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Ageing and Literacy Skills: Evidence from IALS, ALL And PIAAC

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AGEING AND LITERACY SKILLS: EVIDENCE FROM IALS, ALL AND PIAAC

OECD Education Working Paper No. 145

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ABSTRACT

This paper examines the relationship between age and literacy using data from the International Adult Literacy Survey (IALS), the Adult Literacy and Life Skills Survey (ALL) and The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC). A negative partial relationship between literacy and age exists with literacy declining with age, especially after age 45. However, this relationship could reflect some combination of age and birth cohort effects. The analysis shows that in most participating countries the negative literacy-age profile observed in cross-sectional data arises from offsetting ageing and cohort effects. With some exceptions, more recent birth cohorts have lower levels of literacy and individuals from a given birth cohort lose literacy skills after they leave school at a rate greater than indicated by cross-sectional estimates. The results for birth cohort suggest that there is not a general tendency for literacy skills to decline from one generation to the next, but that the majority of the countries examined are doing a poorer job of developing literacy skills in successive generations.

RÉSUMÉ

Ce document étudie les liens entre l’âge et les compétences à l’écrit, à l’aide de données tirées de l’Enquête internationale sur la littératie des adultes (IALS), de l’Enquête sur la littératie et les compétences des adultes (ALL) et de l’Évaluation des compétences des adultes, lancée dans le cadre du Programme de l’OCDE pour l'évaluation internationale des compétences des adultes (PIAAC). Une corrélation négative partielle entre le niveau à l’écrit et l’âge existe, les compétences dans ce domaine déclinant avec l’âge, surtout après 45 ans, mais cette corrélation pourrait mettre en évidence une combinaison d’effets liés à l’âge et à la cohorte de naissance. L’analyse montre que dans la plupart des pays participants, la corrélation négative observée à partir de données transversales entre les compétences à l’écrit et l’âge est due à des effets de compensation liés au vieillissement et à la cohorte. À certaines exceptions près, les générations plus récentes présentent des niveaux plus faibles à l’écrit et les individus appartenant à une cohorte de naissance donnée perdent leurs compétences à l’écrit après leur scolarité à un rythme plus rapide que ce qu’indiquent les estimations transversales. Les résultats relatifs aux cohortes de naissance semblent indiquer qu’il n’y a pas de déclin général du niveau à l’écrit d’une génération à l’autre, mais que la majorité des pays soumis à l’étude parviennent moins bien à développer les compétences à l’écrit de génération en génération.

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1. Introduction

In this paper,[1] we study the relationship between age and literacy skills using data from the International Adult Literacy Survey (IALS) carried out in the 1990s, the International Adult Literacy and Life Skills Survey (ALL) carried out in the 2000s and the recent Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC). When it is possible to do so we use data from countries that participated in all three surveys: Australia, Canada, Italy, the Netherlands, Norway and the United States. We also carry out a similar analysis for the countries that participated only in the IALS and PIAAC rounds of international comparative data collection on adult skills: Denmark, Finland, Ireland, Sweden and Flanders (Belgium).[2]

The IALS, ALL and PIAAC surveys are unique in providing measures of literacy and numeracy skills for a representative sample of the adult population. These surveys combine methods of educational testing with household survey techniques, and also provide detailed individual and demographic information on respondents. A key objective is to assess skills used in daily activities – at work, in the home, and in the community. In other words, these are basic cognitive skills used in daily life. Our focus is on literacy skills as these were assessed in all three surveys. In IALS and ALL separate measures of prose literacy and document literacy were provided, while in PIAAC these are combined into a single literacy measure.

Previous research using the Canadian IALS and ALL data found that there is a weak negative relationship between literacy skills and age, after controlling for other influences (Green and Riddell, 2003, 2013; Ferrer, Green and Riddell, 2006). Green and Riddell (2013) also found a similarly weak relationship between these variables in Norway and the United States. In this paper we begin by investigating the relationship between literacy skills and age in the countries that participated in IALS, ALL and PIAAC, as well as IALS and PIAAC. Again, we find that in all countries examined the partial relationship between literacy skills and age is negative in direction (i.e. literacy skills decline with age, holding constant other influences on literacy). The steepness of the literacy-age gradient does, however, vary considerably across countries. The absence of a positive relationship over at least some age range between basic cognitive skills such as literacy and age is perhaps surprising as individual earnings typically increase with age, albeit at a decreasing rate. The common finding of positively sloped age-earnings profiles is generally attributed to accumulation of human capital with work experience over the life cycle.[3] Taken at face value, these results suggest that the relationship between literacy skills and age does not follow the pattern displayed by other forms of human capital.

However, the relationship between skills and age in cross-sectional data could reflect some combination of age and cohort effects. A 35-year-old in 2012 may differ from a 25-year-old in 2012 both because she is older and because she comes from an earlier birth cohort. Those born in different time periods may experience differences in the nature and quality of schooling and work experience, as well as differences in the contributions of other influences on skills such as parents and peers. In order to distinguish between age and cohort effects, we use the IALS, ALL and PIAAC data to create synthetic cohorts. Each of these surveys provides information on a representative sample of the adult population at a

1. An earlier version of this paper was presented at the OECD 2nd International PIAAC Conference in Haarlem, the Netherlands in November 2015. We thank our discussant John Martin and conference participants for their helpful comments.

2. Four additional countries participated in IALS and PIAAC: the Czech Republic, England/Northern Ireland, Germany and Poland. However, in these countries educational attainment, a crucial variable in our analysis, is unreliable. Thus, we do not examine these countries.

3. Other explanations include internal labour markets and incentive-based pay structures in which wages rise more rapidly with seniority than does worker productivity.

point in time. Thus, 26-35 year-olds surveyed in 1994, 35-44 year-olds surveyed in 2003 and 44-53 year-olds surveyed in 2012 are all representative samples of the 1959-68 birth cohort. Our analysis focuses on literacy, which is measured in a comparable way in the three surveys.[4] For the countries that participated in IALS, ALL and PIAAC we study birth cohorts that appeared in each of the three surveys. For example, for Canada the three surveys were nine years apart so with appropriate age data[5] it is possible to observe representative samples of the following birth cohorts in all three surveys:[6]

1959-1968 birth cohort:

- Age in IALS 1994: 26-35
- Age in ALL 2003: 35-44
- Age in PIAAC 2012: 44-53

1949-58 birth cohort:

- Age in IALS 1994: 36-45
- Age in ALL 2003: 45-54
- Age in PIAAC 2012: 54-63

In addition, we can examine representative samples of the following birth cohorts in two of the three surveys:

1969-1978 birth cohort:

- Age in ALL 2003: 25-34
- Age in PIAAC 2012: 34-43

1939-1948 birth cohort:

- Age in IALS 1994: 46-55
- Age in ALL 2003: 55-64

In the case of countries that did not participate in ALL we study birth cohorts that appeared in both IALS and PIAAC.

Before the cohort analysis we examine the factors that influence literacy skills using the PIAAC data. This investigation yields several noteworthy results. In all of the countries, literacy increases strongly (though at a decreasing rate) with years of schooling. Parental education levels also have a positive association with literacy, but what matters most is having a mother or father with at least a high school education. Parental immigrant status plays no role in Canada and the United States but does influence literacy (principally in a negative manner) in Australia and the European countries. Perhaps most important for this study, we find a negative relation between age and literacy in each country. There is no evidence

4. The IALS and ALL data on prose and document literacy have been re-scaled to be comparable to the PIAAC measure of literacy, which combines both prose and document literacy. In our analysis we use the re-scaled data.

5. Specifically, because the surveys are not exactly 10 years apart, our synthetic cohort analysis requires age measured in years rather than 5-year or 10-year categories. Continuous age data allow us to select specific age groups in each survey such that they provide representative samples of the same birth cohort.

6. We can also study younger and older cohorts that participated in two of the three surveys.

that literacy increases with age beyond that attained by the youngest cohort (25 to 34 year-olds).[7] This relationship is approximately flat until the mid-40s, and then literacy declines at a rate that is initially modest in size but becomes larger for the older age groups. At first glance, these results appear to imply that individuals acquire their literacy through formal schooling and through the efforts of their parents but that their literacy levels do not develop further (and, indeed, subsequently decline) upon leaving school. However, these cross-sectional estimates combine age and cohort effects.

We then extend previous research of Green and Riddell (2013) who use the IALS and ALL data for Canada, Norway and the United States. They show that in these countries the relatively modest negative slope of the profile of literacy relative to age in the cross-sectional IALS and ALL datasets actually arises from a combination of offsetting ageing and cohort effects. In particular, Green and Riddell (2013) find that individuals from a given birth cohort lose literacy skills in the years after they leave school at a rate that is typically greater than is indicated by cross-sectional estimates. At the same time, their evidence indicates that more recent birth cohorts have lower levels of literacy. Thus, 35-year-olds in ALL 2003 have approximately the same average literacy score as 25-year-olds in the same survey not because 25-year-olds should expect to be at the same literacy level in 10 years but because the 35-year-olds started from a higher literacy level at age 25 (i.e. come from a more literate cohort) but lost some of their initial literacy skills during the time since they left school. Their results suggest, at least in the case of Canada, Norway and the United States, a tendency for literacy skills to decline over time at a rate greater than is suggested by cross-sectional data. This paper extends the previous analysis of Canada, Norway and the United States to incorporate the recently available PIAAC data, as well as to examine a broader range of countries. We present results for the six countries that participated in IALS, ALL and PIAAC (Australia, Canada, Italy, the Netherlands, Norway and the United States) and five countries that participated in IALS and PIAAC (Belgium, Denmark, Finland, Ireland and Sweden). In addition to data availability, these countries are of interest for several reasons, including the fact that they provide a wide range of literacy levels and the extent of inequality in their literacy distributions.

The paper is organised as follows. The next section describes our data and reports summary statistics. Section three analyses the generation of literacy skills using the cross-sectional PIAAC data for the six countries that participated in the three surveys. In the fourth section we employ "synthetic cohorts" analysis to estimate separate age and cohort effects using the IALS, ALL and PIAAC data. The final section concludes.

2. Data

Our data comes from The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), a fascinating survey carried out in over 20 OECD countries and economies in 2011-2012. We also make use of the International Adult Literacy Survey (IALS) and International Adult Literacy and Skills Survey (ALL), earlier surveys of literacy skills carried out in the 1990s and 2000s respectively. These surveys represent a breakthrough in providing detailed assessments of the cognitive skills of representative samples of the adult population, assessments that are comparable across countries and language groups. They include standard questions on demographics, labour force status and earnings, but also measure literacy, numeracy and related cognitive skills. A key objective of these assessments is to go beyond testing proficiency in mathematics and reading in order to assess capabilities in applying these cognitive skills to situations found in everyday life.

Our goal is to focus on literacy generation in each country's society and economy and, as a result, we exclude from our samples those born in another country, whose skills were not influenced by the country's

7. In a few countries the literacy proficiency of the 35-44 year age group is a bit greater than that of the youngest age category but the differences are never statistically significant at the 5% level.

educational system. Where appropriate, we also drop observations on aboriginals, whose schooling system and skills are generally very distinct from those of others born in the country of interest. The surveys cover individuals over age 15 but we restrict the analysis to those ages 25 and over in order to focus on those who have completed formal schooling. This sample restriction is necessary when using the synthetic cohort methodology in order to ensure that the age cohorts used in the analysis are representative of the overall population in that cohort. Our analysis focuses on those who have completed formal schooling, and thus have received the contribution made by the formal education system to their literacy skills. In the case of the youngest age group (those ages 15–24), many are still in school. Furthermore, the fraction of the youngest cohort that remains in school is changing over time due to rising educational attainment in most countries. Thus it is not meaningful to compare those in the youngest cohort who have finished formal schooling from one generation to another – doing so would violate the conditions under which the synthetic cohorts methodology is valid.

In the case of Canada, which has the largest sample size for IALS, ALL and PIAAC, the result is analysis samples of 2 982 for IALS, 13 464 for ALL and 17 898 for PIAAC. These samples are used in our analysis of the relationship between age and literacy skills in Canada. PIAAC analysis sample sizes are much smaller for the other countries – generally between 3 000 and 4 000 observations. We include both males and females but control for gender throughout. Finally, we use the sample weights provided with the data in all tables and estimation; thus in each country all summary statistics and regression estimates are representative of the adult native-born non-aboriginal population age 25 and above.

