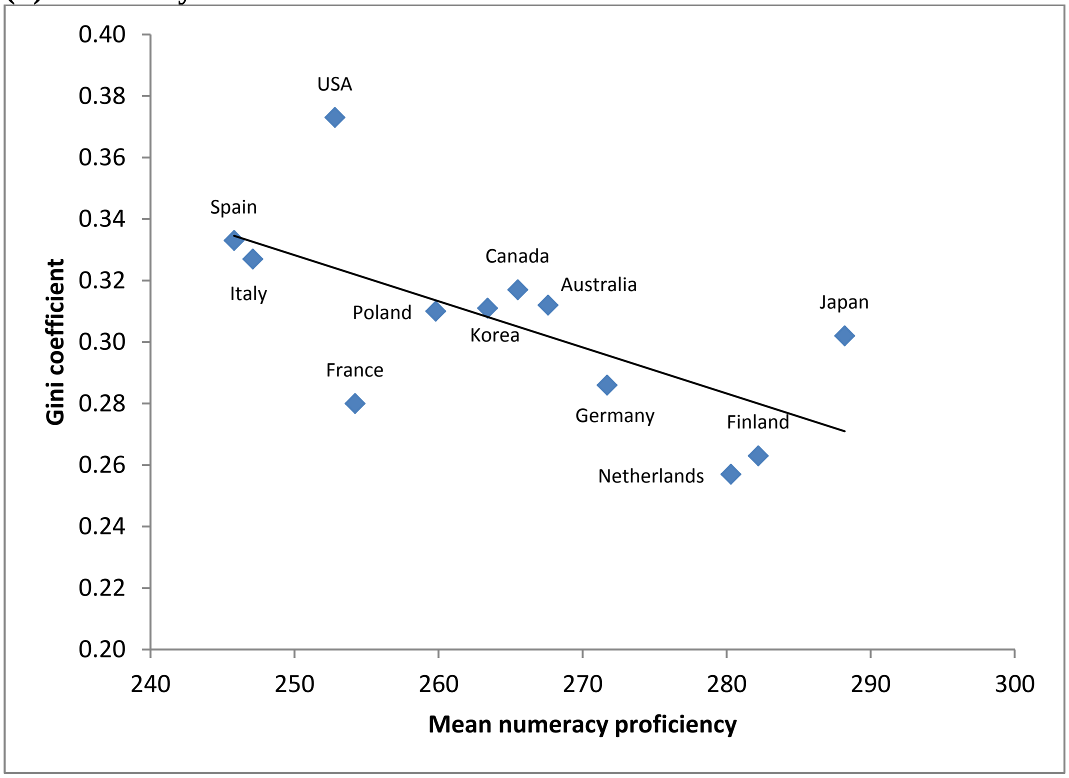
Sources: LIS (2014) and OECD (2013a), restricted to PIAAC national entities as summarized in Annex F.

Figure 2: Skill proficiencies and income inequality, Gini coefficient, with linear trend line

(a) Literacy

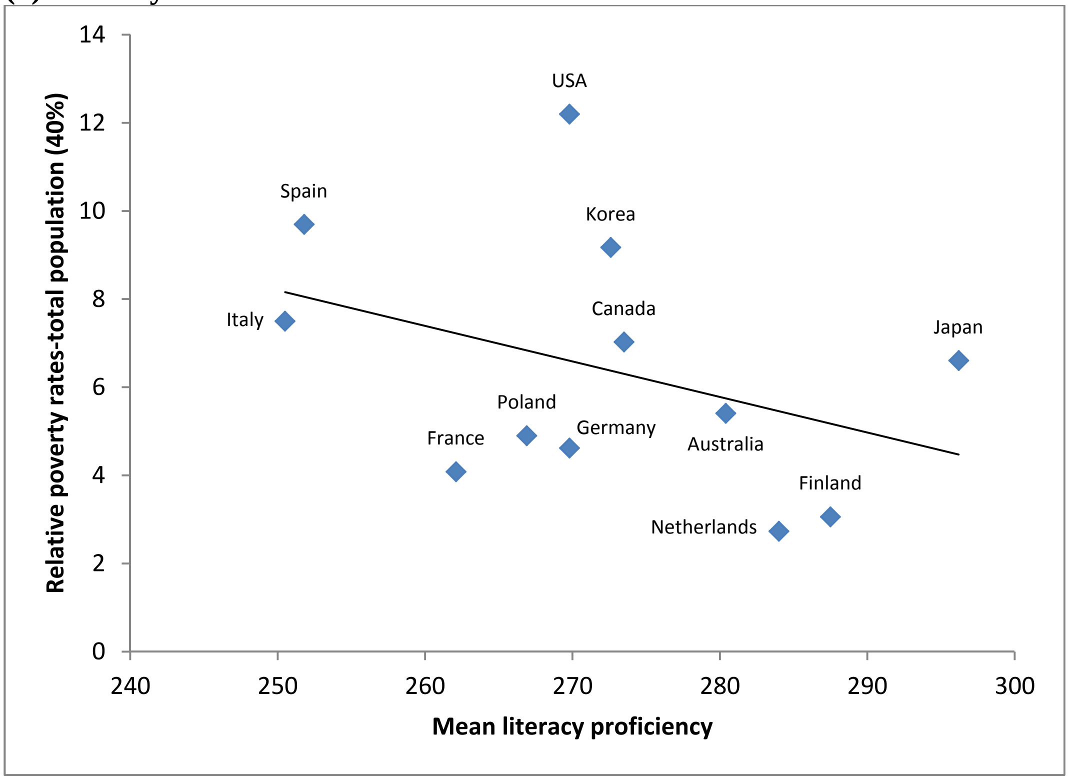


(b) Numeracy

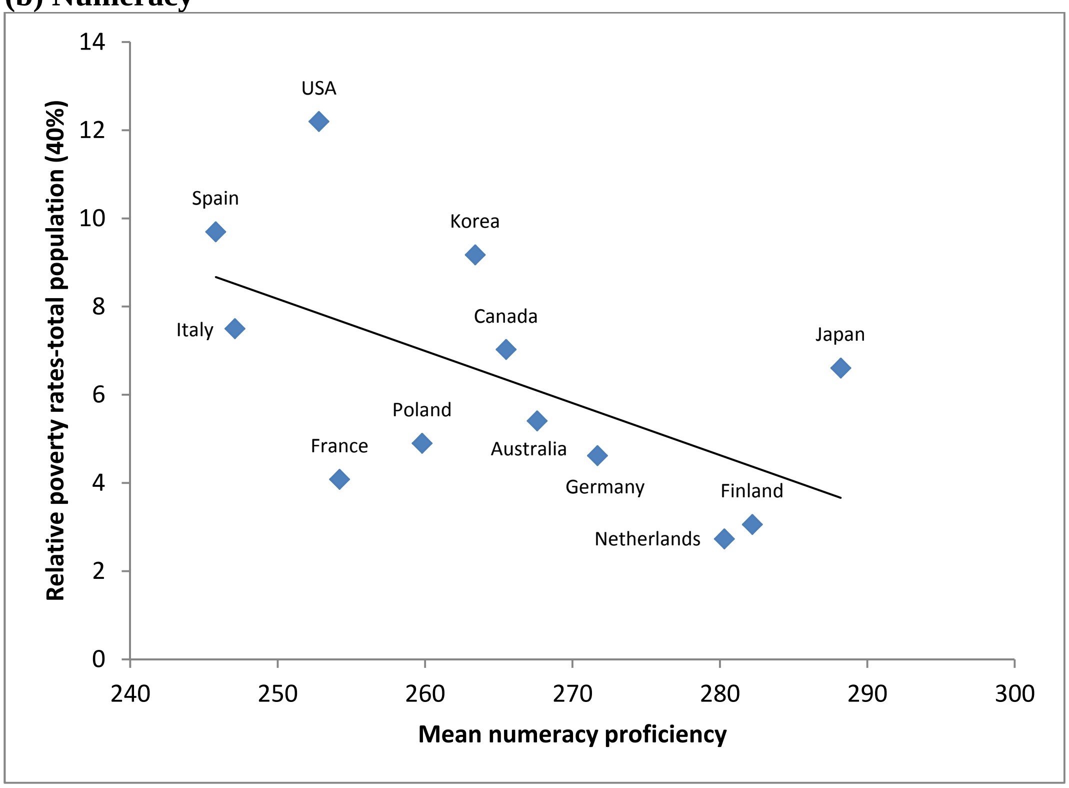


Sources: LIS (2014) and OECD (2013a), restricted to PIAAC national entities as summarized in Annex F.

Figure 3: Skill proficiencies and poverty rate, with linear trend line
(a) Literacy



(b) Numeracy



Sources: LIS (2014) and OECD (2013a), restricted to PIAAC national entities as summarized in Annex F.

Table 1: Distribution of Individual Average Test Scores, by Country

	Literacy							Numeracy							Problem Solving						
			Percentile			Differential				Percentile			Differential				Percentile			Differential	
Country	mean	sd	10	50	90	50-10	90-50	mean	sd	10	50	90	50-10	90-50	mean	sd	10	50	90	50-10	90-50
Austria	269.45	43.96	212.74	272.34	322.85	59.6	50.51	275.04	49.29	212.93	278.23	334.17	65.3	55.94	283.98	38.01	233.31	285.48	331.39	52.17	45.91
Canada	273.34	50.43	208.26	277.65	333.86	69.39	56.21	265.24	55.6	193.82	269.63	332.32	75.81	62.69	282.29	45.23	222.01	285.09	338.05	63.08	52.96
Czech Republic	274.01	40.79	221.08	276.36	323.42	55.28	47.06	275.73	43.72	218.42	278.46	329.36	60.04	50.9	282.99	44.53	223.89	284.85	338.27	60.96	53.42
Denmark	270.79	47.72	209.78	276.16	326.04	66.38	49.88	278.28	51.23	213.4	282.03	339.5	68.63	57.47	283.08	42.39	226.45	286	334.99	59.55	48.99
Estonia	275.88	44.4	217.86	278.71	329.7	60.85	50.99	273.12	45.54	214.82	275.28	328.74	60.46	53.46	277.62	42.67	221.09	279.29	330.86	58.2	51.57
Finland	287.55	50.67	223.75	292.07	347.23	68.32	55.16	282.23	52.21	217.41	285.85	345.05	68.44	59.2	289.37	42.41	232.28	292.1	341.46	59.82	49.36
France	262.14	49.02	197	266.91	320.94	69.91	54.03	254.19	56.17	179.75	259.16	321.55	79.41	62.39	.	.	.	.	.	.	.
Germany	269.81	47.4	206.17	273.33	327.73	67.16	54.4	271.73	53.07	201.93	275.93	335.02	74	59.09	282.58	43.7	224.76	284.71	337.09	59.95	52.38
Ireland	266.54	47.19	206.88	270.45	322.59	63.57	52.14	255.59	53.66	189.53	259.58	318.86	70.05	59.28	276.8	40.16	224.2	278.76	327.21	54.56	48.45
Italy	250.48	44.69	192.39	252.44	306.13	60.05	53.69	247.13	49.99	182.89	249.28	309.15	66.39	59.87	.	.	.	.	.	.	.
Japan	296.24	39.71	243.87	299.59	343.65	55.72	44.06	288.17	43.98	231.68	290.85	341.74	59.17	50.89	294.03	44.46	234.73	297.38	347.44	62.65	50.06
Korea	272.56	41.69	218.5	276	322.31	57.5	46.31	263.39	45.64	203.81	267.1	318.4	63.29	51.3	282.97	37.64	233.05	284.97	329.83	51.92	44.86
Netherlands	284.01	48.39	219.42	289.15	341.04	69.73	51.89	280.35	51.07	214.66	285.8	339.77	71.14	53.97	286.4	41.71	230.82	288.81	337.57	57.99	48.76
Norway	278.43	47.02	218.13	283.46	333.43	65.33	49.97	278.3	54.21	209.68	283.55	341.45	73.87	57.9	286.49	40.25	232.7	289.61	335.03	56.91	45.42
Poland	266.9	47.98	204.28	270.09	325.2	65.81	55.11	259.77	50.72	193.98	262.64	321.84	68.66	59.2	274.92	48.35	211.81	276.96	334.65	65.15	57.69
Slovak Republic	273.85	40.07	221.41	277.9	320.78	56.49	42.88	275.81	47.6	214.32	280.44	331.48	66.12	51.04	281.08	36.9	232.99	282.29	326.67	49.3	44.38
Spain	251.79	49.03	187.39	255.62	310.91	68.23	55.29	245.82	51.32	177.78	250.31	307.39	72.53	57.08	.	.	.	.	.	.	.
Sweden	279.23	50.56	215.4	284.78	337.64	69.38	52.86	279.05	54.87	209.96	284.06	342.8	74.1	58.74	287.77	43.96	228.13	291	340.95	62.87	49.95
United States	269.81	49.19	204.17	273.16	330.3	68.99	57.14	252.84	57.03	177.9	256.08	322.74	78.18	66.66	277.44	43.5	220.45	279.12	331.59	58.67	52.47
Sub-national entities																					
Flanders (Belgium)	275.48	47.08	212.53	280.49	331.6	67.96	51.11	280.39	50.59	213.7	284.41	341.54	70.71	57.13	280.76	43.84	221.68	283.67	334.8	61.99	51.13
England/N. Ireland (UK)	272.46	48.97	209.22	275.63	332.67	66.41	57.04	261.73	54.88	191.64	264.97	329.35	73.33	64.38	280.33	42.05	224.73	281.86	333.3	57.13	51.44
OECD Average	272.42	46.47	211.92	276.3	328.1	64.38	51.8	268.76	51.07	203.05	272.55	330.11	69.5	57.56	.	.	.	.	.	.	.
Partners																					
Cyprus	268.84	40.27	215.3	271.69	318.02	56.39	46.33	264.63	46.84	205.13	267.8	321.31	62.67	53.51	.	.	.	.	.	.	.
Russian Federation	275.23	42.88	217.95	278.2	327.95	60.25	49.75	269.93	41.98	216.53	272.18	321.24	55.65	49.06	276.25	48.98	212.08	278.2	336.35	66.12	58.15

Source: PIAAC and author's calculations.

Table 2: Distribution of Individual Average Test Scores, by Country and Gender
Panel A: Men

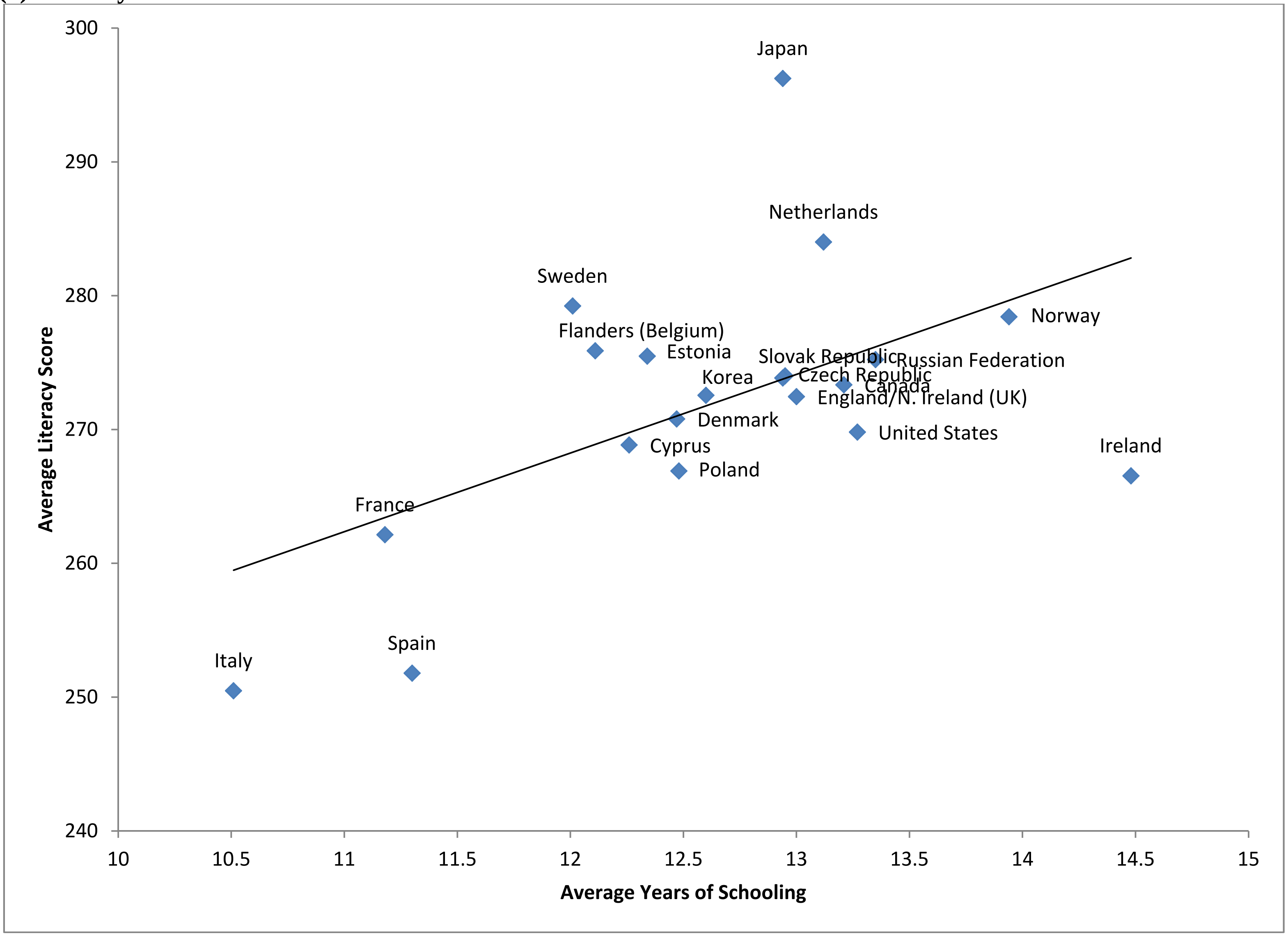
	Literacy							Numeracy							Problem Solving						
			Percentile			Differential				Percentile			Differential				Percentile			Differential	
Country	mean	sd	10	50	90	50-10	90-50	mean	sd	10	50	90	50-10	90-50	mean	sd	10	50	90	50-10	90-50
Austria	271.53	44.64	214.38	275	325.25	60.62	50.25	281.66	50.38	218.37	285.84	340.95	67.47	55.11	288.56	37.56	238.23	290.13	335.35	51.9	45.22
Canada	274.49	50.99	208.67	278.71	335.89	70.04	57.18	272.55	56.19	199.66	277.26	339.96	77.6	62.7	283.28	45.88	222.1	286.19	339.91	64.09	53.72
Czech Republic	275.68	40.83	222.49	277.89	325.01	55.4	47.12	280.2	43.29	223.01	283.27	333.41	60.26	50.14	284.87	45.31	225.11	286.45	341.59	61.34	55.14
Denmark	270.58	49.7	205.69	276.58	327.93	70.89	51.35	283.4	53.06	215.54	288.37	346.11	72.83	57.74	285.3	43.37	226.68	288.79	338.03	62.11	49.24
Estonia	275.06	45.44	216.3	278.03	329.85	61.73	51.82	276.24	47.27	216.52	278.5	333.95	61.98	55.45	279.81	43.03	223.59	281.08	334.17	57.49	53.09
Finland	285.96	51.99	220.61	290.79	346.69	70.18	55.9	287.29	53.68	220.1	291.62	351.43	71.52	59.81	291.13	43.18	232.54	294.1	343.95	61.56	49.85
France	262.05	49.32	196.82	266.33	321.95	69.51	55.62	259.72	56.46	184.63	264.74	327.56	80.11	62.82	.	.	.	.	.	.	.
Germany	272.35	47.69	208.26	275.91	330.61	67.65	54.7	280.28	52.33	211.39	284.86	342.75	73.47	57.89	285.11	44.37	225.94	287.92	339.94	61.98	52.02
Ireland	267.71	49.17	205.35	271.98	325.75	66.63	53.77	261.68	55.51	194.7	266.06	327.12	71.36	61.06	279.7	41.11	225.57	282.07	331.09	56.5	49.02
Italy	250.36	46.41	189.62	251.83	308.96	62.21	57.13	252.5	51.12	187.33	254.6	316.02	67.27	61.42	.	.	.	.	.	.	.
Japan	297.78	40.35	243.77	301.6	345.64	57.83	44.04	294.29	45.23	234.91	297.73	348.85	62.82	51.12	297.83	45.13	237.54	300.97	351.81	63.43	50.84
Korea	275.72	41.57	222.02	279.03	325.23	57.01	46.2	268.56	45.29	209.92	271.76	323.39	61.84	51.63	285.87	37.93	235.45	288.11	332.79	52.66	44.68
Norway	280.34	47.76	218.04	285.66	336.61	67.62	50.95	285.55	54.62	215.22	291.75	348.89	76.53	57.14	289.45	40.78	235.43	293.15	337.77	57.72	44.62
Poland	263.66	49.62	198.13	267.73	323.86	69.6	56.13	260.73	53.47	190.87	264.26	326.19	73.39	61.93	278.66	49.25	214.65	280.88	339.06	66.23	58.18
Slovak Republic	273.47	40.58	220.78	277.17	321.44	56.39	44.27	277	48.38	213.73	281.48	333.57	67.75	52.09	281.88	37.22	233.38	283.08	328.23	49.7	45.15
Spain	254.11	49.94	189.61	257.41	314.68	67.8	57.27	252.04	52.39	183.74	256.21	314.76	72.47	58.55	.	.	.	.	.	.	.
Sweden	280.88	49.97	217.91	285.9	339.21	67.99	53.31	285.73	54.28	217.46	290.36	348.98	72.9	58.62	289.88	44.5	228.58	293.48	343.46	64.9	49.98
United States	270.16	50.44	202.15	273.42	331.99	71.27	58.57	260.05	58.17	183.53	262.99	331.87	79.46	68.88	279.99	44.84	220.99	281.81	336.54	60.82	54.73
Sub-national entities																					
Flanders (Belgium)	278.09	47.91	213.56	283.32	335.05	69.76	51.73	288.31	51.42	220.56	292.62	349.64	72.06	57.02	283.68	44.43	224.03	286.96	338.18	62.93	51.22
England/N. Ireland (UK)	273.9	50.08	209	277.13	335.75	68.13	58.62	268.88	55.79	196.68	272.75	336.79	76.07	64.04	284.96	43.06	226.81	286.65	338.74	59.84	52.09
OECD Average	272.69	47.22	211.16	276.57	329.37	65.41	52.8	273.83	51.92	206.89	277.85	336.11	70.96	58.26	.	.	.	.	.	.	.
Partners																					
Cyprus	267.99	41.00	213.52	271.01	317.96	57.49	46.95	268.46	47.01	209.84	271.34	324.89	61.5	53.55	.	.	.	.	.	.	.