Table A.1 (see Annex A) reports summary statistics for our samples drawn from the Canadian PIAAC, ALL and IALS data. The literacy test outcomes are scaled to fall between 0 and 500, with average literacy scores equal to 268 in IALS, 274 in ALL and 271 in PIAAC. Females are slightly over-represented in the sample relative to the population but we control for gender in all of our estimates. The average number of years of completed schooling (13.7 in PIAAC) is typical of what is found in other Canadian surveys. Also noteworthy is the substantial increase in years of completed schooling between 1994 and 2012. Comparing educational attainment of respondents to that of their parents indicates strong progress in education across generations. This progress is also evident in the substantial decline in the fraction of parents who are high school dropouts between 1994 (IALS) and 2012 (PIAAC). The fact that only 7% to 8% of respondents have an immigrant mother or father in a country in which immigrants represent about 20% of the population can be attributed to our sample being restricted to native-born Canadians. The birth cohorts are ordered from youngest to oldest. As can be seen in Table A.1, 2 of the six birth cohorts appear in all three surveys and an additional two appear in two of the three surveys. The youngest and oldest birth cohorts are represented in only one of the three surveys.

3. The generation of literacy skills

In this section we use PIAAC data to examine the determinants of literacy in cross-sectional data. We begin with Canada, the country with the largest sample size, and then examine the other countries that participated in IALS, ALL and PIAAC: Australia, Italy, the Netherlands, Norway and the United States. Our dependent variable is the log of the literacy score so our estimated coefficients can be interpreted as showing impacts of each explanatory variable in terms of percentage changes in literacy.

Before presenting the estimation results, we begin by setting out a brief, heuristic model of literacy generation. The model will help to put our estimates in context as well as providing guidance in thinking about statistical issues. Consider a simple model in which individuals start out at birth endowed with two key characteristics: their ability and parental resources. By parental resources, we mean something quite broad, incorporating both parental income and parental willingness and ability to support their children's education and literacy acquisition. Pre-school children begin to acquire literacy based on these fundamental characteristics. Once they enter school, ability and parental resources interact with characteristics of the school such as teacher quality, class size and the attitudes and abilities of peers. New additions to literacy with each year of schooling are then functions of individual ability, parental resources, school characteristics and the literacy level at the beginning of the period. These influences may interact in complicated ways. These additions continue until the legal school leaving age. After that point until the end of high school, students make a decision each year on whether to continue in school. That decision will be a function of ability, parental resources and school characteristics, but it is also likely to be a function of literacy acquired to that point. The more literate a student is, the less onerous they are likely to find school and the more likely they are to choose to stay an extra year. Finally, after high school, whether an individual continues to go to school will be determined by a combination of their own decision to apply to continue and the decision of the college or university on whether to admit them. The latter decision will likely be a function of the student's literacy as reflected in her grades. Thus, schooling and literacy are co-determined with extra years of schooling leading to increased literacy but increased literacy also leading to more years of schooling, especially after the legal school leaving age. Indeed, once we account for expectations, the inter-relation between the two may be even tighter. Individuals who do not expect to continue with school past the legal minimum may rationally under-invest in acquiring literacy skills while they are in school.

Once individuals leave school, literacy acquisition is likely more difficult. Literacy skills may be acquired on the job if they are needed for carrying out tasks at work but otherwise further acquisition would require active investment in non-work hours. Indeed, it seems quite possible that individuals could lose literacy skills after they leave formal schooling if those skills depreciate when they are not used.

We are interested in characterising the components of literacy generation, especially in whether literacy declines or rises after leaving school and how this ageing process is related to individual characteristics. If literacy has a "use it or lose it" form then there may be a case for adopting policies that encourage literacy maintenance and "lifelong learning" activities. Also of interest is the relationship of literacy to parental characteristics and resources as well as the linkage between formal schooling and literacy since this is a main channel through which one could hope to influence literacy outcomes. Many of the parameters of interest reflect causal relationships that are difficult to establish definitively because of unobserved factors that may be correlated with both literacy and education. We are fortunate in having data that allow us to control for family background, a key influence that is not observed in many data sources. Nonetheless, there may be other variables that we do not observe and that are correlated with literacy and education or age. Thus our findings are best interpreted as partial correlations that control for a rich set of observables rather than as causal impacts.

The first column of Table A.2a (see Annex A) presents our simplest OLS regression in which the dependent variable is the log of the individual literacy score in Canada and the independent variables are age in 10-year categories, years of schooling, years of schooling squared, and a gender dummy. The coefficient on the gender dummy indicates that there is a statistically significant difference in literacy between men and women conditional on age and education but that this gender gap is small in size (less than 1%).[8] The other variables are also statistically significantly different from zero at the 1% level. The age coefficients imply that the impact of an extra decade of age on literacy (relative to the omitted category, those aged 25-34) is a modest 1.3% decline over one decade but increasingly large declines of 4.2% and 5.7% after 20 and 30 years respectively. The relationship that is economically most substantial is that between literacy and formal schooling. One extra year of schooling, evaluated when the individual

8. In previous analysis with IALS and ALL data we found that females achieve higher scores on prose literacy than do males, and the reverse is true for document literacy. These offsetting coefficients in the individual score regressions resulted in a small and insignificant coefficient in the regression for the average score. The gender coefficient in PIAAC is larger in size and statistically significant, but is nonetheless quantitatively small.

already has 12 years of education, increases literacy by 3.6%. The non-linear (concave) nature of this relationship implies that there are diminishing returns to additional years of schooling. This feature probably reflects the fact that PIAAC assesses basic cognitive skills rather than higher order skills.[9]

As discussed earlier, literacy and years of schooling are likely to be jointly determined. In that case, OLS estimates are likely to suffer from omitted variables bias. Although most attention focuses on the estimated impact of schooling on literacy, other coefficients (including those on age) could also be biased. Such biases may arise because of a correlation between literacy and schooling arising from unobserved variables that are correlated with both education and literacy. One important set of variables that is often not available consists of parental and family background characteristics. Fortunately with the PIAAC data we are able to control for a variety of family background factors including educational attainment and the immigrant status of the respondent’s mother and father.

In the second column of Table A.2a we add variables on parental education and parental immigrant status, allowing mothers and fathers to have separate influences. Introducing these variables has only a small impact on the gender coefficient, but it does have the expected consequence of reducing the coefficient on years of schooling, consistent with the view that parental education exerts an influence on both the child’s educational attainment and her literacy skills. The estimated impact of an additional year of school evaluated at 12 years of schooling falls from 3.6% to 3.2%, a decline of about 10%. Interestingly, including parental background leads to a noteworthy decrease in the absolute value of age coefficients. Relative to the omitted age group (those 25-34 years of age), there is now no significant change in the next 10 years and smaller declines in literacy of 2.5% and 3.3% after 20 and 30 years respectively. This result suggests that it is important to control for family background when examining the relationship between literacy skills and age. Omitting family background may result in over-stating the extent to which literacy declines with age in cross-sectional data.

The parental education variables are jointly highly significantly different from zero but, perhaps surprising, the effect is found mainly at low levels of parental education, a result also found in Green and Riddell (2013) with Canadian ALL data. Having a mother who is a high school dropout decreases average literacy by more than 3%, and having a father with less than high school education is associated with literacy levels about 1% lower. However, parental education beyond high school graduation has no (in the case of mothers) or relatively modest (in the case of fathers) further impacts on literacy. Interestingly, not knowing (or reporting) a parent’s education level – which is the case for 5 to 7% of our sample -- has a strong effect, being associated with approximately 6% lower literacy. While we included this variable in order to allow us keep the observations with missing information on parental education, it seems possible it represents something real. For example, children who do not know a parent’s education likely did not have a close relationship with that parent. Thus, the estimated coefficient may reflect the extent to which literacy is generated through direct parental involvement. Finally, having a mother or father who is an immigrant has no association with literacy, after controlling for other influences. Overall, the results point to a surprisingly weak association between literacy and parental background, although controlling for family background is important for obtaining estimates of the impact of schooling and age that are less affected by omitted variables bias. Formal schooling has the most substantial impact on literacy generation.

The third column replaces the specification based on 10-year age categories with a less restrictive specification using 5-year age categories. The omitted age category remains the same as in column 2 – those aged 25-34. The 5-year age category specification yields a slightly better fit. The implications of the estimates are very similar. Relative to the omitted category, literacy declines gradually with age – for

9. Previous research with IALS and ALL data also found diminishing returns to additional education (e.g. Green and Riddell, 2003, 2013).

example by 2% to 3% for those 45-49 and 50-54 years of age respectively and 3% to 4% for the two oldest age groups.

Columns 4 to 6 report estimates for the same specifications as columns 1 to 3 except that respondent's education is measured in levels rather than in years of completed schooling. High school graduates without post-secondary education are the omitted category. The overall fit is not as good as was obtained with the quadratic years of schooling specification. Importantly, however, the estimated coefficients associated with gender, age of respondent and family background are virtually unchanged. These estimates indicate that high school dropouts have literacy skills 15% to 17% lower than high school graduates, and university graduates have literacy levels 12% to 14% higher. There is also a small 3% to 4% improvement in literacy for those with some post-secondary education below the university level.

Three key findings follow from the estimates reported in Table A.2a. First, the estimates indicate that education has a strong effect on literacy and that formal schooling is the dominant determinant of literacy. This result is robust to controlling for family background, although the partial effect of education on literacy skills is over-stated (albeit modestly) when family background is not included as a control. Parent's education also plays a role, but its influence is quantitatively modest and mainly restricted to parents with low levels of formal education. The second conclusion is that, in cross-sectional Canadian data, literacy gradually declines with age, beginning in the mid-40s, but at a modest rate. The third finding is that the relationship between literacy with age is correlated with family background. As a consequence, the decline of literacy skills with age is over-stated when parents' education and immigrant status is not included as a covariate in skill production equations.

Tables A.2b to A.2f report similar estimated log skill regressions using PIAAC data for the United States, Norway, the Netherlands, Italy and Australia. Several generalisations emerge from these estimates. First, the pattern of skill decline with age in cross-sectional data is evident in each of these countries. In general there is not a statistically significant difference in literacy skills between the omitted 25-34 year-old group and those aged 35-44. However, lower skills are evident among the older age groups, with the largest decline being that for the oldest age groups. The rate at which literacy falls with age is smaller than that in Canada in some countries (such as Italy and the United States), similar in Australia, and much larger in others (such as the Netherlands and Norway). A second noteworthy finding common to these countries is that controlling for family background results in a reduction in the rate at which literacy skills are estimated to decline with age. The extent to which controlling for family background alters the estimated partial correlation between literacy skills and age differs across countries, being least important in the Netherlands and most important in Canada and the United States. Many studies have found that parents' education and other dimensions of family background exert an important influence on educational attainment and skill accumulation. This result suggests that family background may also influence the rate at which skills depreciate over the life cycle.

Another result common to these countries is that respondents with a mother and/or father with low educational attainment (less than high school completion) have lower literacy levels, after controlling for other factors. Interestingly, however, having parents with post-secondary education has either no impact on literacy or a positive effect that is modest in size. This suggests that the main way that highly educated parents influence the literacy skills of their children is indirectly, by influencing their educational attainment, rather than directly.

Immigrant status of parents matters in Australia and the European countries, most prominently in the Netherlands, but does not affect literacy skills of respondents in North America. In Norway and the Netherlands those with immigrant parents have somewhat lower literacy, other things equal. In Italy having an immigrant mother is associated with higher literacy, while the opposite is the case for those with an immigrant father. Australia is the opposite to Italy: having an immigrant mother is associated with lower literacy, but literacy levels are slightly higher for those with immigrant fathers, after controlling for other influences. In all countries, the influence of parental immigrant status may operate through language as the literacy tests are carried out in the official language (or languages) of the country in which the respondent lives.

Formal schooling exerts a strong influence on literacy in each country. The strength of the partial correlation is greatest in Canada and the United States but in all these countries education is the major influence on literacy skills.

4. Age and cohort effects

One of the most striking results from the Table 2 regressions is that literacy skills decline (albeit at a slow rate) with age, beginning in the mid-40s. Prior to the mid-40s there is no increase in literacy; indeed, the coefficient estimates suggest a slight decline albeit one that is not statistically significant. Taken at face value, this suggests that, on average in a wide range of countries, individuals do not enhance their literacy skills after they finish schooling. Essentially, literacy is acquired principally at school with some contribution from their parents, and then declines, albeit gradually at first.

However, interpreting the coefficient on age in a cross-sectional regression requires some care. Differentials between two age groups in a cross section could reflect a variety of possible combinations of true age and cohort (or generational) effects. Thus, while we are tempted to view the literacy level of 35-year-olds in the PIAAC as a reflection of the literacy level the 25-year-olds are likely to be at in 10 years' time, we need to bear in mind that the 35-year-olds come from an older generation and their observed literacy reflects a combination of any generational differential as well as an ageing effect. Only if there are no systematic differences across birth cohorts does the cross-sectional literacy-age profile reflect the true impact of ageing on literacy.

A more complete investigation of cohort and ageing effects requires the use either of true panel data or of at least two cross-sectional datasets constructed in such a way that we can follow "synthetic" cohorts through time. Synthetic cohorts take advantage of the fact that although we do not necessarily observe the same people at different points in time, we do observe representative samples of the population at different points in time. From these samples we can construct representative samples of individuals from the same birth cohort, thus creating a quasi-panel data set from a common birth cohort. We will make use of the IALS, ALL and the PIAAC for this purpose. For example, in the public use version of the IALS (which was carried out in 1994 in Canada), we can observe a set of 10-year age groups for the respondents (i.e. ages 16-25, 26-35, 36-45, 46-55, 56-65). We can also construct age groups in ALL and PIAAC that correspond to the age people in these birth cohorts would be 9 years later in ALL (i.e. 25-34, 35-44, 45-54, 55-64, and 65-74) and 18 years later in PIAAC.[10] Since the three surveys provide representative samples of the adult population, it follows that each provides an unbiased estimate of the literacy distribution for these birth cohorts at three different points in time and we can follow the progress of a given cohort over time. Throughout the analysis we use versions of IALS and ALL that have the re-scaled literacy scores (essential for comparability over time).

To illustrate the age and cohort effects we plot the densities of the literacy distribution from the Canadian samples. Figure A.1 shows the overall distribution of literacy in ALL 2003 and PIAAC 2012. This figure indicates that there has been a noticeable deterioration of literacy in Canada over this 9-year

10. The Canadian public use IALS and ALL data are limited to 10-year age categories. However, the age groups in IALS and ALL data differ by one year, being 16-25, 26-35, etc. in IALS and 15-24, 25-34, etc. in ALL. Because IALS and ALL are nine years apart, we are able to align the age groups in IALS, ALL and PIAAC to provide representative samples of each birth cohort.

period. Throughout most of the range of literacy scores the 2012 distribution lies to the left of the corresponding 2003 distribution. The large sample sizes of the Canadian ALL and PIAAC surveys enables us to show breakdowns by age and birth cohorts. Thus, in Figure A.2, we present the density plots for individuals who are age 25 to 34 in 2003 and individuals who are the same age in 2012. These densities correspond to the literacy for the youngest cohort we examine in 2012 and for the cohort just before them at the same age (observed in 2003). The density for the younger cohort (observed in 2012) has more spread, with both the left and right tails being thicker, especially that of the lower tail. In other words, the younger cohort experiences deterioration in literacy at the low end of the distribution but a slight improvement at the top end. This pattern is reflected in a 10th percentile of 250 and a 90th percentile of 341 in 2003 compared to values of 236 and 342, respectively, in 2012. The reduction in the lower tail is much larger, as reflected in a median value of 294 in 2003 compared to 303 in 2012. Except for the small improvement at the very top of the distribution, literacy proficiency of this age group fell substantially.

In Figure A.3, we present the same density comparison for individuals aged 35 to 44. The outcome is similar to Figure A.2 except that the relative worsening in the lower end of the distribution is not as great and neither is the relative improvement at the very top. For example, the median score fell from 296 in 2003 to 292 in 2012. In contrast, Figure A.4 shows that for the 45 to 54-year-olds, the results in 2012 are worse across the distribution. Finally, Figure 1.A1.5 also shows that those aged 55 to 64 made improvements over time at the bottom of the literacy distribution, but experienced inferior outcomes at the very top end. The 10th percentile rose from 198 in 2003 to 217 in 2012, but the 90th percentile score dropped slightly (from 323 to 321).

The fact that we see different patterns across age groups is important, in part, because observing different relative changes between 2003 and 2012 for different groups suggests that we are witnessing something real rather than just a difference in the tests in the two years. If all plots for all groups showed deterioration at the bottom and slight improvement at the top between ALL and PIAAC, then the simplest explanation for the patterns would be that the test changed in such a way that it generated lower scores on the easier questions that will constitute most of the values at the bottom but better results on the harder tests that will define the shape of the top of the distribution.

We now turn to the analysis of the effects of ageing on literacy skills. Figures A.6 to A.8 present density plots for each year for specific birth cohorts. Note that this contrasts with Figures A.2 to A.5 that examine people of the same age in the two surveys. Figures A.2 to A.5 make comparisons across groups at the same age at different points in time while the Figure 1.1A.6 to 1.A1.8 comparisons follow individual birth cohorts through time. Figure A.6 shows the plots for the 1969-1978 birth cohort: this cohort was age 16 to 25 in 1994, age 25 to 34 in 2003 and 34 to 43 in 2003.[11] The plot indicates deterioration of literacy proficiency between 2003 and 2012 throughout the distribution and an increase in the spread of the distribution. The 10th percentile of the literacy distribution decreases by 20 points (from 250 to 230) for this cohort while the median falls by 10 points from 303 to 293. The decline at the very top is relatively modest – the 90th percentile falls from 341 to 339.

The 1959-196 birth cohort (individuals who were age 26 to 35 in 1994, age 35 to 44 in 2003 and age 44 to 53 in 2012) is plotted in Figure A.7. Between the first two surveys (IALS 1994 and ALL 2003) there is little change at the bottom of the skill distribution but a clear worsening at the top. In contrast, the shift in the skill distribution between 2003 and 2012 shows a very similar pattern to that in Figure A.6 and even greater decline in literacy. The median falls 17 percentage points from 296 to 279 and the 10th percentile declines by 21 percentage points (from 233 to 212). The decline in the 90th percentile is more modest (7 percentage points) but nonetheless substantial.

11. The 1994 distribution is not shown because it would not be representative of the 1969 to 1978 birth cohort, as discussed previously.

Finally, the densities for the 1949 to 1958 birth cohort (those age 36 to 45 in 1994) show similar patterns between each pair of surveys but the magnitudes of the shifts are even larger (Figure A.8). Between 1994 and 2003 there is a substantial decline in literacy at the top of the distribution but little change at the bottom (scores below 235). Between 2003 and 2012 a dramatic deterioration is evident, especially in the top half of the distribution. For example, the median falls 20 percentage points from 288 to 268 and the 90th percentile decreases 16 percentage points from 335 to 319 between the survey years.

Overall, across these three birth cohorts covering those born in the decades of the 1950s, 1960s and 1970s, the pattern of the shifts in the skill distributions between IALS and ALL and those between ALL and PIAAC are broadly similar across birth cohorts but differ between the two time periods. Between 1994 and 2003 there is a decline in literacy at the top of the distribution but little change in the bottom. Between 2003 and 2012 a substantial decline in literacy is evident throughout most of the distribution, especially in the lower half. The magnitudes of the changes between IALS and ALL and between ALL and PIAAC appear to become more pronounced with age.

The fact that the patterns for the three birth cohorts are broadly similar (but differ in magnitudes) does raise questions about the comparability of the data between the three surveys. However, the differences in patterns across age groups discussed previously works against this explanation. A more likely explanation of the patterns is that literacy skills deteriorate after leaving school but that the rate of deterioration increases with age.

To quantify the age and cohort effects, we pool the IALS, ALL and PIAAC data[12] and add cohort dummies to the cross-sectional specifications used in Table A.2.[13] We report the results from this cohort specification for Canada in Table A.3a. Columns 1 and 3 show estimates for the pooled sample that correspond to those reported in Table A.2 for the PIAAC sample. These estimates are very similar to those shown in Table A.2. Columns 2 and 4 include the cohort dummies, allowing us to separate age and cohort effects. As in the earlier specification, the schooling variables enter strongly and significantly. With or without the cohort controls, the schooling effect is very similar to that we witnessed in Table A.2 based on cross-section data. The parental education variables exhibit the same patterns as in earlier estimation, with low as well as unknown/not reported parental education having a large negative impact but the remaining variables having small and insignificant coefficients. Parental immigrant status has little (in the case of mothers) or no (in the case of fathers) impact on the respondent's literacy skills.

The age and cohort effects in the pooled Canadian ALL and PIAAC sample show interesting patterns that mirror earlier findings of Green and Riddell (2013) using IALS and ALL data. Recall from Table A.2 that when we estimate our standard specification with dummies for age categories, we find a cross-sectional age profile with a small negative slope for much of the age range. This cross-sectional finding is replicated in Table A.3a using the pooled sample. In particular, in column 3 (which controls for family background), the first age dummy (corresponding to the 35-44 age group) has a small and insignificant coefficient, while the second and third age dummies (corresponding to the 45-54 and 55-64 age groups) have coefficients that indicate declines in literacy skills of 2.4% and 4.3% respectively relative to the base category (the 26-35 age group). Once we include the cohort dummy variables, however, the age effects indicate a much steeper downward sloping profile, with the 45-54 year-olds having 6.8% lower literacy

12. The age categories in IALS differ by one year from those used to control for age in ALL and PIAAC. However, this small amount of measurement error makes little difference to our results. We estimated the same specifications as in Table 3a using only the pooled ALL and PIAAC data and obtained very similar results.

13. The key identifying assumption is that there are no interactions between the age and cohort effects. For example, this requires that cohorts that finish formal schooling with lower literacy do not lose their literacy as they age at a slower rate than cohorts that finish schooling with higher literacy.

levels and the 55-64 year-olds having 11.0% lower literacy than the base group (see column 4). Also, with the addition of cohort controls the 35-44 year-old age group now shows a statistically significant decline in literacy (of 2.6%) relative to the base group. At the same time, all the cohort dummies have positive effects that increase with the cohort (and in the specification including family background all are statistically significant, most at the 1% level). Cohort 1 (those aged 26-35 in 2003 and 35-44 in 2012), for example, has average literacy levels that are about 2% higher than those for the base cohort, which was 25-34 in 2012. The oldest cohorts have literacy levels that are about 9% higher than the base cohort. Overall, the implication from these results is that the small negative slope of the literacy-age profile (at least up to age 65) arises from a combination of literacy that declines with age at a greater rate than is suggested by the cross-sectional estimates and lower average literacy for more recent cohorts.

Do the ageing patterns observed in Canada also hold in other countries, or are they unique to Canadian society? We address this question using pooled IALS, ALL and PIAAC data in Tables A.3b to A.3f.[14] As noted previously, we chose these countries because they participated in all three rounds of international skills assessment. However, they also have the advantage of having a range of literacy levels and degrees of inequality in their literacy distributions. They also differ substantially in key determinants of literacy such as their education systems and the role of the family.

Tables A.3b and A.3c report estimates for the United States and Norway. Note that these estimates do not control for parents' education, which is not available in all three surveys for these countries. The patterns are similar to those for Canada. In the case of the United States, we again see declining literacy with age and the rate of decline is much steeper when we control for cohort effects (and similar in magnitude to that in Canada). The estimated coefficients associated with the cohort dummies are all positive, statistically significant, and increase monotonically from the youngest to oldest cohorts. In order to check that the U.S. results are not sensitive to the omission of controls for parents' education, we also estimated the same specifications using the pooled ALL and PIAAC samples which contain information on parents' education. The results are very similar, which is consistent with the estimates for Canada in Table A.3a that indicate that controlling for family background has little impact on the estimated relationship between literacy proficiency and age once cohort dummies are included (compare columns 2 and 4 in Table A.3a).