Panel B: Women

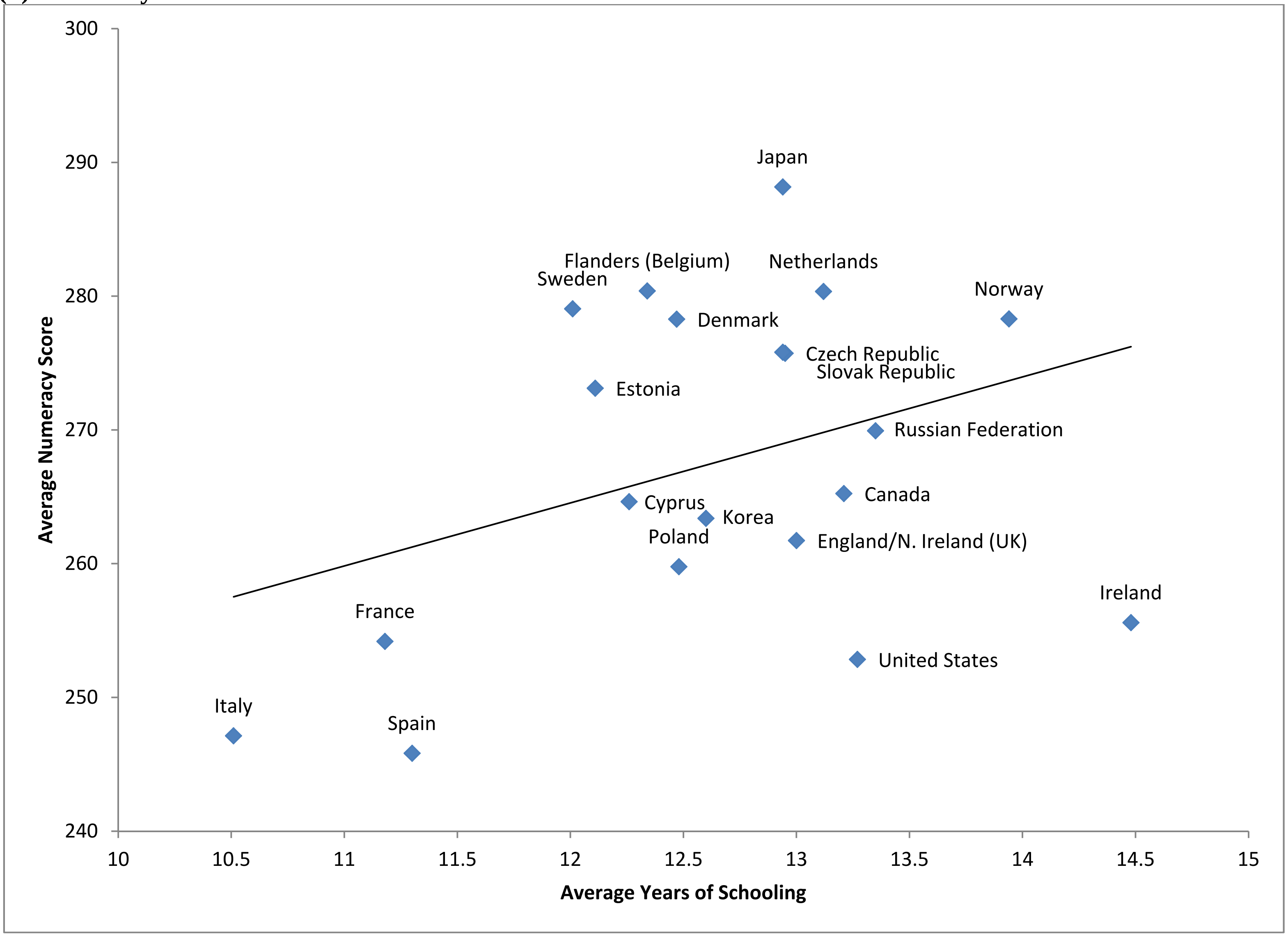
	Literacy							Numeracy							Problem Solving						
			Percentile			Differential				Percentile			Differential				Percentile			Differential	
Country	mean	sd	10	50	90	50-10	90-50	mean	sd	10	50	90	50-10	90-50	mean	sd	10	50	90	50-10	90-50
Austria	267.39	43.17	211.34	269.83	320.2	58.49	50.37	268.47	47.28	208.46	271.15	325.78	62.69	54.63	279.22	37.89	229.04	280.75	326.74	51.71	45.99
Canada	272.19	49.84	208.02	276.51	331.92	68.49	55.41	257.94	54.01	188.65	262.17	323.16	73.52	60.99	281.3	44.56	221.93	284.07	336.11	62.14	52.04
Czech Republic	272.32	40.67	219.37	274.62	321.9	55.25	47.28	271.19	43.69	214.02	273.49	324.01	59.47	50.52	280.91	43.56	222.74	283.18	334.56	60.44	51.38
Denmark	271	45.63	214.05	275.78	324.11	61.73	48.33	273.09	48.77	211.36	276.68	331.45	65.32	54.77	280.92	41.29	226.28	283.56	331.97	57.28	48.41
Estonia	276.64	43.42	219.2	279.35	329.57	60.15	50.22	270.26	43.69	213.57	272.58	323.54	59.01	50.96	275.64	42.24	219.08	277.73	328.24	58.65	50.51
Finland	289.15	49.25	226.75	293.19	347.83	66.44	54.64	277.11	50.16	215.17	280.6	337.56	65.43	56.96	287.62	41.56	232.01	290.05	339.06	58.04	49.01
France	262.23	48.73	197.23	267.39	320.01	70.16	52.62	248.92	55.38	175.14	254.34	314.46	79.2	60.12	.	.	.	.	.	.	.
Germany	267.21	46.96	203.71	270.47	324.75	66.76	54.28	262.99	52.38	194.7	267.12	325.82	72.42	58.7	279.8	42.78	223.29	281.54	333.85	58.25	52.31
Ireland	265.43	45.19	208.18	269.23	319.51	61.05	50.28	249.76	51.15	186.33	253.62	309.81	67.29	56.19	274.15	39.07	223.02	276.13	322.55	53.11	46.42
Italy	250.61	42.9	195.89	252.9	303.49	57.01	50.59	241.76	48.24	179.33	244.38	301.03	65.05	56.65	.	.	.	.	.	.	.
Japan	294.69	38.99	244.02	297.39	341.66	53.37	44.27	281.98	41.77	228.59	284.46	332.78	55.87	48.32	289.41	43.19	231.78	292.94	341.1	61.16	48.16
Korea	269.43	41.56	215.02	273.15	318.6	58.13	45.45	258.27	45.4	198.24	262.62	312.01	64.38	49.39	279.98	37.09	230.73	281.82	326.01	51.09	44.19
Norway	276.43	46.14	218.05	281.29	329.64	63.24	48.35	270.72	52.71	205.17	276.05	331.26	70.88	55.21	283.37	39.44	230.32	286.1	331.67	55.78	45.57
Poland	270.08	46.09	211.2	272.23	326.47	61.03	54.24	258.83	47.84	197	260.96	317.25	63.96	56.29	271.28	47.16	208.82	272.98	329.62	64.16	56.64
Slovak Republic	274.22	39.55	222.07	278.66	320.27	56.59	41.61	274.62	46.78	214.98	279.5	329.28	64.52	49.78	280.27	36.53	232.64	281.45	324.91	48.81	43.46
Spain	249.45	47.98	185.68	253.81	306.77	68.13	52.96	239.54	49.43	171.92	244.94	297.34	73.02	52.4	.	.	.	.	.	.	.
Sweden	277.54	51.11	211.33	283.79	335.92	72.46	52.13	272.17	54.63	202.84	277.9	335.01	75.06	57.11	285.58	43.28	227.54	288.94	337.65	61.4	48.71
United States	269.47	47.96	206.48	272.99	328.38	66.51	55.39	245.96	55.04	173	250.72	313.07	77.72	62.35	275.08	42.08	219.97	276.92	326.79	56.95	49.87
Sub-national entities																					
Flanders (Belgium)	272.81	46.07	211.59	277.76	327.57	66.17	49.81	272.28	48.4	208.97	276.02	330.97	67.05	54.95	277.71	43	219.19	280.26	330.77	61.07	50.51
England/N. Ireland (UK)	271.03	47.79	209.63	274.35	329.41	64.72	55.06	254.62	53.01	186.86	258.04	320.06	71.18	62.02	275.67	40.46	222.16	277.21	326.82	55.05	49.61
OECD Average	270.97	45.45	211.94	274.73	325.4	62.79	50.67	262.52	49.49	198.72	266.37	321.78	67.65	55.41	.	.	.	.	.	.	.
Partners																					
Cyprus	269.6	39.58	217.33	272.24	318.07	54.91	45.83	261.19	46.41	200.74	264.62	317.08	63.88	52.46	.	.	.	.	.	.	.

Source: PIAAC and author's calculations.

Figure 4: Average Years of Schooling and Skill Levels by Country
(a) Literacy

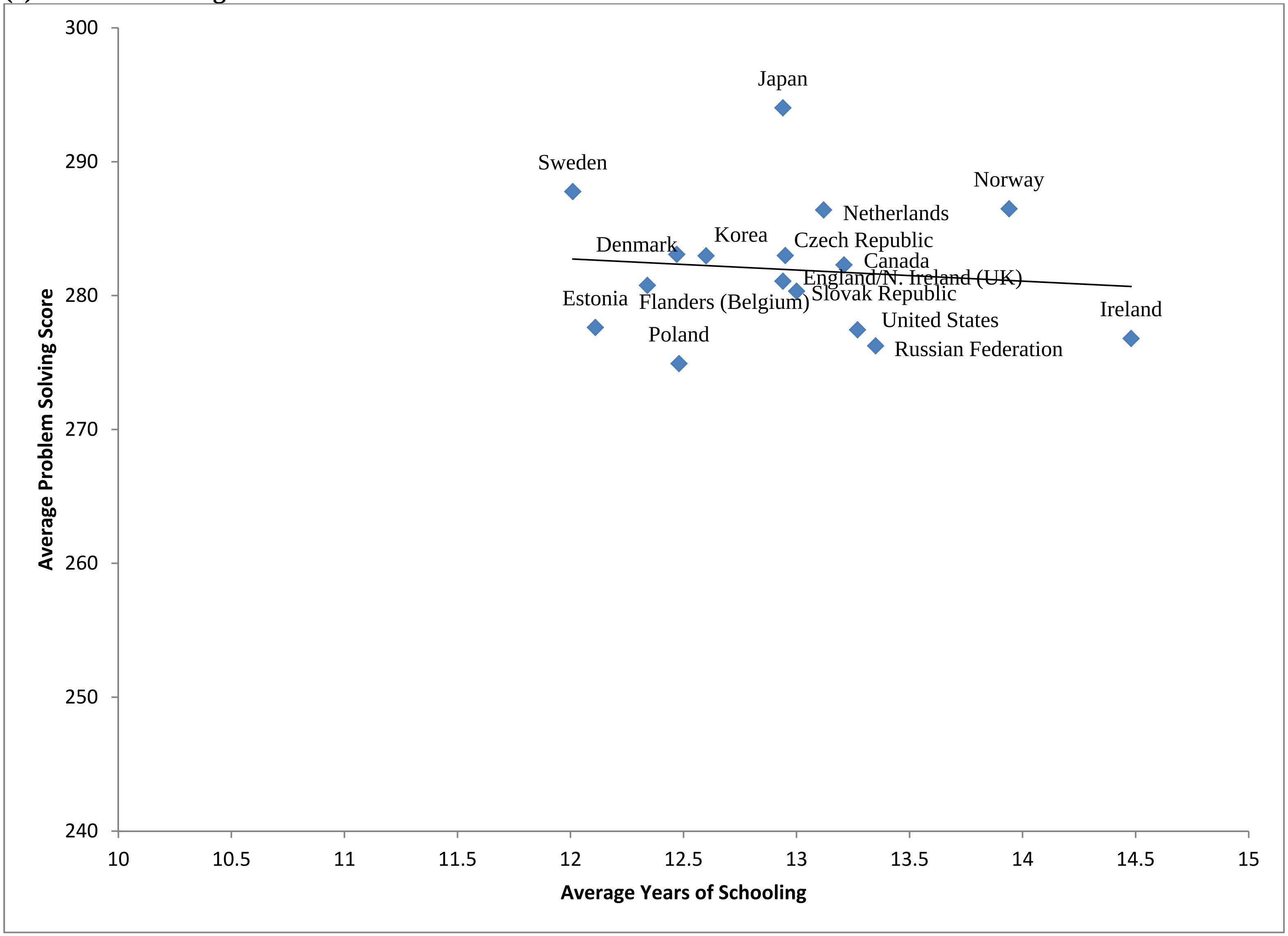


(b) Numeracy



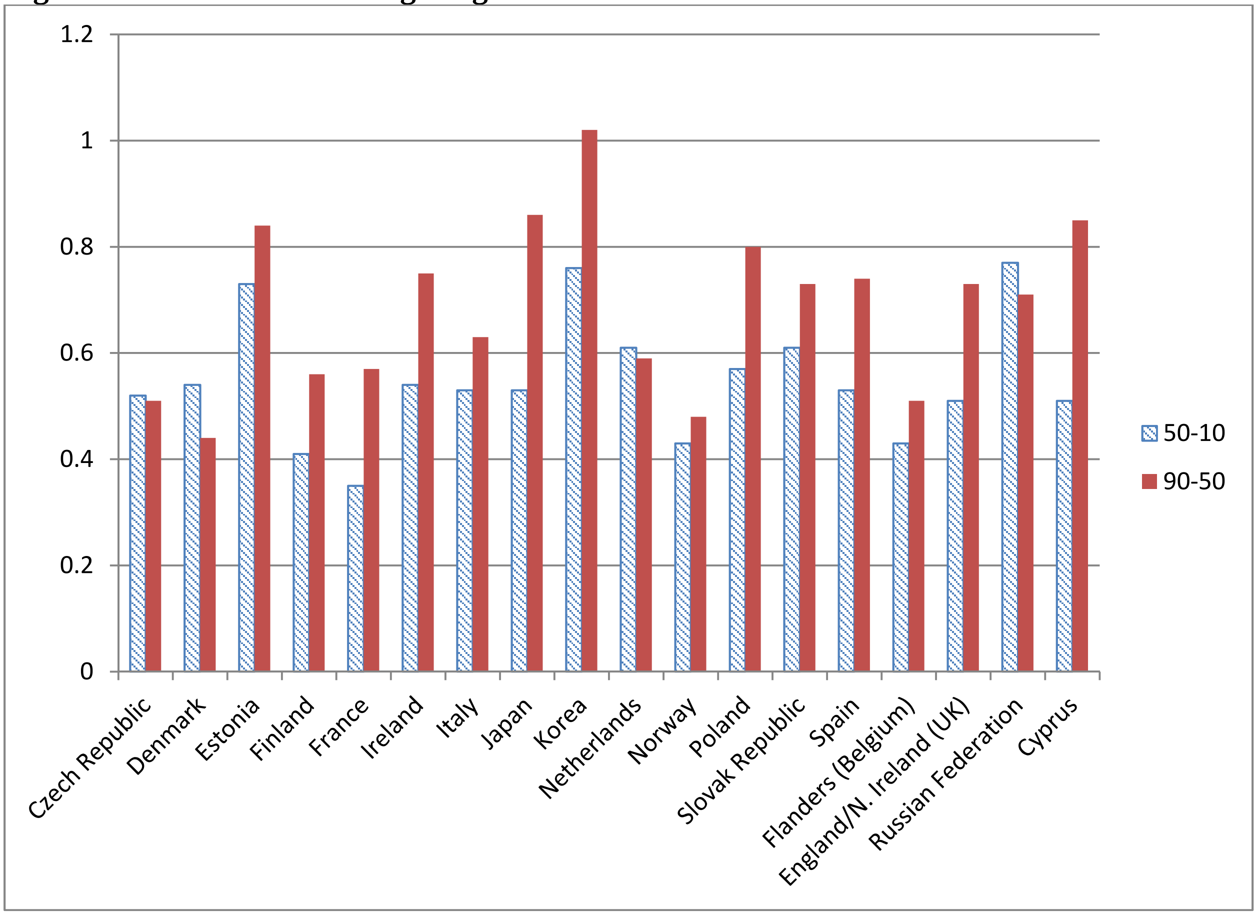
300
290
280
270
260
250
240
Average Numeracy Score
Japan
Flanders (Belgium)
Netherlands
Sweden
Norway
Denmark
Czech Republic
Slovak Republic
Estonia
Russian Federation
Canada
Cyprus
Korea
Poland
England/N. Ireland (UK)
Ireland
France
United States
Italy
Spain
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
Average Years of Schooling