The same pattern is also evident – indeed, more pronounced -- in Norway. The rate at which skills fall with age is significantly greater in Norway than in Canada and the United States, with or without controlling for cohort effects. The estimated cohorts effects are all positive, statistically significant and increasing in size from the youngest to oldest cohorts. The cohort effects are also much larger than their counterparts in Canada and the United States, ranging from about 4% for the youngest cohort to 16% to 17% for the oldest (cohorts 4 and 5). Accordingly, our estimates indicate a steep decline in literacy with age in Norway, after controlling for differences in literacy across birth cohorts.

Table A.3d presents the same type of analysis for the Netherlands. There are noteworthy differences from the patterns found with the Canadian, U.S. and Norwegian data. In the Netherlands the estimated cohort effects are negative in sign, and are statistically significant when parental immigrant status is included as a control (parental education is not available in the Netherlands data). They are, however, small in size (most around -2%, with those for the oldest cohorts being -3%). As a consequence, the estimated relationship between literacy and age, controlling for cohort differences, is less pronounced than the cross-sectional estimates suggest but remains negative. Indeed, even with cohort controls included the partial relationship between literacy and age is quite steep in the Netherlands.

14. In the case of Italy it appears that ALL significantly understated the literacy proficiency of the adult population (Paccagnella, forthcoming). We therefore omit ALL and report results based on the pooled IALS and PIAAC samples.

Italy displays dramatically different behaviour than other countries. Without taking account of cohort differences there is no relationship between literacy and age in the Italian cross-sectional data. However, the estimated cohort effects are statistically significant, negative in sign and those for the older cohorts are large in size. Thus when cohort differences are taken into account there is a positive relationship between literacy and age. These results are inconsistent with other evidence about the relationship between literacy skills and age and warrant further investigation.

The results for Australia, which are based only on ALL and PIAAC and reported in Table A.3f, are similar to those for Canada and the United States. One small difference is that Australia is the only country in which cross-sectional estimates show some evidence of improvement in literacy with age relative to the base 25-34 year-old group (see columns 1 and 3). However, the difference in literacy between 35-39 and 40-44 year-olds and the base group is small (about 1%) and becomes insignificant once cohort dummies are included (see columns 2 and 4 of Table A.3f). At ages above 44, literacy declines at a rate similar to that in Canada and the United States, and lower than in Norway and the Netherlands. The pattern of the estimated cohort effects is also similar to that of Canada and the United States. As a consequence, when we compare columns 3 and 4 in Table A.3f we see the familiar result that the cross-sectional estimates of the relationship between literacy and age understate the true relationship.

Tables A.4a to A.4e contain estimated age and birth cohort effects for five countries that participated in IALS and PIAAC. Parental education is not available in the IALS data for these European countries, so controls for family background are limited to parental immigrant status. With the exception of Belgium, the cross-sectional literacy-age profile is steeper in these countries than in Australia, Canada and the United States (Belgium's cross-sectional profile is similar to Canada and the United States) Sweden and Ireland have particularly steep declines in literacy with age according to cross-sectional estimates, while the estimated profile in Denmark and Finland is similar to that in Norway and the Netherlands. Adding birth cohort dummies to the estimated relationship yields positive cohort effects that increase in size with older cohorts in Denmark, Ireland and Sweden. In these countries the extent to which literacy declines with age is understated in cross-sectional data. In contrast, the estimated cohort dummies in Finland and Belgium are negative in sign, although relatively small in size. In these countries the relationship between literacy and age is flatter once we control for differences in literacy across cohorts. Nonetheless, even after controlling for cohort differences there is a negative relationship between literacy proficiency and age in each of these countries. The extent to which literacy declines with age is particularly large in Ireland, Sweden and Denmark. In Belgium and Finland the estimated literacy-age profile is similar to that found for Canada and the United States.

5. Conclusion

The IALS, ALL and PIAAC surveys are unique in providing measures of basic literacy skills for representative samples of the adult population in participating countries. In this paper, we use these data to investigate the relationship between literacy skills and ageing in 11 OECD countries that participated in at least two of these surveys. Our cross-sectional analysis of the factors that influence literacy skills uses the PIAAC data for countries that participated in all three surveys: Australia, Canada, Italy, the Netherlands, Norway, and the United States. This analysis concludes that formal education is the primary driver of adult literacy skills. The characteristics of the respondents' parents –educational attainment and immigrant status – have significant effects on the respondents' education, but a direct impact on literacy that is relatively modest in size. Perhaps surprising is the general finding that literacy skills do not improve with age even over early phases of the adult life cycle. Rather, literacy proficiency shows little change from the mid-20s (after most individuals have completed formal schooling) to the mid-40s, and then declines. Taken at face value, these results suggest that literacy skills are primarily determined by formal schooling and to some extent by family background, and then decline with age, very gradually at first but at an increasing rate.

To investigate these issues further, we take advantage of the fact that the IALS, ALL and PIAAC surveys provide representative samples of the adult population at three points in time during the decades of the 1990s, 2000s and 2010s, which allows us to separately identify birth cohort and ageing effects. Doing so indicates that after controlling for cohort effects, literacy skills decline with age after completing formal schooling in all but one of these 11 countries. Italy is the sole exception to this common finding. We also find that in most of these OECD countries successive birth cohorts have poorer literacy outcomes – i.e. begin their adult lives with lower levels of literacy proficiency. The negative relationship between literacy skills and age found using cross-sectional data in most countries results from offsetting age and cohort effects. Once we control for cohort effects, the rate at which literacy proficiency falls with age is, in most countries, more pronounced, in some cases much more pronounced. In other words, the cross-sectional partial correlation between literacy and age understates the extent to which literacy declines with age. In contrast, in Finland, Italy and the Netherlands more recent cohorts have higher literacy than earlier birth cohorts. In these countries cross-sectional estimates overstate the rate at which literacy declines with age. In Finland and the Netherlands the estimated literacy improvement among more recent cohorts is modest in size, and the partial relationship between literacy and age remains strongly negative even after controlling for cohort effects. In Italy, however, the estimated improvement in literacy among more recent cohorts is so large that the implied partial relationship between literacy and age, controlling for cohort effects, is positive. Given the unexpected nature of this result, investigation of the reliability of the Italian data is warranted. Apart from the surprising Italian results, our analysis suggests that declining literacy with age is a pervasive phenomenon, but whether estimates of this relationship based on cross-sectional data under- or over-state this relationship varies across countries.

The rate at which literacy proficiency declines with age varies considerably across these OECD countries. Broadly speaking, countries fall into two main groups. Literacy falls moderately with age in Australia, Belgium, Canada, Finland, the Netherlands and the United States. For example, in this group the literacy skills of those age 55-64 are 8% to 11% lower than those age 25-34, controlling for other influences on skills. In Denmark, Ireland, Norway and Sweden literacy proficiency falls substantially with age – assessed skills of 55-64 year-olds are 18% to 23% below those of 25-34 year-olds. The reasons for these differences and their policy implications deserve attention.

There are also noteworthy differences across countries in the extent to which literacy skills are rising or falling across successive generations. In Finland, the Netherlands and Italy the estimated improvement in literacy across generations is relatively modest – gains between 1% and 2% for those born in the 1970s and 1980s relative to those born in the 1960s (1958-1967) and gains of 2% to 5% relative to those born in the 1950s (1948-1957). However, in the majority of countries literacy skills are falling across generations, in many cases at a more substantial rate. Belgium and Sweden show the smallest decline in literacy across birth cohorts – drops in literacy proficiency of 1% to 2% between those born in the 1960s and those born in the 1980s, and 2% to 4% between those born in the 1950s and those born in the 1980s. Ireland and Norway exhibit the greatest decline – decreases of 8% to 9% and 12 to 14% respectively across these birth cohorts. The remaining countries fall in between these extremes. Understanding the reasons for these changes in literacy proficiency across successive generations, and their policy implications, is an important issue for future research.

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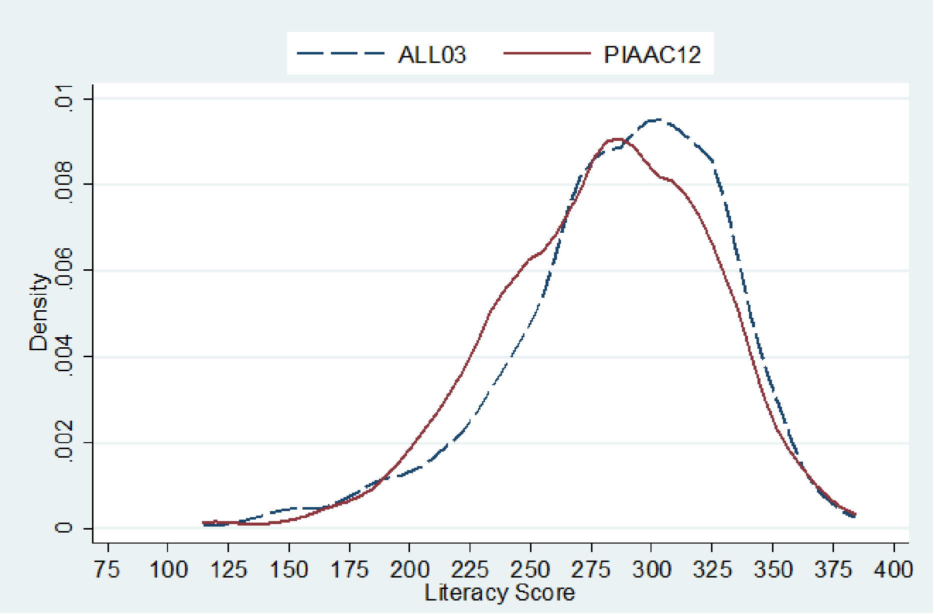
ANNEX A. SUPPORTING ANALYSIS

Distribution of literacy, Canada, PIAAC 2012 and ALL 2003

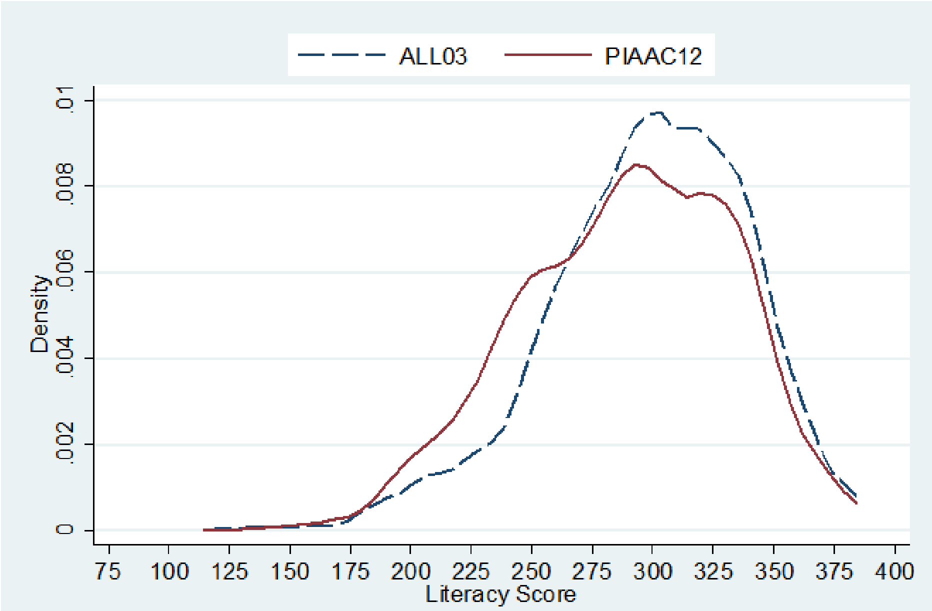
Figure A.1. Literacy in Canada, 2003 and 2012



Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

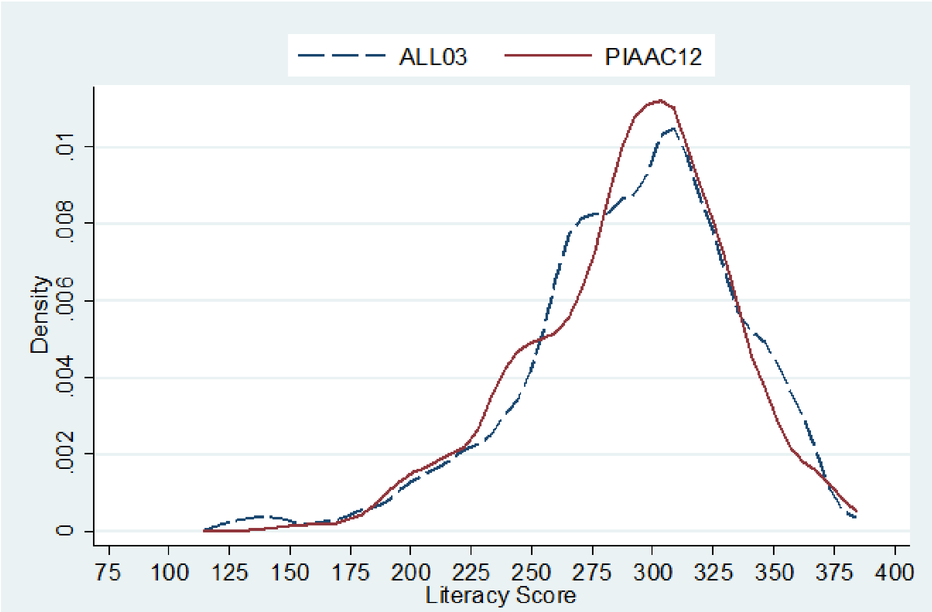
Distribution of literacy by age group, Canada, PIAAC 2012 and ALL 2003

Figure A.2. Literacy in Canada, age 25-34



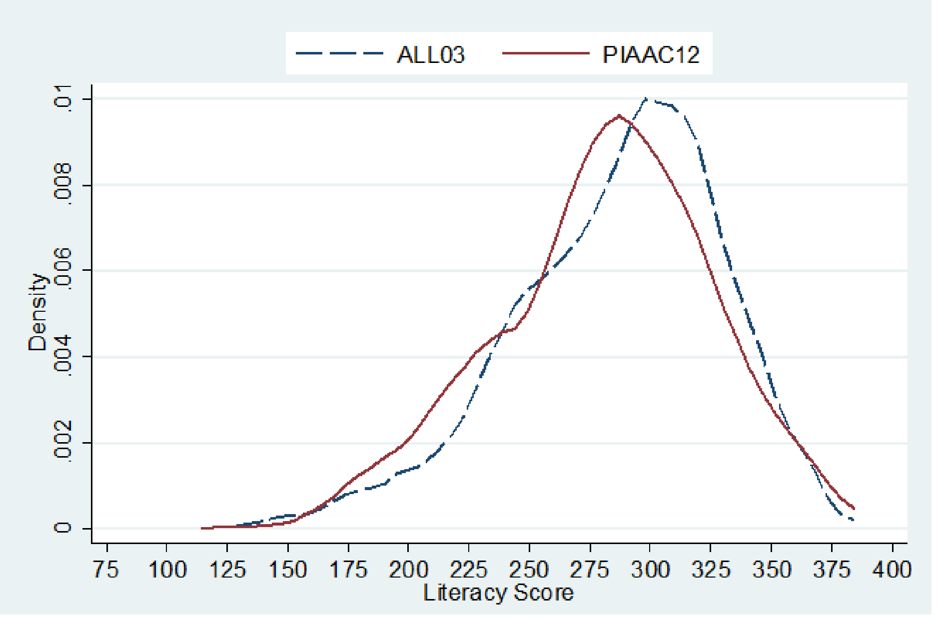
Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Figure A.3. Literacy in Canada, age 35-44



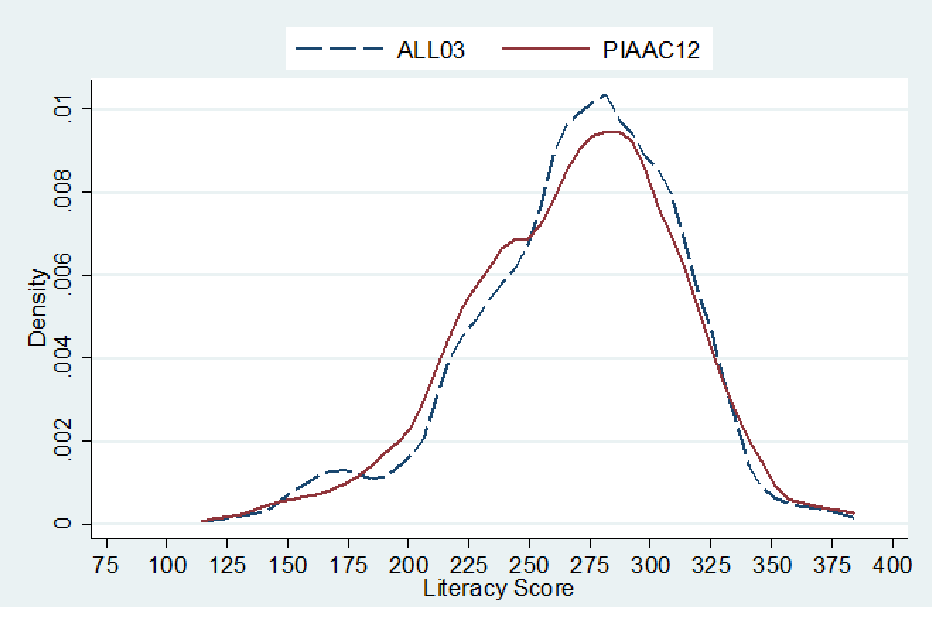
Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Figure A.4. Literacy in Canada, age 45-54



Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

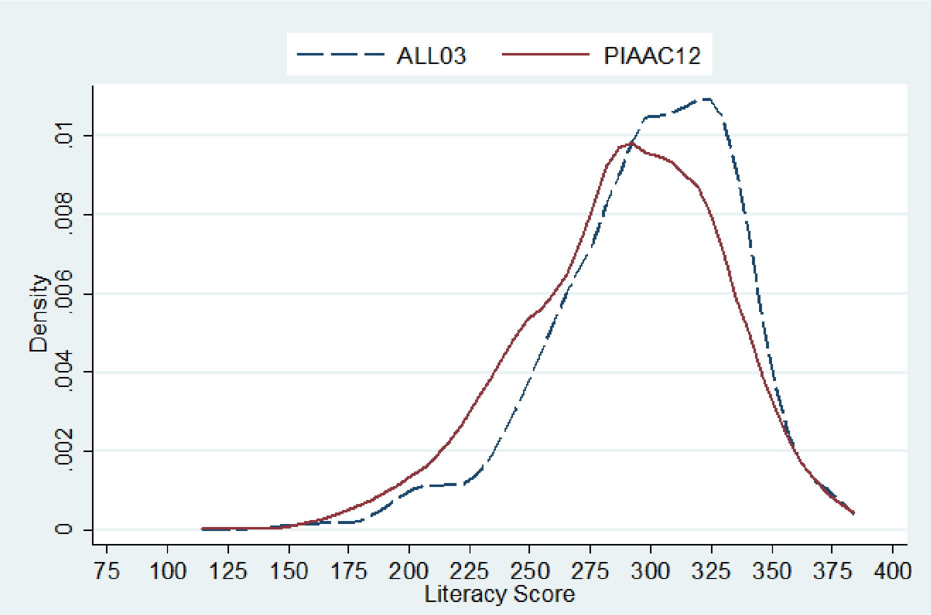
Figure A.5. Literacy in Canada, age 55-64



Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

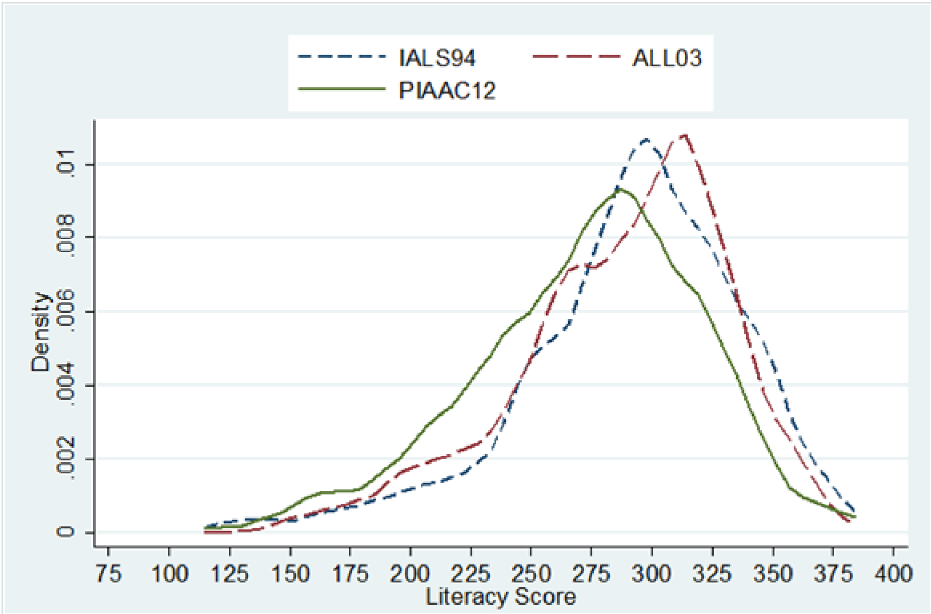
Distribution of literacy by birth cohort, Canada, PIAAC 2012 - ALL 2003 – IALS 1994

Figure A.6. Literacy in Canada, 16-25 in 1994



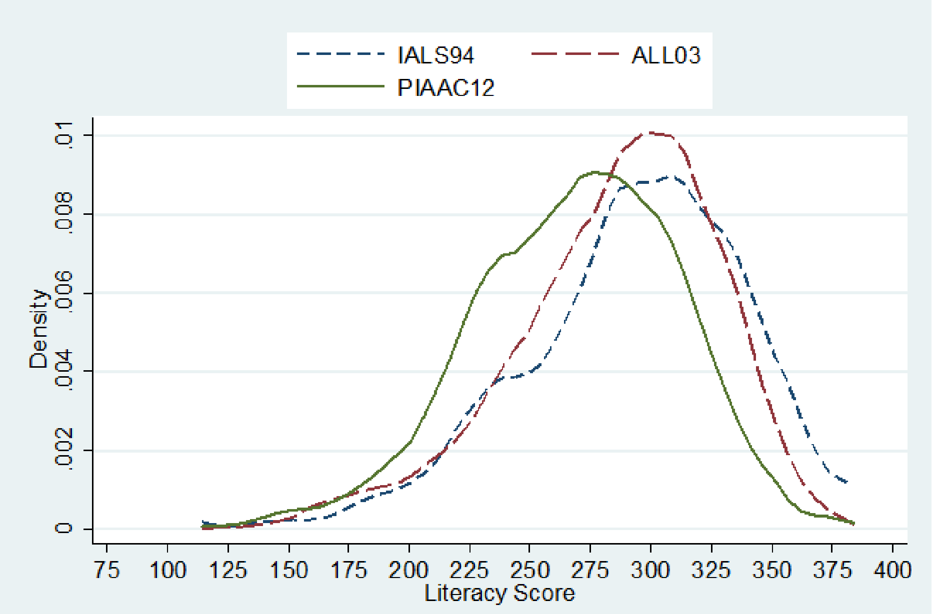
Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Figure A.7. Literacy in Canada, 26-35 in 1994



Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Figure A.8. Literacy in Canada, 36-45 in 1994



Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.1. Summary statistics, Canada

	PIAAC	ALL	IALS
Literacy	270.593	274.489	268.362
Female	0.5411	0.553	0.565
Years of schooling	13.694	12.731	11.720
Years of schooling squared	252.981	174.798	149.155
Education - level of attainment			
Less than high school	0.1593	0.2586	0.3944
High school	0.2158	0.2991	0.2840
Above high school	-	0.4423	-
Some post secondary	0.4061	-	0.1848
University degree	0.2188	-	0.1247
Age of respondent			
Age: 25-34	0.1979	0.2101	0.3142
Age: 35-44	0.2247	0.2911	0.3125
Age: 45-54	0.2908	0.2907	0.2019
Age: 55-64	0.2866	0.2081	0.1714
Mother's education			
ISCED1,2,3(short)	0.4476	0.5543	0.6033
ISCED 3(long), 4	0.3165	0.2325	0.2223

Table A.1. Summary statistics, Canada (*continued*)

	PIAAC	ALL	IALS
ISCED5,6	0.1818	0.1303	0.0245
None reported	0.0541	0.0829	0.1599
Father's education			
ISCED1,2,3(short)	0.4815	0.5854	0.6298
ISCED 3(long), 4	0.2884	0.1965	0.1506
ISCED5,6	0.1568	0.1119	0.0443
None reported	0.0733	0.1062	0.1754
Parental immigration			
Immigrant mother	0.0684	0.0681	0.0741
Immigrant father	0.0799	0.0861	0.0848
Cohort age in PIAAC			
Cohort 0 25-34	0.1979	-	-
Cohort 1 35-44	0.2247	0.2101	-
Cohort 2 45-54	0.2908	0.2911	0.3142
Cohort 3 55-64	0.2866	0.2907	0.3125
Cohort 4 55-64 in ALL	-	0.2081	0.2019
Cohort 5 55-64 in IALS	-	-	0.1714
Observations	17 898	13 464	2 982

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.2a. Regression results, Canada, PIAAC Survey

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.0090***	-0.0070**	-0.0071**	-0.0101***	-0.0079**	-0.0080**
	[0.003]	[0.003]	[0.003]	[0.004]	[0.003]	[0.003]
Years of schooling	0.0472***	0.0414***	0.0413***			
	[0.001]	[0.001]	[0.001]			
Years of schooling squared	-0.0005***	-0.0004***	-0.0004***			
	[0.000]	[0.000]	[0.000]			
Own education						
Less than high school				-0.1715***	-0.1511***	-0.1510***
				[0.008]	[0.008]	[0.008]
Some post secondary				0.0354***	0.0315***	0.0311***
				[0.005]	[0.005]	[0.005]
University degree				0.1436***	0.1236***	0.1234***
				[0.005]	[0.005]	[0.005]
Age of respondent (10-year bands)						
Age: 35-44	-0.0129***	-0.0033		-0.0127**	-0.0029	
	[0.005]	[0.005]		[0.005]	[0.005]	
Age: 45-54	-0.0422***	-0.0250***		-0.0402***	-0.0228***	
	[0.005]	[0.005]		[0.005]	[0.005]	
Age: 55-64	-0.0569***	-0.0333***		-0.0582***	-0.0338***	
	[0.005]	[0.005]		[0.005]	[0.005]	
Age of respondent (5-year bands)						
Age: 35-39			-0.0001			0.0014
			[0.006]			[0.006]
Age: 40-44			-0.0066			-0.0071
			[0.006]			[0.006]
Age: 45-49			-0.0202***			-0.0182***
			[0.007]			[0.007]
Age: 50-54			-0.0296***			-0.0272***
			[0.006]			[0.006]
Age: 55-59			-0.0301***			-0.0305***
			[0.006]			[0.006]
Age: 60-64			-0.0374***			-0.0379***
			[0.006]			[0.006]
Mother's education						
ISCED1,2,3 (short)		-0.0322***	-0.0318***		-0.0328***	-0.0324***
		[0.004]	[0.004]		[0.004]	[0.004]
ISCED5,6		0.0074	0.0075		0.0081*	0.0082*
		[0.005]	[0.005]		[0.005]	[0.005]
None reported		-0.0649***	-0.0643***		-0.0655***	-0.0650***
		[0.011]	[0.011]		[0.011]	[0.011]
Father's education						
ISCED1,2,3 (short)		-0.0097**	-0.0094**		-0.0096**	-0.0093**
		[0.004]	[0.004]		[0.004]	[0.004]
ISCED5,6		0.0135***	0.0133***		0.0155***	0.0153***

Table A.2a. Regression results, Canada, PIAAC Survey (*continued*)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		[0.005]	[0.005]		[0.005]	[0.005]
None reported		-0.0656***	-0.0657***		-0.0637***	-0.0639***
		[0.009]	[0.009]		[0.009]	[0.009]
Parental immigration						
Immigrant mother		0.0096	0.0098		0.0095	0.0098
		[0.007]	[0.007]		[0.007]	[0.007]
Immigrant father		0.0053	0.0053		0.0075	0.0074
		[0.006]	[0.006]		[0.006]	[0.006]
Constant	5.1093***	5.1792***	5.1797***	5.6245***	5.6295***	5.6296***
	[0.013]	[0.014]	[0.014]	[0.005]	[0.006]	[0.006]
Observations	17 898	17 898	17 898	17 898	17 898	17 898
R-squared	0.333	0.361	0.362	0.323	0.352	0.352

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Source: OECD (2016).

Table A.2b. Regression results, United States, PIAAC Survey

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.0107**	-0.0054	-0.0054	-0.0112**	-0.0054	-0.0054
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
Years of schooling	0.0501***	0.0412***	0.0411***			
	[0.001]	[0.002]	[0.002]			
Years of schooling squared	-0.0004***	-0.0004***	-0.0004***			
	[0.000]	[0.000]	[0.000]			
Own education						
Less than high school				-0.1604***	-0.1263***	-0.1263***
				[0.012]	[0.012]	[0.012]
Some post secondary				0.0578***	0.0476***	0.0477***
				[0.008]	[0.007]	[0.007]
University degree				0.1633***	0.1299***	0.1295***
				[0.006]	[0.006]	[0.006]
Age of respondent (10-year bands)						
Age: 35-44	-0.0077	-0.0067		-0.0107	-0.0081	
	[0.007]	[0.007]		[0.007]	[0.007]	
Age: 45-54	-0.0233***	-0.0154**		-0.0261***	-0.0156**	
	[0.008]	[0.007]		[0.008]	[0.008]	
Age: 55-64	-0.0473***	-0.0290***		-0.0462***	-0.0246***	
	[0.008]	[0.007]		[0.008]	[0.008]	
Age of respondent (5-year bands)			-0.0044			-0.0056
Age: 35-39			[0.009]			[0.009]
			-0.0088			-0.0105
Age: 40-44			[0.009]			[0.009]
			-0.0167*			-0.0170*

Table A.2b. Regression results, United States, PIAAC Survey (*continued*)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Age: 45-49			[0.009]			[0.009]
			-0.0139			-0.0139
Age: 50-54			[0.009]			[0.009]
			-0.0360***			-0.0328***
Age: 55-59			[0.009]			[0.010]
			-0.0223**			-0.0168*
Age: 60-64			[0.009]			[0.009]
Mother's education						
ISCED1,2,3(short)		-0.0381***	-0.0386***		-0.0398***	-0.0404***
		[0.008]	[0.008]		[0.008]	[0.008]
ISCED5,6		0.0085	0.0085		0.0146**	0.0146**
		[0.007]	[0.007]		[0.007]	[0.007]
None reported		-0.0561**	-0.0567**		-0.0652**	-0.0658**
		[0.029]	[0.028]		[0.031]	[0.031]
Father's education						
ISCED1,2,3(short)		-0.0361***	-0.0365***		-0.0401***	-0.0405***
		[0.008]	[0.008]		[0.008]	[0.008]
ISCED5,6		0.0227***	0.0228***		0.0237***	0.0239***
		[0.007]	[0.007]		[0.007]	[0.007]
None reported		-0.0850***	-0.0854***		-0.0900***	-0.0904***
		[0.016]	[0.016]		[0.017]	[0.017]
Parental immigration						
Immigrant mother		-0.0095	-0.0094		-0.0018	-0.0017
		[0.014]	[0.014]		[0.015]	[0.015]
Immigrant father		-0.0079	-0.0075		-0.0056	-0.0052
		[0.012]	[0.012]		[0.013]	[0.013]
Constant	5.0218***	5.1352***	5.1362***	5.5811***	5.5934***	5.5936***
	[0.018]	[0.020]	[0.020]	[0.008]	[0.008]	[0.008]
Observations	3 513	3 513	3 513	3 513	3 513	3 513
R-squared	0.329	0.371	0.372	0.295	0.345	0.346

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Source: OECD (2016).

Table A.2c. Regression results, Norway, PIAAC Survey

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.0188***	-0.0178***	-0.0177***	-0.0235***	-0.0221***	-0.0220***
	[0.005]	[0.004]	[0.004]	[0.005]	[0.004]	[0.004]
Years of schooling	0.0350***	0.0311***	0.0309***			
	[0.001]	[0.002]	[0.002]			
Years of schooling squared	-0.0003***	-0.0003***	-0.0003***			
	[0.000]	[0.000]	[0.000]			
Own education						
Less than high school				-0.0441***	-0.0395***	-0.0390***
				[0.008]	[0.008]	[0.008]
Some post secondary				0.0375***	0.0321***	0.0323***
				[0.007]	[0.007]	[0.007]
University degree				0.1189***	0.1062***	0.1060***
				[0.005]	[0.005]	[0.005]
Age of respondent (10-year bands)						
Age: 35-44	-0.0178***	-0.0084		-0.0172***	-0.0080	
	[0.006]	[0.006]		[0.006]	[0.006]	
Age: 45-54	-0.0529***	-0.0379***		-0.0515***	-0.0368***	
	[0.006]	[0.006]		[0.006]	[0.006]	
Age: 55-64	-0.1116***	-0.0930***		-0.1136***	-0.0950***	
	[0.007]	[0.007]		[0.007]	[0.007]	
Age of respondent (5-year bands)						
Age: 35-39			-0.0058			-0.0076
			[0.007]			[0.007]
Age: 40-44			-0.0115			-0.0091
			[0.007]			[0.007]
Age: 45-49			-0.0262***			-0.0258***
			[0.007]			[0.007]
Age: 50-54			-0.0517***			-0.0497***
			[0.008]			[0.008]
Age: 55-59			-0.0817***			-0.0824***
			[0.009]			[0.009]
Age: 60-64			-0.1040***			-0.1071***
			[0.009]			[0.009]
Mother's education						
ISCED1,2,3(short)		-0.0163***	-0.0144***		-0.0173***	-0.0155***
		[0.006]	[0.006]		[0.005]	[0.006]
ISCED5,6		0.0145**	0.0151**		0.0117*	0.0123**
		[0.006]	[0.006]		[0.006]	[0.006]
None reported		-0.1198***	-0.1179***		-0.1336***	-0.1319***
		[0.038]	[0.038]		[0.039]	[0.039]
Father's education						
ISCED1,2,3(short)		-0.0167***	-0.0164***		-0.0161***	-0.0157***
		[0.006]	[0.006]		[0.006]	[0.006]
ISCED5,6		0.0144***	0.0139**		0.0143***	0.0139**
		[0.005]	[0.005]		[0.005]	[0.005]

Table A.2c. Regression results, Norway, PIAAC Survey (*continued*)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
None reported		-0.0249	-0.0240		-0.0260	-0.0254
		[0.035]	[0.034]		[0.035]	[0.035]
Parental immigration						
Immigrant mother		-0.0066	-0.0065		-0.0082	-0.0080
		[0.014]	[0.014]		[0.015]	[0.015]
Immigrant father		-0.0359*	-0.0363*		-0.0380*	-0.0383*
		[0.019]	[0.019]		[0.020]	[0.020]
Constant	5.2559***	5.3051***	5.3065***	5.6618***	5.6672***	5.6666***
	[0.020]	[0.021]	[0.021]	[0.006]	[0.007]	[0.007]
Observations	3 431	3 431	3 431	3 431	3 431	3 431
R-squared	0.311	0.330	0.334	0.312	0.332	0.335

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD (2016).