(c) Problem Solving



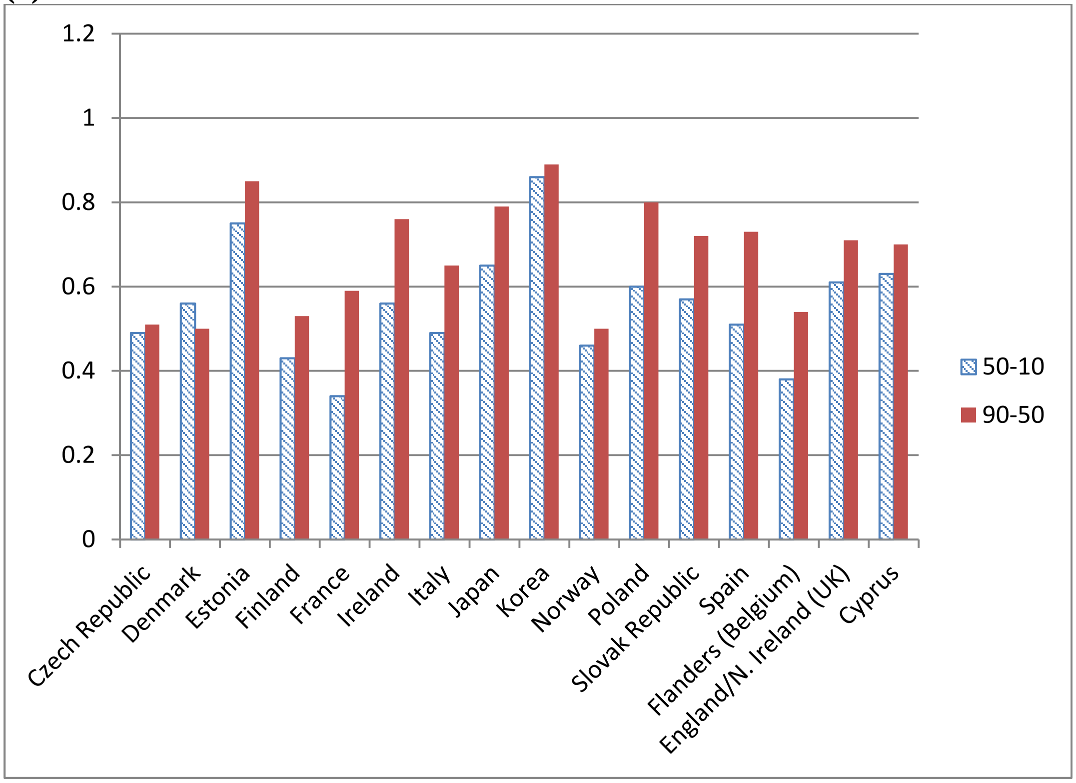
Source: PIAAC and author's calculations.

Figure 5: 50-10 and 90-50 Log Wage Differentials

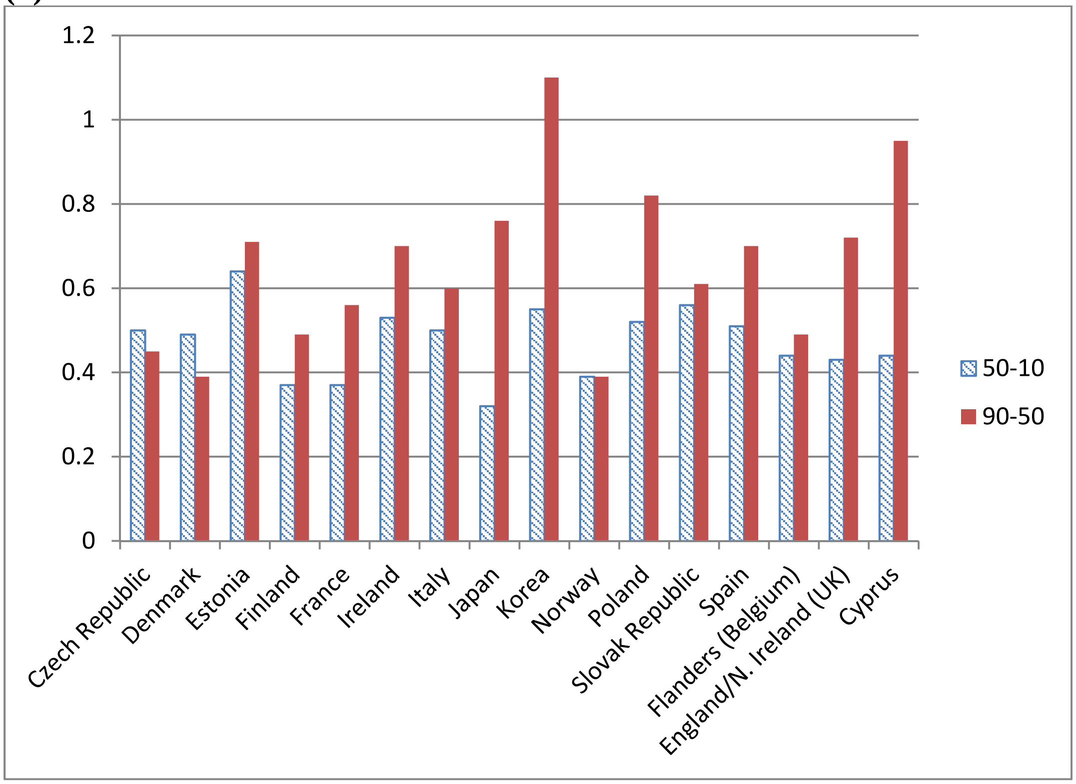


Source: PIAAC and author's calculations.

Figure 6: 50-10 and 90-50 Log Wage Differentials, by Gender
(a) Men



(b) Women



Source: PIAAC and author’s calculations.

Table 3: Decomposition Results, Base Category: U.K., Skills Only as Regressors

Country	Total Difference (country *j*-*b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0564	-0.0060	-0.0133	-0.0372
Denmark	-0.0870	-0.0117	-0.0111	-0.0642
Estonia	0.0668	-0.0076	-0.0018	0.0761
Finland	-0.1460	-0.0068	-0.0162	-0.1229
Ireland	0.0929	-0.0034	-0.0022	0.0985
Japan	0.0864	-0.0114	0.0198	0.0780
Korea	0.1668	-0.0172	0.0036	0.1804
Netherlands	0.1013	-0.0077	-0.0137	0.1227
Norway	-0.0896	-0.0090	-0.0091	-0.0715
Poland	0.0631	-0.0074	0.0064	0.0641
Slovak Republic	0.2134	-0.0137	-0.0084	0.2356
Sub-national entities				
Flanders (Belgium)	-0.1303	-0.0041	-0.0174	-0.1088
Partners				
Russian Federation	0.3129	-0.0164	-0.0114	0.3407
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.0549	0.0630	-0.0338	-0.0841
Denmark	-0.0366	0.0261	-0.0233	-0.0394
Estonia	0.1640	0.0560	0.0039	0.1042
Finland	-0.1392	-0.0282	0.0071	-0.1181
Ireland	0.0189	-0.0051	-0.0208	0.0449
Japan	0.0348	0.0007	0.0166	0.0175
Korea	0.2336	0.0444	-0.0088	0.1980
Netherlands	0.0553	-0.0045	-0.0134	0.0732
Norway	-0.1217	-0.0233	0.0087	-0.1071
Poland	0.0959	0.0134	0.0033	0.0792
Slovak Republic	0.0024	0.0278	-0.0270	0.0016
Sub-national entities				
Flanders (Belgium)	-0.1317	0.0354	-0.0527	-0.1144
Partners				
Russian Federation	0.2404	0.0014	-0.0047	0.2437
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.1861	-0.0649	-0.0309	-0.0903
Denmark	-0.2821	-0.0495	-0.0408	-0.1918
Estonia	0.0964	-0.0252	-0.0063	0.1280
Finland	-0.1658	0.0119	-0.0510	-0.1268
Ireland	0.0181	-0.0079	-0.0073	0.0333
Japan	0.1158	-0.0343	0.0483	0.1018
Korea	0.2475	-0.0611	0.0230	0.2857
Netherlands	-0.1304	-0.0326	-0.0139	-0.0840
Norway	-0.2366	-0.0170	-0.0276	-0.1920
Poland	0.0477	-0.0251	0.0150	0.0578
Slovak Republic	0.0046	-0.0434	-0.0118	0.0599
Sub-national entities				
Flanders (Belgium)	-0.2082	-0.0218	-0.0223	-0.1640
Partners				
Russian Federation	-0.0492	0.0154	-0.1181	0.0534

Source: PIAAC and author's calculations.

Table 4: Summary Statistics of Major Demographic and Work-Related Characteristics

Variable	**ages 24 and less=1**		**ages 25-34=1**		**ages 35-44=1**		**ages 45-54=1**		**55 plus=1**		**education (years)**		**experience (years)**		**female=1**	
Country	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Austria	0.16	0.37	0.19	0.39	0.22	0.42	0.24	0.43	0.19	0.39	.	.	20.01	12.6	0.5	0.5
Canada	0.17	0.38	0.2	0.4	0.2	0.4	0.23	0.42	0.21	0.4	13.21	2.72	19.29	12.7	0.5	0.5
Czech Republic	0.16	0.37	0.22	0.41	0.22	0.41	0.18	0.39	0.22	0.41	12.95	2.66	19.99	12.92	0.5	0.5
Denmark	0.17	0.38	0.18	0.38	0.22	0.41	0.22	0.41	0.22	0.41	12.47	2.72	20.96	13.65	0.5	0.5
Estonia	0.18	0.38	0.21	0.41	0.21	0.4	0.2	0.4	0.2	0.4	12.11	2.69	18.96	12.99	0.52	0.5
Finland	0.17	0.38	0.19	0.39	0.18	0.39	0.21	0.41	0.25	0.43	.	.	19.04	13.64	0.5	0.5
France	0.17	0.38	0.19	0.39	0.21	0.41	0.21	0.41	0.22	0.41	11.18	3.58	19.45	13.18	0.51	0.5
Germany	0.16	0.36	0.18	0.38	0.22	0.41	0.25	0.43	0.2	0.4	.	.	19.21	13.02	0.5	0.5
Ireland	0.17	0.38	0.24	0.43	0.23	0.42	0.19	0.39	0.16	0.37	14.48	3.22	17.04	11.97	0.51	0.5
Italy	0.14	0.35	0.19	0.39	0.24	0.43	0.22	0.41	0.2	0.4	10.51	3.85	18.14	12.34	0.5	0.5
Japan	0.14	0.35	0.19	0.39	0.24	0.42	0.19	0.39	0.24	0.43	12.94	2.41	18.81	12.68	0.5	0.5
Korea	0.16	0.37	0.2	0.4	0.24	0.43	0.23	0.42	0.17	0.37	12.6	3.18	13.18	10.75	0.5	0.5
Netherlands	0.17	0.37	0.18	0.39	0.21	0.41	0.23	0.42	0.21	0.41	13.12	2.79	18.74	12.39	.	.
Norway	0.18	0.39	0.2	0.4	0.22	0.41	0.21	0.41	0.2	0.4	13.94	2.61	18.68	12.77	0.49	0.5
Poland	0.18	0.38	0.23	0.42	0.19	0.39	0.2	0.4	0.21	0.41	12.48	3.06	17	12.45	0.51	0.5
Slovak Republic	0.18	0.38	0.23	0.42	0.2	0.4	0.2	0.4	0.2	0.4	12.94	2.8	19.12	12.52	0.5	0.5
Spain	0.12	0.32	0.21	0.41	0.25	0.43	0.22	0.42	0.2	0.4	11.3	3.55	17.4	12.15	0.5	0.5
Sweden	0.19	0.39	0.19	0.39	0.2	0.4	0.2	0.4	0.22	0.41	12.01	2.54	19.31	13.84	0.49	0.5
United States	0.19	0.39	0.2	0.4	0.2	0.4	0.22	0.41	0.19	0.39	13.27	3.07	19.4	13.19	0.51	0.5
Sub-national entities																
Flanders (Belgium)	0.15	0.36	0.18	0.38	0.2	0.4	0.23	0.42	0.23	0.42	12.34	2.93	20.78	12.5	0.5	0.5
England/N. Ireland (UK)	0.18	0.38	0.21	0.4	0.21	0.41	0.21	0.41	0.19	0.39	13	2.25	19.6	13	0.5	0.5
OECD Average	0.17	0.37	0.2	0.4	0.21	0.41	0.21	0.41	0.21	0.4	.	.	18.77	12.73	.	.
Partners																
Cyprus	0.19	0.39	0.24	0.43	0.2	0.4	0.19	0.4	0.17	0.38	12.26	3.11	17.49	12.31	0.52	0.5
Russian Federation	0.17	0.38	0.23	0.42	0.19	0.39	0.21	0.41	0.19	0.39	13.35	3.32	18.37	12.35	.	.

Source: PIAAC and author's calculations. Note: Since age and gender indicators are dummy variables, means for those variables are fractions of the sample.

Table 5: Decomposition Results, Base Category: U.K., All Major Regressors

Country	Total Difference (country *j*-*b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0599	0.0064	-0.0523	-0.0140
Denmark	-0.0900	0.0157	-0.0297	-0.0759
Estonia	0.0626	0.0028	-0.0434	0.1032
Ireland	0.0899	0.0101	0.0063	0.0735
Japan	0.0838	0.0076	0.0100	0.0662
Korea	0.1637	-0.0076	0.0232	0.1481
Netherlands	0.0979	0.0055	0.0196	0.0729
Norway	-0.0926	0.0071	-0.0417	-0.0579
Poland	0.0591	0.0199	-0.0109	0.0502
Slovak Republic	0.2104	-0.0041	-0.0363	0.2508
Sub-national entities				
Flanders (Belgium)	-0.1331	-0.0054	-0.0261	-0.1015
Partners				
Russian Federation	0.3061	0.0229	-0.0960	0.3793
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.0652	0.0730	-0.1038	-0.0343
Denmark	-0.0469	0.0603	-0.0584	-0.0488
Estonia	0.1537	0.0628	-0.0365	0.1274
Ireland	0.0086	0.0299	-0.0342	0.0129
Japan	0.0245	0.0532	-0.0652	0.0365
Korea	0.2232	0.0773	0.0262	0.1198
Netherlands	0.0440	0.0117	0.0587	-0.0264
Norway	-0.1320	-0.0035	-0.0720	-0.0565
Poland	0.0917	0.0853	-0.0506	0.0569
Slovak Republic	-0.0079	0.0783	-0.0959	0.0098
Sub-national entities				
Flanders (Belgium)	-0.1420	0.0042	-0.0617	-0.0845
Partners				
Russian Federation	0.2301	0.0533	-0.1114	0.2882
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.1772	-0.0413	-0.0701	-0.0657
Denmark	-0.2815	-0.0739	-0.0565	-0.1512
Estonia	0.0970	-0.0119	-0.0806	0.1894
Ireland	0.0186	0.0098	0.0487	-0.0399
Japan	0.1163	-0.0125	0.0984	0.0304
Korea	0.2481	-0.0517	0.0686	0.2312
Netherlands	-0.1299	-0.0472	-0.0006	-0.0822
Norway	-0.2361	-0.0319	-0.0511	-0.1530
Poland	0.0450	-0.0211	0.0256	0.0406
Slovak Republic	0.0052	-0.0587	-0.0537	0.1176
Sub-national entities				
Flanders (Belgium)	-0.2054	-0.0215	-0.0448	-0.1391
Partners				
Russian Federation	-0.0487	0.0340	-0.2112	0.1285

Source: PIAAC and author’s calculations.

Table 6: Decomposition Results, Base Category: U.K., All Regressors, Subsample of Men

Country	Total Difference (country *j-b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0736	-0.0019	-0.0683	-0.0034
Denmark	-0.0789	0.0129	-0.0263	-0.0655
Estonia	0.0214	-0.0044	-0.0668	0.0926
Ireland	0.1048	0.0047	-0.0151	0.1151
Japan	0.0762	0.0034	-0.0044	0.0772
Korea	0.1296	-0.0170	0.0191	0.1274
Norway	-0.0618	0.0062	-0.0481	-0.0199
Poland	0.0461	0.0287	-0.0351	0.0524
Slovak Republic	0.2887	-0.0001	-0.0570	0.3459
Sub-national entities				
Flanders (Belgium)	-0.1673	-0.0094	-0.0454	-0.1125
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.1772	0.0088	-0.1293	-0.0567
Denmark	-0.0828	-0.0190	-0.0289	-0.0349
Estonia	0.0924	0.0288	-0.0933	0.1569
Ireland	-0.0142	0.0249	-0.0703	0.0313
Japan	0.0157	0.0834	-0.0748	0.0072
Korea	0.1964	0.0520	0.0106	0.1338
Norway	-0.1678	-0.0339	-0.0977	-0.0362
Poland	0.0538	0.0333	-0.0664	0.0869
Slovak Republic	-0.0456	0.0358	-0.1095	0.0280
Sub-national entities				
Flanders (Belgium)	-0.2532	-0.0912	-0.0714	-0.0905
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.2302	-0.0170	-0.1398	-0.0734
Denmark	-0.2454	-0.0431	-0.0723	-0.1300
Estonia	0.0678	-0.0141	-0.0943	0.1761
Ireland	0.0273	-0.0083	0.0522	-0.0166
Japan	0.0606	-0.0466	0.0623	0.0448
Korea	0.1543	-0.0553	0.0660	0.1436
Norway	-0.2299	-0.0425	-0.0505	-0.1369
Poland	0.0389	0.0185	0.0306	-0.0102
Slovak Republic	-0.0032	-0.0513	-0.0576	0.1058
Sub-national entities				
Flanders (Belgium)	-0.1895	0.0313	-0.0762	-0.1446

Source: PIAAC and author’s calculations.

Table 7: Decomposition Results, Base Category: U.K., All Regressors, Subsample of Women

Country	Total Difference (country *j*-*b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0572	0.0008	-0.0299	-0.0280
Denmark	-0.0943	0.0193	-0.0291	-0.0845
Estonia	0.0592	0.0131	-0.0236	0.0698
Ireland	0.0870	0.0150	0.0295	0.0424
Japan	-0.0128	0.0011	-0.0187	0.0047
Korea	0.1808	0.0045	0.0080	0.1684
Norway	-0.1320	0.0080	-0.0373	-0.1027
Poland	0.0800	0.0153	0.0315	0.0332
Slovak Republic	0.0867	-0.0013	-0.0096	0.0977
Sub-national entities				
Flanders (Belgium)	-0.0905	0.0061	-0.0058	-0.0909
Panel B: 50-10 Log Wage Differential				
Czech Republic	0.0250	0.1255	-0.0424	-0.0581
Denmark	0.0196	0.1480	-0.0887	-0.0397
Estonia	0.1728	0.1142	-0.0504	0.1090
Ireland	0.0771	0.0245	0.0318	0.0208
Japan	-0.1301	-0.0007	-0.1064	-0.0230
Korea	0.1324	0.0548	-0.0154	0.0931
Norway	-0.0874	0.0516	-0.0752	-0.0637
Poland	0.1544	0.1207	0.0185	0.0152
Slovak Republic	0.0737	0.1342	-0.0731	0.0126
Sub-national entities				
Flanders (Belgium)	-0.0407	0.0639	-0.0362	-0.0684
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.1855	-0.1259	-0.0106	-0.0490
Denmark	-0.3029	-0.1014	-0.0507	-0.1508
Estonia	0.0077	-0.0223	-0.0345	0.0645
Ireland	0.0153	0.0062	0.0407	-0.0316
Japan	0.0224	0.0162	0.0164	-0.0102
Korea	0.3903	-0.0182	0.0497	0.3587
Norway	-0.3073	-0.0895	-0.0057	-0.2121
Poland	0.0551	-0.0401	0.0380	0.0572
Slovak Republic	-0.0726	-0.1156	0.0548	-0.0117
Sub-national entities				
Flanders (Belgium)	-0.2044	-0.0490	-0.0305	-0.1249

Source: PIAAC and author’s calculations.

Table 8: Decomposition Results, Base Category: U.K., All Regressors, Subsample of Immigrants

Country	Total Difference (country *j-b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0957	0.0340	0.0066	-0.1363
Denmark	0.0769	0.0675	-0.0567	0.0661
Estonia	0.0562	-0.0160	-0.0474	0.1196
Ireland	0.0739	0.0228	-0.0104	0.0616
Japan	0.0803	1.0180	0.3623	-1.3000
Korea	0.0604	0.4167	0.1645	-0.5207
Norway	-0.1469	0.0619	-0.0864	-0.1223
Poland	0.3867	0.4502	0.1334	-0.1968
Slovak Republic	-0.1794	0.0938	-0.0216	-0.2515
Sub-national entities				
Flanders (Belgium)	-0.1039	0.0860	-0.0456	-0.1442
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.1086	0.0758	-0.0783	-0.1061
Denmark	0.1704	0.2356	-0.0425	-0.0228
Estonia	0.1594	0.0568	-0.0611	0.1638
Ireland	-0.0846	-0.0023	-0.0781	-0.0042
Japan	0.2483	-0.2129	0.4612	0.0000
Korea	-0.1491	0.0602	-0.2074	-0.0019
Norway	-0.1539	0.1033	-0.2065	-0.0508
Poland	0.3497	-0.1962	-0.0570	0.6029
Slovak Republic	-0.2119	-0.1144	0.0224	-0.1199
Sub-national entities				
Flanders (Belgium)	-0.0839	0.0434	-0.1115	-0.0158
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.1849	-0.1520	0.1669	-0.1998
Denmark	-0.2648	-0.1096	-0.1263	-0.0289
Estonia	0.0375	-0.0946	-0.0235	0.1556
Ireland	0.0887	0.1555	-0.0668	0.0000
Japan	0.0420	2.5176	0.5310	-3.0066
Korea	-0.0269	-0.4713	0.5198	-0.0754
Norway	-0.2717	0.0027	-0.1330	-0.1414
Poland	0.8721	-0.4431	1.3152	0.0000
Slovak Republic	-0.3290	-0.0715	-0.1368	-0.1207
Sub-national entities				
Flanders (Belgium)	-0.1661	0.1845	-0.1998	-0.1508

Source: PIAAC and author’s calculations.

Table 9: Decomposition Results, Base Category: U.K., All Regressors, Subsample of Non-immigrants

Country	Total Difference (country *j-b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0641	0.0069	-0.0544	-0.0166
Denmark	-0.1057	0.0059	-0.0280	-0.0836
Estonia	0.0503	0.0091	-0.0465	0.0878
Ireland	0.1000	0.0082	0.0053	0.0865
Japan	0.0876	0.0066	0.0076	0.0734
Korea	0.1681	-0.0049	0.0163	0.1568
Norway	-0.0849	0.0004	-0.0395	-0.0458
Poland	0.0637	0.0190	-0.0170	0.0617
Slovak Republic	0.2139	-0.0018	-0.0386	0.2543
Sub-national entities				
Flanders (Belgium)	-0.1315	-0.0135	-0.0226	-0.0954
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.0976	0.0843	-0.1144	-0.0674
Denmark	-0.0500	0.0608	-0.0608	-0.0500
Estonia	0.1335	0.0986	-0.0711	0.1060
Ireland	0.0636	0.0491	-0.0104	0.0249
Japan	0.0306	0.0513	-0.0609	0.0402
Korea	0.2368	0.1040	0.0014	0.1314
Norway	-0.1280	-0.0040	-0.0720	-0.0520
Poland	0.0754	0.0947	-0.0533	0.0341
Slovak Republic	0.0005	0.0720	-0.0877	0.0162
Sub-national entities				
Flanders (Belgium)	-0.1565	0.0009	-0.0646	-0.0928
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.1550	-0.0400	-0.0776	-0.0374
Denmark	-0.2789	-0.0942	-0.0446	-0.1402
Estonia	0.1319	-0.0356	-0.0491	0.2166
Ireland	-0.0171	-0.0331	0.0242	-0.0082
Japan	0.1041	-0.0103	0.0866	0.0278
Korea	0.2443	-0.0532	0.0580	0.2395
Norway	-0.2318	-0.0439	-0.0473	-0.1406
Poland	0.0648	-0.0156	0.0082	0.0722
Slovak Republic	0.0066	-0.0527	-0.0648	0.1241
Sub-national entities				
Flanders (Belgium)	-0.2049	-0.0428	-0.0360	-0.1262

Source: PIAAC and author’s calculations.

Table 10: Country Statistics

Country	Union Density	Public Sector Employment	Worker Protection Index	Minimum Wage Legislation	Product Market Regulation Index
Year of Data Series	2010-11	2008	2013	2013	2013
U.K.	25.8	17.4	1.62	yes	1.09
Czech Republic	17.3	12.8	2.66	yes	1.39
Denmark	68.8	28.7	2.32	no	1.22
Estonia	8.1	18.7	2.07	yes	1.33
Ireland	35.5	14.8	2.07	yes	1.44
Japan	18.6	6.7	2.09	yes	1.51
Korea	9.7	5.7	2.17	yes	1.88
Netherlands	18.2	12	2.94	yes	0.91
Norway	54.6	29.3	2.31		1.49
Poland	15	9.7		yes	Not available
Slovak Republic	17.2	10.7	2.26	yes	1.31
Sub-national entities					
Flanders (Belgium)	52	17.1	2.95	yes	1.39
Partners					
Russian Federation	Not available	20.2	2.47	Not available	Not available

Source: OECD data portal.