Table A.2d. Regression results, the Netherlands, PIAAC Survey

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.0170***	-0.0181***	-0.0181***	-0.0162***	-0.0172***	-0.0172***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Years of schooling	0.0400***	0.0364***	0.0363***			
	[0.001]	[0.002]	[0.002]			
Years of schooling squared	-0.0004***	-0.0003***	-0.0003***			
	[0.000]	[0.000]	[0.000]			
Own education						
Less than high school				-0.1033***	-0.0972***	-0.0954***
				[0.007]	[0.007]	[0.007]
Some post secondary				0.0390***	0.0331***	0.0341***
				[0.009]	[0.009]	[0.009]
University degree				0.0985***	0.0881***	0.0892***
				[0.004]	[0.004]	[0.004]
Age of respondent (10-year bands)						
Age: 35-44	-0.0021	0.0008		-0.0030	-0.0006	
	[0.006]	[0.006]		[0.006]	[0.006]	
Age: 45-54	-0.0450***	-0.0396***		-0.0450***	-0.0406***	
	[0.006]	[0.006]		[0.006]	[0.006]	
Age: 55-64	-0.0997***	-0.0929***		-0.0998***	-0.0937***	
	[0.007]	[0.007]		[0.007]	[0.007]	
Age of respondent (5-year bands)						
Age: 35-39			0.0006			-0.0013
			[0.007]			[0.007]
Age: 40-44			0.0005			-0.0006
			[0.007]			[0.007]

Table A.2d. Regression results, the Netherlands, PIAAC Survey (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Age: 45-49			-0.0244***			-0.0242***
			[0.007]			[0.007]
Age: 50-54			-0.0566***			-0.0590***
			[0.008]			[0.008]
Age: 55-59			-0.0790***			-0.0813***
			[0.008]			[0.008]
Age: 60-64			-0.1048***			-0.1049***
			[0.008]			[0.008]
Mother's education						
ISCED1,2,3(short)		-0.0182***	-0.0172***		-0.0156***	-0.0146**
		[0.006]	[0.006]		[0.006]	[0.006]
ISCED5,6		0.0076	0.0083		0.0081	0.0085
		[0.008]	[0.008]		[0.008]	[0.008]
None reported		-0.0775**	-0.0779**		-0.0922**	-0.0922**
		[0.039]	[0.039]		[0.037]	[0.037]
Father's education						
ISCED1,2,3(short)		-0.0196***	-0.0192***		-0.0184***	-0.0180***
		[0.006]	[0.006]		[0.006]	[0.006]
ISCED5,6		0.0080	0.0080		0.0062	0.0060
		[0.006]	[0.006]		[0.006]	[0.006]
None reported		-0.0764***	-0.0759***		-0.0860***	-0.0858***
		[0.027]	[0.028]		[0.026]	[0.026]
Parental immigration						
Immigrant mother		-0.0209*	-0.0226*		-0.0189	-0.0206*
		[0.012]	[0.012]		[0.012]	[0.012]
Immigrant father		-0.0385***	-0.0375***		-0.0407***	-0.0397***
		[0.013]	[0.013]		[0.013]	[0.013]
Constant	5.2270***	5.2928***	5.2935***	5.6936***	5.7182***	5.7168***
	[0.019]	[0.021]	[0.021]	[0.006]	[0.007]	[0.007]
Observations	3 786	3 786	3 786	3 786	3 786	3 786
R-squared	0.369	0.389	0.393	0.366	0.386	0.391

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Source: OECD (2016).

Table A.2e. Regression results, Italy, PIAAC Survey

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.0055	0.0072	0.0071	-0.0011	0.0009	0.0006
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Years of schooling	0.0566***	0.0580***	0.0579***			
	[0.004]	[0.004]	[0.004]			
Years of schooling squared	-0.0015***	-0.0017***	-0.0017***			
	[0.000]	[0.000]	[0.000]			
Own education						
Less than high school				-0.1255***	-0.1171***	-0.1171***
				[0.006]	[0.006]	[0.006]
Some post secondary				0.0361*	0.0360*	0.0364*
				[0.022]	[0.020]	[0.020]
University degree				0.0597***	0.0458***	0.0455***
				[0.007]	[0.008]	[0.008]
Age of respondent (10-year bands)						
Age: 35-44	0.0028	0.0067		0.0017	0.0057	
	[0.008]	[0.008]		[0.008]	[0.008]	
Age: 45-54	0.0026	0.0094		-0.0020	0.0051	
	[0.008]	[0.008]		[0.008]	[0.009]	
Age: 55-64	-0.0260***	-0.0188**		-0.0587***	-0.0510***	
	[0.009]	[0.009]		[0.009]	[0.009]	
Age of respondent (5-year bands)						
Age: 35-39			0.0019			0.0003
			[0.009]			[0.009]
Age: 40-44			0.0114			0.0107
			[0.009]			[0.009]
Age: 45-49			0.0071			0.0022
			[0.010]			[0.010]
Age: 50-54			0.0124			0.0085
			[0.010]			[0.011]
Age: 55-59			-0.0168			-0.0365***
			[0.012]			[0.013]
Age: 60-64			-0.0199*			-0.0604***
			[0.011]			[0.011]
Mother's education						
ISCED1,2,3(short)		-0.0203**	-0.0202**		-0.0185**	-0.0185**
		[0.009]	[0.009]		[0.009]	[0.009]
ISCED5,6		0.0264*	0.0265*		0.0201	0.0203
		[0.015]	[0.015]		[0.016]	[0.016]
None reported		-0.0647	-0.0660		-0.0671	-0.0665
		[0.065]	[0.065]		[0.060]	[0.060]
Father's education						
ISCED1,2,3(short)		-0.0261***	-0.0265***		-0.0314***	-0.0317***
		[0.008]	[0.008]		[0.008]	[0.008]
ISCED5,6		-0.0162	-0.0161		-0.0181	-0.0179
		[0.014]	[0.014]		[0.014]	[0.014]

Table A.2e. Regression results, Italy, PIAAC Survey (*continued*)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
None reported		-0.0866	-0.0842		-0.0995*	-0.0977
		[0.056]	[0.057]		[0.060]	[0.060]
Parental immigration						
Immigrant mother		0.0392**	0.0394**		0.0460**	0.0456**
		[0.020]	[0.020]		[0.020]	[0.020]
Immigrant father		-0.0736**	-0.0748***		-0.0712**	-0.0744**
		[0.029]	[0.029]		[0.030]	[0.030]
Constant	5.1094***	5.1455***	5.1460***	5.5832***	5.6171***	5.6175***
	[0.026]	[0.028]	[0.029]	[0.007]	[0.010]	[0.010]
Observations	3 678	3 678	3 678	3 678	3 678	3 678
R-squared	0.294	0.304	0.304	0.242	0.253	0.254

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Source: OECD (2016).

Table A.2f. Regression results, Australia, PIAAC Survey

Variables	(1)	(2)	(3)
Female	-0.0090*	-0.0065	-0.0066
	[0.005]	[0.005]	[0.005]
Own education			
Less than high school	-0.2375***	-0.2121***	-0.2115***
	[0.029]	[0.028]	[0.028]
Some post secondary	0.0429***	0.0350***	0.0346***
	[0.006]	[0.006]	[0.006]
University degree	0.1619***	0.1337***	0.1343***
	[0.006]	[0.006]	[0.006]
Age of respondent (10-year bands)			
Age: 35-44	-0.0065	-0.0027	
	[0.007]	[0.006]	
Age: 45-54	-0.0347***	-0.0245***	
	[0.007]	[0.007]	
Age: 55-64	-0.0586***	-0.0446***	
	[0.008]	[0.009]	
Age of respondent (5-year bands)			
Age: 35-39			0.0034
			[0.008]
Age: 40-44			-0.0096
			[0.008]
Age: 45-49			-0.0131
			[0.009]
Age: 50-54			-0.0371***
			[0.009]

Table A.2f. Regression results, Australia, PIAAC Survey (*continued*)

Variables	(1)	(2)	(3)
Age: 55-59			-0.0467***
			[0.011]
Age: 60-64			-0.0431***
			[0.010]
Mother's education			
Less than high school		-0.0373***	-0.0365***
		[0.008]	[0.008]
Some post secondary		0.0030	0.0022
		[0.008]	[0.008]
University degree		0.0156*	0.0149*
		[0.009]	[0.009]
None reported		-0.0760***	-0.0755***
		[0.013]	[0.013]
Father's education			
Less than high school		-0.0055	-0.0053
		[0.008]	[0.008]
Some post secondary		0.0117*	0.0124*
		[0.007]	[0.007]
University degree		0.0257***	0.0245***
		[0.008]	[0.008]
None reported		-0.0569***	-0.0567***
		[0.012]	[0.012]
Parental immigration			
Immigrant mother		-0.0307***	-0.0309***
		[0.009]	[0.009]
Immigrant father		0.0145*	0.0139*
		[0.008]	[0.008]
Constant	5.6192***	5.6402***	5.6405***
	[0.007]	[0.007]	[0.007]
Observations	4 426	4 426	4 426
R-squared	0.2507	0.3064	0.3082

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Source: OECD (2016).

Table A.3a. Regression results, Canada, IALS, ALL and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	0.0034	0.0034	0.0049*	0.0050*
	[0.003]	[0.003]	[0.003]	[0.003]
Years of schooling	0.0443***	0.0445***	0.0402***	0.0399***
	[0.001]	[0.001]	[0.001]	[0.001]
Years of schooling squared	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0122***	-0.0240***	-0.0046	-0.0259***
	[0.004]	[0.005]	[0.004]	[0.005]
Age: 45-54	-0.0369***	-0.0632***	-0.0244***	-0.0682***
	[0.004]	[0.007]	[0.004]	[0.007]
Age: 55-64	-0.0584***	-0.1014***	-0.0428***	-0.1099***
	[0.004]	[0.009]	[0.004]	[0.010]
Mother's education				
ISCED1,2,3(short)			-0.0291***	-0.0322***
			[0.003]	[0.003]
ISCED5,6			0.0004	0.0031
			[0.004]	[0.004]
None reported			-0.0474***	-0.0538***
			[0.008]	[0.008]
Father's education				
ISCED1,2,3(short)			-0.0125***	-0.0163***
			[0.003]	[0.003]
ISCED5,6			0.0052	0.0059
			[0.004]	[0.004]
None reported			-0.0448***	-0.0506***
			[0.007]	[0.007]
Parental immigration				
Immigrant mother			0.0088	0.0091*
			[0.005]	[0.005]
Immigrant father			0.0067	0.0073
			[0.005]	[0.005]
Cohort				
Cohort 1		0.0093*		0.0202***
		[0.006]		[0.006]
Cohort 2		0.0200***		0.0418***
		[0.007]		[0.007]
Cohort 3		0.0455***		0.0769***
		[0.008]		[0.009]
Cohort 4		0.0556***		0.0934***
		[0.013]		[0.014]

Table A.3a. Regression results, Canada, IALS, ALL and PIAAC pooled (*continued*)

Variables	(1)	(2)	(3)	(4)
Cohort 5		0.0522		0.0892**
		[0.038]		[0.039]
Constant	5.1451***	5.1360***	5.2072***	5.1958***
	[0.016]	[0.015]	[0.018]	[0.017]
Observations	34 308	34 308	34 308	34 308
R-squared	0.337	0.339	0.354	0.358

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.3b. Regression results, United States, IALS, ALL and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	0.0064*	0.0059	0.0062	0.0057
	[0.004]	[0.004]	[0.004]	[0.004]
Years of schooling	0.0479***	0.0481***	0.0479***	0.0482***
	[0.001]	[0.001]	[0.001]	[0.001]
Years of schooling squared	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0088*	-0.0268***	-0.0097*	-0.0264***
	[0.005]	[0.006]	[0.005]	[0.006]
Age: 45-54	-0.0254***	-0.0595***	-0.0270***	-0.0594***
	[0.005]	[0.007]	[0.005]	[0.007]
Age: 55-64	-0.0530***	-0.1066***	-0.0543***	-0.1067***
	[0.005]	[0.009]	[0.005]	[0.009]
Parental immigration				
Immigrant mother			-0.0166*	-0.0170*
			[0.009]	[0.009]
Immigrant father			-0.0293***	-0.0293***
			[0.009]	[0.009]
Cohort				
Cohort 1		0.0171**		0.0155**
		[0.007]		[0.007]
Cohort 2		0.0338***		0.0308***
		[0.008]		[0.008]
Cohort 3		0.0514***		0.0479***
		[0.010]		[0.010]
Cohort 4		0.0710***		0.0688***
		[0.011]		[0.011]
Cohort 5		0.0974***		0.0972***
		[0.014]		[0.014]
Constant	5.0545***	5.0373***	5.0572***	5.0411***
	[0.014]	[0.015]	[0.014]	[0.015]
Observations	7 758	7 758	7 758	7 758
R-squared	0.330	0.337	0.333	0.339