Appendices

Table A1: Regressions of Skills on Education and Experience

Panel A: Literacy

Variable	**Education**		**Education Squared/100**		**Experience**		**Experience Squared/100**		**R-Squared**
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	14.945	1.358	-27.91	5.009	-0.694	0.146	0.818	0.322	0.178
Czech Republic	13.967	2.782	-27.094	9.44	-1.079	0.227	1.289	0.509	0.194
Denmark	18.126	1.95	-43.075	7.295	-0.526	0.186	-0.344	0.387	0.199
Estonia	6.074	1.461	0.703	5.874	-1.069	0.153	0.952	0.351	0.176
France	7.649	0.773	-1.966	3.415	-0.417	0.158	0.321	0.339	0.31
Ireland	8.971	2.026	-8.038	7.074	0.054	0.218	-0.109	0.518	0.219
Italy	12.068	1.252	-28.514	5.027	0.217	0.256	-0.482	0.634	0.23
Japan	8.482	2.627	-6.323	9.432	0.298	0.158	-2.115	0.354	0.238
Korea	12.29	1.174	-24.08	4.664	-1.51	0.19	2.932	0.505	0.279
Netherlands	8.491	2.125	-1.4	8.179	-0.577	0.207	-0.389	0.483	0.252
Norway	12.308	2.775	-19.748	9.77	0.111	0.207	-1.365	0.461	0.16
Poland	2.671	1.911	17.608	7.575	-1.332	0.197	2.443	0.546	0.226
Slovak Republic	21.731	1.632	-57.873	5.787	-0.224	0.181	0.188	0.426	0.178
Spain	5.829	1.093	5.355	4.536	-0.003	0.167	-0.818	0.398	0.296
Sweden	18.635	2.482	-43.549	9.944	-0.545	0.2	0.075	0.47	0.201
United States	15.242	2.103	-21.839	7.586	-0.829	0.28	1.146	0.569	0.308
Sub-national entities									
Flanders (Belgium)	1.821	1.686	27.117	6.911	-0.429	0.202	-0.048	0.478	0.289
England/N. Ireland (UK)	64.357	11.193	-213.024	41.612	1.255	0.226	-2.672	0.496	0.14
OECD Average	14.092	0.763	-26.314	2.838	-0.405	0.047	0.101	0.11	0.226
Partners									
Cyprus	2.181	1.385	9.477	5.607	0.322	0.242	-0.575	0.563	0.12
Russian Federation	10.695	3.919	-30.787	12.931	0.28	0.434	-0.485	1.043	0.028

Panel B: Numeracy

Variable	**Education**		**Education Squared/100**		**Experience**		**Experience Squared/100**		**R-Squared**
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	14.776	1.421	-24.422	5.18	-0.667	0.172	0.904	0.376	0.173
Czech Republic	18.577	2.579	-37.129	8.904	-0.831	0.23	0.937	0.522	0.25
Denmark	16.155	2.458	-32.94	9.333	0.18	0.187	-1.12	0.385	0.185
Estonia	7.66	1.423	-2.554	5.675	-0.562	0.168	0.181	0.37	0.187
France	7.912	0.902	5.546	3.94	0.112	0.174	-0.223	0.38	0.348
Ireland	9.208	2.448	-6.29	8.384	0.037	0.241	0.334	0.563	0.207
Italy	16.5	1.342	-43.925	5.51	0.58	0.258	-0.752	0.611	0.245
Japan	11.45	3.002	-11.031	11.055	0.639	0.194	-1.71	0.443	0.223
Korea	14.282	1.334	-27.666	5.272	-1.237	0.206	2.563	0.585	0.295
Netherlands	10.258	2.101	-7.005	7.94	-0.413	0.245	-0.035	0.565	0.223
Norway	16.803	3.184	-31.134	11.327	0.488	0.251	-1.576	0.566	0.165
Poland	6.154	2.149	5.01	8.378	-0.88	0.22	1.92	0.602	0.2
Slovak Republic	25.223	1.881	-62.528	6.524	0.173	0.208	-0.538	0.486	0.227
Spain	9.1	1.288	-6.808	5.243	0.52	0.174	-1.58	0.418	0.299
Sweden	17.765	2.503	-36.421	10.063	-0.687	0.24	1.071	0.536	0.178
United States	15.966	2.031	-18.578	7.216	-0.493	0.281	0.718	0.565	0.321
Sub-national entities									
Flanders (Belgium)	2.846	1.849	25.676	7.979	0.112	0.22	-0.873	0.523	0.278
England/N. Ireland (UK)	59.357	13.043	-191.576	48.326	1.317	0.272	-2.339	0.557	0.133
OECD Average	15.555	0.869	-27.987	3.228	-0.09	0.052	-0.118	0.12	0.23
Partners									
Cyprus	7.909	1.877	-5.572	7.491	0.5	0.251	-0.743	0.57	0.188
Russian Federation	14.078	4.504	-39.611	14.585	0.24	0.319	-0.593	0.803	0.058

Panel C: Problem Solving									
Variable	**Education**		**Education Squared/100**		**Experience**		**Experience Squared/100**		**R-Squared**
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	13.62	1.447	-31.798	5.353	-1.067	0.166	0.476	0.366	0.123
Czech Republic	11.213	3.503	-20.005	11.997	-1.527	0.303	1.201	0.707	0.17
Denmark	11.284	2.313	-23.201	8.76	-0.812	0.192	-0.838	0.404	0.223
Estonia	3.507	2.205	5.539	8.809	-1.611	0.179	0.533	0.437	0.209
Ireland	12.829	2.391	-22.678	8.104	-0.863	0.233	0.562	0.601	0.202
Japan	-3.292	3.761	31.76	13.235	0.37	0.263	-3.349	0.636	0.168
Korea	8.55	2.307	-16.699	8.422	-2.582	0.261	4.518	0.768	0.161
Netherlands	2.578	2.347	13.163	9.056	-1.07	0.209	0.226	0.463	0.21
Norway	4.194	3.016	4.87	10.294	-0.953	0.209	-0.456	0.456	0.213
Poland	-1.315	3.796	24.049	13.753	-1.345	0.339	0.691	0.972	0.138
Slovak Republic	4.513	3.445	-2.266	11.615	-0.717	0.262	0.644	0.63	0.09
Sweden	16.349	2.577	-39.712	9.47	-1.335	0.209	0.32	0.486	0.27
United States	10.852	2.878	-14.996	10.332	-1.011	0.285	0.746	0.617	0.181
Sub-national entities									
Flanders (Belgium)	0.956	2.146	22.186	8.657	-1.119	0.233	0.103	0.552	0.257
England/N. Ireland (UK)	48.596	10.818	-158.784	39.963	-0.069	0.202	-1.083	0.465	0.144
OECD Average	9.629	1.005	-15.238	3.663	-1.047	0.062	0.286	0.153	0.184
Partners									
Russian Federation	6.098	4.339	-14.492	15.037	0.564	0.64	-2.909	1.863	0.034

Note: Constant term is also included.

Source: PIAAC and author’s calculations.

Table A2: Regressions of Skills on Education and Experience, Men

Panel A: Literacy

Variable	**Education**		**Education Squared/100**		**Experience**		**Experience Squared/100**		**R-Squared**
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	15.487	1.617	-28.996	5.841	-0.917	0.21	1.174	0.458	0.191
Czech Republic	17.114	4.159	-37.988	13.855	-1.229	0.352	1.202	0.777	0.189
Denmark	18.507	2.507	-42.569	9.345	-0.357	0.266	-0.841	0.555	0.209
Estonia	7.052	1.789	-3.678	7.294	-0.886	0.235	0.612	0.532	0.158
France	5.364	1.054	7.263	4.768	-0.497	0.224	0.263	0.49	0.292
Ireland	13.994	3.263	-24.295	11.101	0.121	0.317	-0.082	0.701	0.244
Italy	12.148	1.686	-25.151	6.657	0.29	0.399	-0.523	0.88	0.253
Japan	7.52	3.289	-6.36	11.902	0.613	0.228	-2.972	0.489	0.256
Korea	10.602	1.836	-18.458	7.111	-2.009	0.254	3.647	0.638	0.275
Norway	10.26	3.625	-14.185	12.699	0.43	0.297	-2.086	0.657	0.149
Poland	2.426	2.288	21.012	9.118	-1.386	0.269	2.439	0.707	0.245
Slovak Republic	22.655	1.869	-59.829	6.852	-0.243	0.246	0.093	0.563	0.187
Spain	5.113	1.557	8.802	6.686	0.093	0.222	-1.217	0.516	0.312
Sweden	13.16	3.236	-21.457	12.927	-0.65	0.267	0.318	0.574	0.189
United States	15.422	2.867	-21.808	10.393	-1.213	0.355	1.666	0.721	0.321
Sub-national entities									
Flanders (Belgium)	1.295	2.366	28.867	9.454	-0.26	0.27	-0.635	0.627	0.291
England/N. Ireland (UK)	67.816	15.784	-224.592	58.802	1.256	0.357	-2.682	0.746	0.14
OECD Average	14.467	1.11	-27.26	4.121	-0.403	0.069	0.022	0.154	0.229
Partners									
Cyprus	2.986	1.919	5.896	7.521	0.457	0.374	-0.829	0.812	0.112

Panel B: Numeracy

Variable	**Education**		**Education Squared/100**		**Experience**		**Experience Squared/100**		**R-Squared**
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	16.124	1.762	-27.446	6.419	-0.82	0.247	0.965	0.529	0.201
Czech Republic	19.351	4.397	-39.438	14.688	-0.763	0.331	0.252	0.738	0.25
Denmark	18.589	2.74	-39.438	10.349	0.435	0.29	-1.822	0.586	0.21
Estonia	8.69	1.83	-4.979	7.429	-0.412	0.261	-0.286	0.573	0.199
France	6.322	1.168	12.265	5.182	-0.019	0.233	-0.349	0.504	0.338
Ireland	15.757	3.83	-27.43	12.945	0.207	0.362	-0.028	0.788	0.242
Italy	16.014	2.056	-37.276	8.391	0.67	0.407	-0.981	0.866	0.273
Japan	13.105	3.845	-20.5	14.152	1.086	0.304	-2.973	0.667	0.233
Korea	11.634	1.929	-18.241	7.49	-1.721	0.253	3.144	0.681	0.285
Norway	16.327	3.918	-30.736	13.719	0.906	0.362	-2.597	0.795	0.161
Poland	6.037	2.357	10.538	9.154	-0.967	0.276	1.983	0.735	0.245
Slovak Republic	25.255	2.443	-60.698	8.572	-0.013	0.278	-0.38	0.654	0.235
Spain	8.738	1.675	-3.696	6.996	0.585	0.236	-1.993	0.55	0.335
Sweden	14.478	3.419	-22.936	13.647	-0.684	0.321	1.001	0.677	0.172
United States	18.183	2.959	-24.706	10.421	-0.865	0.363	1.083	0.72	0.358
Sub-national entities									
Flanders (Belgium)	3.449	2.394	23.445	9.91	0.413	0.297	-1.736	0.696	0.289
England/N. Ireland (UK)	76.51	17.802	-252.493	66.253	1.517	0.408	-2.894	0.814	0.15
OECD Average	17.327	1.241	-33.163	4.601	-0.026	0.076	-0.448	0.167	0.246
Partners									
Cyprus	8.872	2.423	-9.684	9.409	0.714	0.403	-1.352	0.874	0.188

Panel C: Problem Solving									
Variable	**Education**		**Education Squared/100**		**Experience**		**Experience Squared/100**		**R-Squared**
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	15.27	1.888	-36.581	6.795	-1.182	0.23	0.52	0.541	0.147
Czech Republic	10.53	4.89	-17.295	16.555	-1.775	0.463	1.113	1.072	0.192
Denmark	13.126	2.93	-28.818	10.886	-0.545	0.285	-1.604	0.565	0.254
Estonia	3.677	2.464	5.184	9.693	-1.538	0.272	0.472	0.671	0.182
Ireland	16.179	3.835	-33.092	13.031	-0.915	0.333	0.661	0.807	0.23
Japan	3.147	4.807	5.83	16.919	0.62	0.339	-4.229	0.81	0.208
Korea	9.711	2.747	-20.838	9.784	-2.853	0.299	4.548	0.862	0.215
Norway	5.61	3.866	-0.512	13.077	-0.699	0.289	-1.046	0.632	0.227
Poland	0.294	4.37	20.584	16.245	-0.574	0.492	-1.557	1.349	0.161
Slovak Republic	5.129	4.6	-2.849	15.397	-0.785	0.334	0.96	0.84	0.101
Sweden	14.315	3.646	-30.15	13.682	-1.471	0.236	0.538	0.523	0.292
United States	14.654	3.597	-26.928	13.087	-1.493	0.456	1.442	0.948	0.214
Sub-national entities									
Flanders (Belgium)	0.316	2.757	24.295	10.84	-0.795	0.302	-0.915	0.692	0.289
England/N. Ireland (UK)	54.461	14.842	-178.938	55.168	0.215	0.338	-1.82	0.743	0.172
OECD Average	11.887	1.423	-22.865	5.188	-0.985	0.092	-0.065	0.219	0.206

Note: Constant term is also included.

Source: PIAAC and author’s calculations.

Table A3: Regressions of Skills on Education and Experience, Women

Panel A: Literacy

Variable	Education		Education Squared/100		Experience		Experience Squared/100		R-Squared
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	14.293	2.006	-26.278	7.418	-0.48	0.214	0.415	0.495	0.166
Czech Republic	11.531	3.847	-17.651	13.332	-1.068	0.341	1.726	0.771	0.211
Denmark	18.049	3.057	-44.492	11.309	-0.768	0.261	0.328	0.544	0.192
Estonia	5.071	2.337	5.656	9.284	-1.264	0.192	1.35	0.427	0.196
France	9.847	1.122	-10.971	4.751	-0.424	0.215	0.549	0.526	0.333
Ireland	4.147	2.328	7.652	8.309	0.14	0.294	-0.725	0.742	0.201
Italy	11.996	1.696	-31.538	6.788	0.149	0.358	-0.272	0.932	0.208
Japan	8.905	3.588	-3.787	13.204	0.031	0.241	-1.448	0.608	0.23
Korea	13.591	1.575	-29.092	6.211	-1.009	0.249	2.053	0.803	0.292
Norway	14.867	4.183	-27.056	14.465	-0.185	0.333	-0.783	0.806	0.181
Poland	2.251	3.165	16.778	12.302	-1.36	0.271	2.71	0.735	0.2
Slovak Republic	20.87	2.425	-56.062	8.602	-0.252	0.265	0.398	0.643	0.168
Spain	6.725	1.348	1.776	5.552	-0.273	0.239	-0.415	0.601	0.299
Sweden	25.199	3.603	-69.509	14.288	-0.353	0.269	-0.522	0.616	0.226
United States	15.249	2.725	-22.296	9.758	-0.487	0.38	0.666	0.83	0.3
Sub-national entities									
Flanders (Belgium)	1.848	2.705	27.041	11.409	-0.67	0.282	0.607	0.696	0.294
England/N. Ireland (UK)	61.378	14.393	-203.177	53.21	1.319	0.316	-2.89	0.736	0.142
OECD Average	14.46	1.066	-28.412	3.956	-0.409	0.068	0.22	0.167	0.226
Partners									
Cyprus	1.328	2.061	13.239	8.365	0.176	0.356	-0.18	0.914	0.127

Panel B: Numeracy

Variable	Education		Education Squared/100		Experience		Experience Squared/100		R-Squared
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	13.805	2.083	-22.241	7.641	-0.506	0.251	0.523	0.58	0.162
Czech Republic	18.205	3.535	-35.517	12.382	-1.123	0.346	2.162	0.798	0.267
Denmark	14.028	3.508	-26.55	13.292	-0.158	0.259	-0.365	0.539	0.177
Estonia	7.505	2.36	-1.187	9.475	-0.838	0.197	0.953	0.424	0.2
France	9.09	1.199	0.576	5.247	0.109	0.237	-0.026	0.56	0.373
Ireland	3.029	2.778	13.971	9.676	0.095	0.313	-0.379	0.8	0.194
Italy	16.031	1.661	-45.865	6.842	0.362	0.368	-0.317	0.993	0.228
Japan	12.429	3.703	-12.828	13.692	0.198	0.249	-0.806	0.625	0.217
Korea	16.297	1.873	-36.386	7.397	-0.756	0.284	1.508	0.907	0.311
Norway	18.084	5.096	-34.431	17.8	0.215	0.347	-1.177	0.846	0.186
Poland	5.307	3.472	4.752	13.484	-0.88	0.3	2.085	0.798	0.169
Slovak Republic	25.708	2.698	-65.839	9.394	0.318	0.304	-0.6	0.695	0.224
Spain	9.522	1.556	-9.178	6.371	0.189	0.249	-1.239	0.615	0.3
Sweden	21.248	4.172	-49.346	16.417	-0.632	0.308	0.803	0.69	0.206
United States	15.308	3.159	-16.992	11.348	-0.109	0.413	-0.038	0.907	0.313
Sub-national entities									
Flanders (Belgium)	1.12	2.935	31.986	12.552	-0.175	0.291	-0.444	0.695	0.292
England/N. Ireland (UK)	45.223	17.143	-141.581	63.26	1.333	0.349	-2.588	0.773	0.126
OECD Average	14.82	1.236	-26.274	4.584	-0.139	0.073	0.003	0.178	0.232
Partners									
Cyprus	6.262	2.604	1.203	10.474	0.36	0.359	-0.647	0.9	0.196

Panel C: Problem Solving									
Variable	**Education**		**Education Squared/100**		**Experience**		**Experience Squared/100**		**R-Squared**
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	
Canada	11.772	2.173	-26.096	7.857	-0.988	0.254	0.489	0.567	0.103
Czech Republic	13.835	4.078	-27.986	14.005	-1.548	0.456	1.986	1.147	0.168
Denmark	9.813	3.421	-18.212	12.769	-1.178	0.273	0.098	0.592	0.207
Estonia	4.547	3.146	2.614	12.687	-1.81	0.229	0.955	0.536	0.244
Ireland	10.279	3.245	-14.664	10.766	-0.651	0.295	-0.238	0.781	0.192
Japan	-5.885	5.72	43.285	20.337	0.111	0.394	-3.243	1.035	0.154
Korea	7.829	4.245	-14.568	15.604	-2.616	0.382	5.311	1.315	0.13
Norway	3.809	4.192	7.015	14.274	-1.155	0.284	-0.149	0.66	0.218
Poland	-3.16	6.285	30.535	22.742	-2.366	0.435	3.727	1.276	0.141
Slovak Republic	4.981	5.303	-5.162	17.7	-0.658	0.41	0.324	1.03	0.084
Sweden	18.984	3.657	-50.659	13.689	-1.207	0.303	0.037	0.714	0.26
United States	8.488	4.117	-7.461	14.17	-0.576	0.374	0.003	0.811	0.164
Sub-national entities									
Flanders (Belgium)	1.05	3.524	21.943	14.762	-1.547	0.35	1.243	0.92	0.243
England/N. Ireland (UK)	44.236	14.232	-144.131	52.678	-0.197	0.266	-0.92	0.627	0.135
OECD Average	9.327	1.489	-14.539	5.426	-1.17	0.092	0.687	0.239	0.175

Note: Constant term is also included.

Source: PIAAC and author's calculations.

Table A4: Log Wage Effects of Skills, Marginal Effects of a 10 Skill Points Increase

Variable	**Literacy**		**Numeracy**		**Problem Solving**		
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	R-Squared
Czech Republic	0.010	0.008	0.000	0.006	0.010	0.006	0.155
Denmark	-0.002	0.004	0.012	0.004	0.003	0.005	0.406
Estonia	-0.006	0.008	0.027	0.006	0.007	0.007	0.134
Ireland	0.005	0.009	0.017	0.008	0.000	0.006	0.262
Japan	-0.019	0.010	0.034	0.009	0.010	0.007	0.265
Korea	0.019	0.008	0.007	0.008	-0.009	0.008	0.216
Netherlands	0.010	0.007	0.006	0.005	0.007	0.007	0.312
Norway	-0.002	0.006	0.019	0.004	0.003	0.005	0.312
Poland	0.010	0.008	0.008	0.008	0.013	0.006	0.281
Slovak Republic	-0.009	0.013	0.011	0.011	0.017	0.012	0.092
Sub-national entities							
Flanders (Belgium)	0.003	0.005	0.011	0.003	0.004	0.003	0.333
England/N. Ireland (UK)	0.000	0.006	0.015	0.006	0.021	0.006	0.318
OECD Average	0.002	0.002	0.014	0.002	0.007	0.002	0.257
Partners							
Russian Federation	-0.001	0.011	0.002	0.014	0.024	0.010	0.029

Note: Education, experience, experience squared, four categorical age group dummies, and a constant term are also included.
Source: PIAAC and author's calculations.

Table A5: Log Wage Effects of Skills, Marginal Effects of a 10 Skill Point Increase, by Gender

Panel A: Men

Variable	**Literacy**		**Numeracy**		**Problem Solving**		
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	R-Squared
Czech Republic	0.018	0.010	-0.016	0.008	0.005	0.007	0.142
Denmark	0.004	0.007	0.009	0.007	0.002	0.008	0.425
Estonia	-0.002	0.010	0.015	0.009	0.008	0.009	0.119
Ireland	0.004	0.014	0.015	0.013	-0.002	0.009	0.218
Japan	-0.011	0.014	0.028	0.011	0.003	0.009	0.251
Korea	0.020	0.011	0.007	0.011	-0.010	0.009	0.230
Norway	0.010	0.009	0.012	0.006	-0.003	0.008	0.287
Poland	0.016	0.013	0.003	0.012	0.011	0.008	0.266
Slovak Republic	0.001	0.021	0.006	0.018	0.012	0.019	0.068
Sub-national entities							
Flanders (Belgium)	0.008	0.006	0.009	0.004	0.001	0.005	0.334
England/N. Ireland (UK)	0.006	0.009	0.013	0.009	0.020	0.008	0.341
OECD Average	0.007	0.004	0.009	0.003	0.004	0.003	0.244

Panel B: Women

Variable	**Literacy**		**Numeracy**		**Problem Solving**		
Country	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	R-Squared
Czech Republic	0.002	0.009	0.015	0.010	0.012	0.007	0.219
Denmark	-0.002	0.006	0.007	0.005	0.004	0.004	0.398
Estonia	0.008	0.009	0.004	0.008	0.012	0.007	0.179
Ireland	0.009	0.011	0.014	0.008	0.000	0.008	0.316
Japan	-0.007	0.010	0.015	0.011	0.011	0.007	0.202
Korea	0.025	0.015	-0.001	0.011	-0.014	0.013	0.168
Norway	-0.005	0.006	0.014	0.005	0.009	0.005	0.364
Poland	0.010	0.010	0.007	0.009	0.009	0.007	0.347
Slovak Republic	-0.013	0.013	0.009	0.011	0.023	0.010	0.171
Sub-national entities							
Flanders (Belgium)	0.003	0.008	0.007	0.006	0.005	0.005	0.345
England/N. Ireland (UK)	0.002	0.010	0.010	0.009	0.019	0.007	0.297
OECD Average	0.003	0.003	0.009	0.003	0.008	0.002	0.273

Note: Education, experience, experience squared, four categorical age group dummies, and a constant term are also included.
Source: PIAAC and author’s calculations.

Table A6: Decomposition Results, Base Category: U.K., All Major Regressors including Gender

Country	Total Difference (country *j*-*b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0599	0.0062	-0.0458	-0.0203
Denmark	-0.0900	0.0139	-0.0288	-0.0750
Estonia	0.0626	0.0007	-0.0141	0.0760
Ireland	0.0899	0.0121	0.0032	0.0746
Japan	0.0838	0.0105	0.0196	0.0536
Korea	0.1637	-0.0020	0.0227	0.1431
Norway	-0.0926	0.0070	-0.0410	-0.0585
Poland	0.0591	0.0165	-0.0029	0.0455
Slovak Republic	0.2104	-0.0087	-0.0162	0.2353
Sub-national entities				
Flanders (Belgium)	-0.1331	-0.0053	-0.0273	-0.1006
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.0652	0.0619	-0.0884	-0.0387
Denmark	-0.0469	0.0532	-0.0523	-0.0477
Estonia	0.1537	0.0679	-0.0177	0.1035
Ireland	0.0086	0.0260	-0.0249	0.0076
Japan	0.0245	0.0537	-0.0572	0.0280
Korea	0.2232	0.0780	0.0385	0.1067
Norway	-0.1320	-0.0085	-0.0739	-0.0496
Poland	0.0917	0.0941	-0.0486	0.0462
Slovak Republic	-0.0079	0.0593	-0.0688	0.0017
Sub-national entities				
Flanders (Belgium)	-0.1420	-0.0003	-0.0660	-0.0757
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.1772	-0.0573	-0.0599	-0.0600
Denmark	-0.2815	-0.0806	-0.0542	-0.1468
Estonia	0.0970	-0.0201	-0.0069	0.1240
Ireland	0.0186	0.0091	0.0300	-0.0204
Japan	0.1163	-0.0095	0.1085	0.0173
Korea	0.2481	-0.0477	0.0582	0.2377
Norway	-0.2361	-0.0277	-0.0567	-0.1517
Poland	0.0450	-0.0388	0.0471	0.0368
Slovak Republic	0.0052	-0.0718	-0.0074	0.0844
Sub-national entities				
Flanders (Belgium)	-0.2054	-0.0154	-0.0547	-0.1353

Source: PIAAC and author’s calculations.

Table A7: Decomposition Results, Base Category: U.K., Major Regressors plus Non-formal Education

Country	Total Difference (country *j*-*b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0635	0.0242	-0.0492	-0.0384
Denmark	-0.1525	-0.0019	-0.0300	-0.1206
Estonia	0.0751	0.0128	-0.0297	0.0920
Ireland	0.0631	0.0162	0.0224	0.0245
Japan	0.0578	0.0138	0.0352	0.0088
Korea	0.1631	0.0030	0.0309	0.1292
Netherlands	-0.0063	-0.0050	-0.0021	0.0009
Norway	-0.1287	0.0016	-0.0325	-0.0978
Poland	0.0448	0.0322	0.0082	0.0045
Slovak Republic	0.3083	0.0095	-0.0374	0.3361
Sub-national entities				
Flanders (Belgium)	-0.1437	-0.0025	-0.0075	-0.1337
Partners				
Russian Federation	0.4968	0.0409	-0.0744	0.5303
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.1600	0.0029	-0.0799	-0.0830
Denmark	-0.1848	-0.0363	-0.0554	-0.0931
Estonia	0.1192	0.0281	-0.0458	0.1368
Ireland	0.0412	-0.0221	0.0343	0.0289
Japan	0.0553	0.0186	0.0147	0.0220
Korea	0.2306	0.0851	0.0091	0.1363
Netherlands	-0.0769	-0.0258	-0.0041	-0.0470
Norway	-0.1890	-0.0296	-0.0719	-0.0875
Poland	0.0747	0.0591	0.0115	0.0041
Slovak Republic	-0.0552	-0.0206	-0.0529	0.0184
Sub-national entities				
Flanders (Belgium)	-0.1831	-0.0448	-0.0435	-0.0949
Partners				
Russian Federation	0.2676	0.0837	-0.0980	0.2819
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.1479	0.0064	-0.0958	-0.0585
Denmark	-0.2675	-0.0217	-0.0418	-0.2040
Estonia	0.1038	0.0119	-0.0489	0.1408
Ireland	0.0377	-0.0060	0.0664	-0.0227
Japan	0.0859	-0.0048	0.0990	-0.0083
Korea	0.2018	-0.0611	0.0887	0.1741
Netherlands	-0.1245	-0.0023	-0.0043	-0.1178
Norway	-0.2105	-0.0126	-0.0402	-0.1578
Poland	0.0183	-0.0117	-0.0139	0.0439
Slovak Republic	0.0946	0.0101	-0.0426	0.1271
Sub-national entities				
Flanders (Belgium)	-0.1670	-0.0288	0.0040	-0.1422
Partners				
Russian Federation	0.0764	0.0502	-0.1351	0.1612

Source: PIAAC and author’s calculations.

Table A8: Decomposition Results, Base Category: U.K., Major Regressor except Age Group Controls

Country	Total Difference (country *j-b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0599	0.0116	-0.0551	-0.0164
Denmark	-0.0900	0.0138	-0.0285	-0.0753
Estonia	0.0626	0.0090	-0.0508	0.1044
Ireland	0.0899	0.0126	0.0056	0.0717
Japan	0.0838	0.0107	0.0086	0.0645
Korea	0.1637	0.0013	0.0165	0.1459
Netherlands	0.0979	0.0025	0.0215	0.0739
Norway	-0.0926	0.0082	-0.0401	-0.0607
Poland	0.0591	0.0252	-0.0126	0.0465
Slovak Republic	0.2104	0.0060	-0.0462	0.2506
Sub-national entities				
Flanders (Belgium)	-0.1331	0.0013	-0.0296	-0.1048
Partners				
Russian Federation	0.3061	0.0370	-0.1070	0.3761
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.0652	0.0957	-0.1089	-0.0520
Denmark	-0.0469	0.0537	-0.0470	-0.0536
Estonia	0.1537	0.0799	-0.0603	0.1341
Ireland	0.0086	0.0004	0.0023	0.0059
Japan	0.0245	0.0016	-0.0132	0.0361
Korea	0.2232	0.0825	0.0204	0.1204
Netherlands	0.0440	0.0168	0.0654	-0.0382
Norway	-0.1320	0.0000	-0.0704	-0.0616
Poland	0.0917	0.0880	-0.0482	0.0519
Slovak Republic	-0.0079	0.0620	-0.0816	0.0118
Sub-national entities				
Flanders (Belgium)	-0.1420	0.0085	-0.0647	-0.0858
Partners				
Russian Federation	0.2301	0.0823	-0.1317	0.2795
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.1772	-0.0331	-0.0995	-0.0446
Denmark	-0.2815	-0.0810	-0.0450	-0.1555
Estonia	0.0970	-0.0194	-0.0731	0.1894
Ireland	0.0186	0.0200	0.0270	-0.0284
Japan	0.1163	0.0423	0.0546	0.0194
Korea	0.2481	-0.0161	0.0385	0.2256
Netherlands	-0.1299	-0.0569	-0.0048	-0.0682
Norway	-0.2361	-0.0305	-0.0524	-0.1532
Poland	0.0450	-0.0037	0.0117	0.0370
Slovak Republic	0.0052	-0.0257	-0.0614	0.0923
Sub-national entities				
Flanders (Belgium)	-0.2054	-0.0044	-0.0601	-0.1409
Partners				
Russian Federation	-0.0487	0.0669	-0.2429	0.1274

Source: PIAAC and author’s calculations.

Table A9: Decomposition Results, Base Cat.: U.K., All Regressors, Hourly Earnings with Bonuses

Country	Total Difference (country *j*-*b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.0530	0.0052	-0.0513	-0.0069
Denmark	-0.1036	0.0161	-0.0351	-0.0846
Estonia	0.0577	0.0031	-0.0434	0.0981
Ireland	0.0810	0.0103	0.0058	0.0649
Japan	0.0788	0.0084	0.0112	0.0592
Korea	0.1648	-0.0089	0.0281	0.1456
Netherlands	0.0947	0.0056	0.0169	0.0723
Norway	-0.0964	0.0068	-0.0415	-0.0617
Poland	0.0598	0.0187	-0.0065	0.0477
Slovak Republic	0.2117	-0.0040	-0.0323	0.2480
Sub-national entities				
Flanders (Belgium)	-0.1323	-0.0059	-0.0235	-0.1028
Partners				
Russian Federation	0.2420	0.0211	-0.0893	0.3102
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.0330	0.0817	-0.1067	-0.0080
Denmark	-0.0327	0.0725	-0.0573	-0.0480
Estonia	0.1409	0.0631	-0.0287	0.1065
Ireland	0.0333	0.0242	-0.0100	0.0191
Japan	0.0546	0.0798	-0.0633	0.0381
Korea	0.2662	0.0992	0.0181	0.1489
Netherlands	0.0566	0.0424	0.0319	-0.0177
Norway	-0.1368	-0.0111	-0.0692	-0.0566
Poland	0.1301	0.1051	-0.0336	0.0587
Slovak Republic	0.0212	0.0639	-0.0666	0.0238
Sub-national entities				
Flanders (Belgium)	-0.1173	0.0091	-0.0408	-0.0856
Partners				
Russian Federation	0.1701	0.0786	-0.1183	0.2097
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.2069	-0.0694	-0.0718	-0.0658
Denmark	-0.2879	-0.0795	-0.0491	-0.1594
Estonia	0.0827	-0.0146	-0.0826	0.1799
Ireland	-0.0184	-0.0075	0.0322	-0.0431
Japan	0.0790	-0.0186	0.0802	0.0174
Korea	0.2231	-0.0723	0.0840	0.2115
Netherlands	-0.1494	-0.0652	-0.0093	-0.0749
Norway	-0.2314	-0.0391	-0.0462	-0.1461
Poland	0.0328	-0.0285	0.0325	0.0288
Slovak Republic	0.0607	-0.0396	-0.0414	0.1417
Sub-national entities				
Flanders (Belgium)	-0.2199	-0.0448	-0.0367	-0.1384
Partners				
Russian Federation	-0.0420	-0.0167	-0.1724	0.1471

Source: PIAAC and author’s calculations.

Table A10: Decomposition Results, Base Category: U.K., All Regressors, Monthly Earnings

Country	Total Difference (country *j-b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.2408	-0.0120	-0.0746	-0.1542
Denmark	0.0499	0.0333	0.0950	-0.0784
Estonia	-0.1242	-0.0024	-0.0721	-0.0497
Ireland	0.0872	0.0149	0.0363	0.0360
Japan	0.0419	0.0011	0.0146	0.0263
Korea	-0.1071	-0.0147	0.0072	-0.0996
Netherlands	0.1617	0.0181	0.0974	0.0462
Norway	-0.0622	0.0140	0.0089	-0.0850
Poland	-0.1542	0.0193	-0.0644	-0.1092
Slovak Republic	0.0180	-0.0071	-0.0708	0.0959
Sub-national entities				
Flanders (Belgium)	-0.2488	-0.0271	-0.0419	-0.1797
Partners				
Russian Federation	0.2037	0.0346	-0.1278	0.2970
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.6298	-0.1029	-0.1443	-0.3826
Denmark	0.1973	0.0819	0.2128	-0.0975
Estonia	-0.3871	-0.0960	-0.0858	-0.2052
Ireland	-0.0247	0.0450	0.0230	-0.0927
Japan	-0.0347	0.0397	0.0345	-0.1090
Korea	-0.3909	-0.2121	-0.0145	-0.1643
Netherlands	0.2922	0.1730	0.1879	-0.0687
Norway	-0.0171	0.1086	0.0119	-0.1375
Poland	-0.5487	-0.1452	-0.0475	-0.3560
Slovak Republic	-0.5573	-0.1363	-0.0954	-0.3255
Sub-national entities				
Flanders (Belgium)	-0.5771	-0.1831	-0.0401	-0.3540
Partners				
Russian Federation	-0.3422	-0.0639	-0.1068	-0.1714
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.2542	0.0164	-0.0996	-0.1709
Denmark	-0.2503	-0.0826	-0.0494	-0.1183
Estonia	0.0599	0.1046	-0.1148	0.0701
Ireland	0.0173	-0.0502	0.0989	-0.0315
Japan	-0.0061	-0.0176	0.0578	-0.0463
Korea	0.0060	0.0482	0.0191	-0.0613
Netherlands	-0.0751	-0.1016	0.0197	0.0068
Norway	-0.2456	-0.0964	-0.0333	-0.1158
Poland	-0.0370	0.0509	-0.0694	-0.0185
Slovak Republic	-0.0241	0.0512	-0.1079	0.0327
Sub-national entities				
Flanders (Belgium)	-0.2310	-0.0382	-0.0504	-0.1423
Partners				
Russian Federation	-0.2064	0.0783	-0.2744	-0.0103

Source: PIAAC and author’s calculations.

Table A11: Decomposition Results, Base Cat.: U.K., All Regressors, Monthly Earnings with Bonuses

Country	Total Difference (country *j*-*b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.2361	-0.0128	-0.0733	-0.1501
Denmark	0.0383	0.0324	0.0812	-0.0753
Estonia	-0.1283	-0.0001	-0.0721	-0.0561
Ireland	0.0973	0.0130	0.0359	0.0484
Japan	0.0553	0.0056	0.0111	0.0385
Korea	-0.1005	-0.0153	0.0122	-0.0973
Netherlands	0.1530	0.0176	0.0939	0.0416
Norway	-0.0646	0.0139	0.0091	-0.0876
Poland	-0.1568	0.0190	-0.0607	-0.1150
Slovak Republic	0.0507	-0.0072	-0.0686	0.1265
Sub-national entities				
Flanders (Belgium)	-0.2514	-0.0272	-0.0393	-0.1848
Partners				
Russian Federation	0.0895	0.0325	-0.1256	0.1826
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.5827	-0.1684	-0.1033	-0.3110
Denmark	0.1915	0.0638	0.2100	-0.0823
Estonia	-0.3662	-0.0992	-0.0785	-0.1885
Ireland	0.0151	0.0522	0.0274	-0.0645
Japan	0.0085	0.0606	0.0382	-0.0903
Korea	-0.3232	-0.1853	-0.0050	-0.1329
Netherlands	0.3179	0.1666	0.2038	-0.0525
Norway	-0.0064	0.1197	0.0022	-0.1283
Poland	-0.4933	-0.1328	-0.0319	-0.3286
Slovak Republic	-0.5407	-0.1403	-0.1229	-0.2775
Sub-national entities				
Flanders (Belgium)	-0.5921	-0.1654	-0.0507	-0.3760
Partners				
Russian Federation	-0.3449	-0.0635	-0.0799	-0.2014
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.2751	0.0196	-0.1041	-0.1906
Denmark	-0.2362	-0.0380	-0.0736	-0.1246
Estonia	0.0704	0.1232	-0.1131	0.0604
Ireland	0.0131	-0.0331	0.0848	-0.0386
Japan	0.0106	-0.0170	0.0683	-0.0407
Korea	0.0413	0.0437	0.0708	-0.0732
Netherlands	-0.0664	-0.0784	0.0151	-0.0030
Norway	-0.2353	-0.0726	-0.0387	-0.1240
Poland	-0.0634	0.0976	-0.0803	-0.0807
Slovak Republic	0.0767	0.0979	-0.0945	0.0733
Sub-national entities				
Flanders (Belgium)	-0.2437	-0.0263	-0.0485	-0.1689
Partners				
Russian Federation	-0.1708	0.1081	-0.2725	-0.0064

Source: PIAAC and author’s calculations.

Table A12: Decomposition Results, Base Category: U.K., All Regressors, Monthly Earnings Self-Employed

Country	Total Difference (country *j-b*)	Observable Quantities Component	Observable Returns Component	Unobservables Component
Panel A: Standard Deviation of Log Wage				
Czech Republic	-0.2782	-0.0435	-0.0421	-0.1926
Denmark	-0.2178	-0.0119	-0.0091	-0.1968
Estonia	0.2927	-0.1004	0.0947	0.2985
Ireland	0.2409	-0.0033	0.0068	0.2374
Japan	0.1189	-0.1128	-0.0295	0.2612
Korea	-0.1752	-0.0074	-0.0047	-0.1632
Netherlands	1.0263	-0.0866	0.0614	1.0515
Norway	0.0458	-0.0772	0.0445	0.0785
Poland	-0.2859	-0.0140	0.1157	-0.3875
Slovak Republic	0.3354	-0.0684	0.0070	0.3969
Sub-national entities				
Flanders (Belgium)	-0.3928	-0.0840	0.0070	-0.3157
Partners				
Russian Federation	0.8221	-0.0024	0.1570	0.6675
Panel B: 50-10 Log Wage Differential				
Czech Republic	-0.6796	0.1995	-0.4426	-0.4366
Denmark	-0.4475	-0.0612	0.3182	-0.7045
Estonia	0.4925	-0.1213	0.2802	0.3335
Ireland	-0.3830	-0.0207	-0.0015	-0.3607
Japan	-0.4112	0.1725	-0.2590	-0.3246
Korea	-0.8938	0.1103	-0.1062	-0.8979
Netherlands	0.1766	0.1412	-0.0622	0.0976
Norway	-0.3830	0.0612	-0.0849	-0.3593
Poland	-0.1599	0.4649	-0.0042	-0.6206
Slovak Republic	0.0870	-0.0579	0.2223	-0.0774
Sub-national entities				
Flanders (Belgium)	-0.8938	-0.2388	-0.0188	-0.6363
Partners				
Russian Federation	0.9625	0.3448	0.2290	0.3887
Panel C: 90-50 Log Wage Differential				
Czech Republic	-0.2731	0.0000	-0.1258	-0.1472
Denmark	-0.1766	0.1299	-0.1864	-0.1202
Estonia	1.2097	0.1811	0.1062	0.9223
Ireland	-0.1671	0.0258	-0.1156	-0.0773
Japan	-0.1076	0.1423	0.0192	-0.2691
Korea	-0.2412	-0.0119	-0.1379	-0.0914
Netherlands	-0.1485	-0.1977	0.0721	-0.0229
Norway	-0.1076	0.0112	-0.0547	-0.0641
Poland	0.2288	0.0236	0.2178	-0.0126
Slovak Republic	-0.1014	0.2548	-0.3639	0.0077
Sub-national entities				
Flanders (Belgium)	0.2288	0.1910	-0.0210	0.0589
Partners				
Russian Federation	0.1643	0.2707	-0.4412	0.3348

Source: PIAAC and author's calculations.