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.3c. Regression results, Norway, IALS, ALL and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	-0.0073**	-0.0073***	-0.0074**	-0.0074***
	[0.003]	[0.003]	[0.003]	[0.003]
Years of schooling	0.0244***	0.0282***	0.0246***	0.0282***
	[0.001]	[0.001]	[0.001]	[0.001]
Years of schooling squared	-0.0002***	-0.0002***	-0.0002***	-0.0002***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0115***	-0.0542***	-0.0119***	-0.0540***
	[0.004]	[0.005]	[0.004]	[0.005]
Age: 45-54	-0.0520***	-0.1333***	-0.0525***	-0.1329***
	[0.004]	[0.006]	[0.004]	[0.006]
Age: 55-64	-0.1130***	-0.2314***	-0.1134***	-0.2308***
	[0.004]	[0.008]	[0.004]	[0.008]
Parental immigration				
Immigrant mother			-0.0173	-0.0090
			[0.011]	[0.011]
Immigrant father			-0.0239*	-0.0162
			[0.014]	[0.014]
Cohort				
Cohort 1		0.0402***		0.0394***
		[0.006]		[0.006]
Cohort 2		0.0911***		0.0900***
		[0.007]		[0.007]
Cohort 3		0.1274***		0.1261***
		[0.008]		[0.008]
Cohort 4		0.1775***		0.1760***
		[0.010]		[0.010]
Cohort 5		0.1624***		0.1606***
		[0.016]		[0.016]
		[0.012]		[0.012]
Constant	5.4279***	5.3444***	5.4277***	5.3453***
	[0.009]	[0.011]	[0.009]	[0.011]
Observations	9 963	9 963	9 963	9 963
R-squared	0.278	0.306	0.279	0.306

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.3d. Regression results, the Netherlands, IALS, ALL and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	-0.0068**	-0.0070**	-0.0067**	-0.0070**
	[0.003]	[0.003]	[0.003]	[0.003]
Years of schooling	0.0253***	0.0252***	0.0254***	0.0253***
	[0.001]	[0.001]	[0.001]	[0.001]
Years of schooling squared	-0.0002***	-0.0002***	-0.0003***	-0.0002***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0110***	-0.0109**	-0.0124***	-0.0112***
	[0.004]	[0.004]	[0.004]	[0.004]
Age: 45-54	-0.0485***	-0.0454***	-0.0497***	-0.0452***
	[0.004]	[0.006]	[0.004]	[0.006]
Age: 55-64	-0.0960***	-0.0854***	-0.0977***	-0.0856***
	[0.004]	[0.008]	[0.004]	[0.008]
Parental immigration				
Immigrant mother			-0.0162**	-0.0171**
			[0.008]	[0.008]
Immigrant father			-0.0295***	-0.0293***
			[0.010]	[0.010]
Cohort				
Cohort 1		-0.0193**		-0.0205***
		[0.008]		[0.008]
Cohort 2		-0.0137		-0.0165**
		[0.009]		[0.008]
Cohort 3		-0.0188**		-0.0217**
		[0.009]		[0.009]
Cohort 4		-0.0280**		-0.0311***
		[0.011]		[0.011]
Cohort 5		-0.0282**		-0.0309**
		[0.013]		[0.013]
Constant	5.3927***	5.4092***	5.3947***	5.4128***
	[0.011]	[0.012]	[0.011]	[0.012]
Observations	9 980	9 980	9 980	9 980
R-squared	0.305	0.306	0.308	0.309

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.3e. Regression results, Italy, IALS and PIAAC only pooled

Variables	(1)	(2)	(3)	(4)
Female	0.0030	0.0030	0.0030	0.0029
	[0.006]	[0.006]	[0.006]	[0.006]
Years of schooling	0.0894***	0.0865***	0.0894***	0.0865***
	[0.005]	[0.005]	[0.005]	[0.005]
Years of schooling squared	-0.0027***	-0.0026***	-0.0027***	-0.0026***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0075	-0.0016	-0.0076	-0.0018
	[0.008]	[0.008]	[0.008]	[0.008]
Age: 45-54	-0.0083	0.0174*	-0.0082	0.0173*
	[0.008]	[0.010]	[0.008]	[0.010]
Age: 55-64	-0.0098	0.0358***	-0.0100	0.0354**
	[0.010]	[0.014]	[0.010]	[0.014]
Parental immigration				
Immigrant mother			0.0370	0.0341
			[0.023]	[0.023]
Immigrant father			-0.0223	-0.0234
			[0.024]	[0.024]
Cohort				
Cohort 2		-0.0162*		-0.0160*
		[0.009]		[0.009]
Cohort 3		-0.0415***		-0.0411***
		[0.011]		[0.011]
Cohort 4		-0.0687***		-0.0685***
		[0.013]		[0.013]
Constant	4.9015***	4.9260***	4.9017***	4.9262***
	[0.032]	[0.031]	[0.032]	[0.031]
Observations	5 376	5 376	5 376	5 376
R-squared	0.354	0.359	0.354	0.360

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.3f. Regression results, Australia, ALL and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	0.0139***	0.0139***	0.0146***	0.0149***
	[0.004]	[0.004]	[0.004]	[0.004]
Own education				
Less than high school	-0.2293***	-0.2309***	-0.2100***	-0.2112***
	[0.016]	[0.016]	[0.016]	[0.016]
Some post secondary	0.0445***	0.0443***	0.0382***	0.0379***
	[0.0054]	[0.0054]	[0.004]	[0.004]
University degree	0.1632***	0.1631***	0.1374	0.1367
	[0.004]	[0.004]	[0.004]	[0.004]
Age of respondent (5-year bands)				
Age: 35-39	0.0091*	0.0103	0.0149***	0.0080
	[0.005]	[0.008]	[0.005]	[0.008]
Age: 40-44	0.0026	-0.0023	0.0121**	-0.0041
	[0.006]	[0.012]	[0.006]	[0.010]
Age: 45-49	-0.0098	-0.0280*	0.0030	-0.0230*
	[0.007]	[0.012]	[0.007]	[0.012]
Age: 50-54	-0.0243***	-0.0637***	-0.0090	-0.0477***
	[0.007]	[0.019]	[0.007]	[0.015]
Age: 55-59	-0.0347***	-0.0959***	-0.0174**	-0.0717***
	[0.007]	[0.023]	[0.007]	[0.012]
Age: 60-64	-0.0604***	-0.1264***	-0.0370***	-0.0980***
	[0.007]	[0.026]	[0.008]	[0.020]
Mother's education				
Less than high school			-0.0458***	-0.0474***
			[0.005]	[0.005]
Some post secondary			0.0059	0.0079
			[0.007]	[0.007]
University degree			0.0162**	0.0163**
			[0.007]	[0.007]
None reported			-0.0768***	-0.0759***
			[0.013]	[0.012]
Father's education				
Less than high school			-0.0169***	-0.0187***
			[0.005]	[0.005]
Some post secondary			0.0105*	0.0127*
			[0.006]	[0.006]
University degree			0.0162***	0.0159***
			[0.006]	[0.006]
None reported			-0.0628***	-0.0616***
			[0.012]	[0.012]

Table A.3f. Regression results, Australia, ALL and PIAAC pooled (*continued*)

Variables	(1)	(2)	(3)	(4)
Parental immigration				
Immigrant mother			-0.0205***	-0.0207***
			[0.006]	[0.006]
Immigrant father			0.0088	0.0092
			[0.005]	[0.006]
Cohort (5 year bands)				
Cohort 1		-0.0013		0.0078
		[0.009]		[0.007]
Cohort 2		0.0110		0.0097
		[0.013]		[0.009]
Cohort 3		0.0271**		0.0263**
		[0.013]		[0.012]
Cohort 4		0.0246		0.0321**
		[0.018]		[0.014]
Cohort 5		0.0541***		0.0500***
		[0.021]		[0.016]
Cohort 6		0.0678***		0.0665***
		[0.024]		[0.019]
Cohort 7		0.0648***		0.0639***
		[0.028]		[0.023]
Constant	5.6000***	5.5999***	5.6239***	5.6228***
	[0.005]	[0.005]	[0.006]	[0.006]
Observations	9 366	9 366	9 366	9 366
R-squared	0.248	0.249	0.289	0.292

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.4a. Regression results, Denmark, IALS and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	-0.0000	0.0001	-0.0001	0.0000
	[0.004]	[0.004]	[0.004]	[0.004]
Years of schooling	0.0506***	0.0629***	0.0507***	0.0628***
	[0.006]	[0.006]	[0.006]	[0.006]
Years of schooling squared	-0.0009***	-0.0014***	-0.0009***	-0.0014***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0320***	-0.0344***	-0.0312***	-0.0339***
	[0.005]	[0.005]	[0.005]	[0.005]
Age: 45-54	-0.0671***	-0.0955***	-0.0662***	-0.0945***
	[0.006]	[0.007]	[0.006]	[0.007]
Age: 55-64	-0.1225***	-0.1807***	-0.1218***	-0.1795***
	[0.005]	[0.008]	[0.005]	[0.008]
Parental immigration				
Immigrant mother			-0.0247*	-0.0144
			[0.014]	[0.014]
Immigrant father			-0.0244	-0.0148
			[0.024]	[0.023]
Cohort				
Cohort 2		0.0198***		0.0194***
		[0.006]		[0.006]
Cohort 3		0.0559***		0.0550***
		[0.007]		[0.007]
Cohort 4		0.1134***		0.1121***
		[0.010]		[0.010]
Constant	5.1847***	5.0967***	5.1840***	5.0972***
	[0.041]	[0.043]	[0.041]	[0.043]
Observations	6 312	6 312	6 312	6 312
R-squared	0.329	0.348	0.330	0.348

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.4b. Regression results, Finland, IALS and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	0.0015	0.0018	0.0017	0.0021
	[0.004]	[0.004]	[0.004]	[0.004]
Years of schooling	0.0429***	0.0416***	0.0426***	0.0411***
	[0.005]	[0.005]	[0.004]	[0.005]
Years of schooling squared	-0.0007***	-0.0007***	-0.0007***	-0.0007***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0118**	-0.0102*	-0.0111**	-0.0093*
	[0.006]	[0.006]	[0.006]	[0.006]
Age: 45-54	-0.0451***	-0.0304***	-0.0443***	-0.0287***
	[0.006]	[0.007]	[0.006]	[0.007]
Age: 55-64	-0.1050***	-0.0832***	-0.1035***	-0.0801***
	[0.006]	[0.009]	[0.006]	[0.009]
Parental Immigration				
Immigrant mother			-0.0653	-0.0675
			[0.045]	[0.045]
Immigrant father			-0.0924*	-0.0961*
			[0.052]	[0.052]
Cohort				
Cohort 2		-0.0175***		-0.0183***
		[0.006]		[0.006]
Cohort 3		-0.0290***		-0.0307***
		[0.008]		[0.008]
Cohort 4		-0.0289**		-0.0321***
		[0.011]		[0.011]
Constant	5.2727***	5.2883***	5.2746***	5.2920***
	[0.032]	[0.033]	[0.031]	[0.032]
Observations	5 304	5 304	5 304	5 304
R-squared	0.343	0.344	0.346	0.348

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.4c. Regression results, Ireland, IALS and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	-0.0109*	-0.0117**	-0.0107*	-0.0116**
	[0.006]	[0.006]	[0.006]	[0.006]
Years of schooling	0.0368***	0.0423***	0.0369***	0.0424***
	[0.001]	[0.001]	[0.001]	[0.001]
Years of schooling squared	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0755***	-0.0836***	-0.0752***	-0.0837***
	[0.010]	[0.010]	[0.010]	[0.010]
Age: 45-54	-0.1056***	-0.1785***	-0.1053***	-0.1785***
	[0.011]	[0.014]	[0.011]	[0.014]
Age: 55-64	-0.1209***	-0.2371***	-0.1202***	-0.2370***
	[0.011]	[0.018]	[0.011]	[0.018]
Parental immigration				
Immigrant mother			-0.0321	-0.0236
			[0.021]	[0.021]
Immigrant father			0.0090	0.0227
			[0.023]	[0.023]
Cohort				
Cohort 2		0.0772***		0.0773***
		[0.010]		[0.010]
Cohort 3		0.1366***		0.1367***
		[0.015]		[0.015]
Cohort 4		0.1719***		0.1720***
		[0.021]		[0.022]
Constant	5.2395***	5.1560***	5.2386***	5.1551***
	[0.016]	[0.019]	[0.016]	[0.019]
Observations	4 569	4 569	4 569	4 569
R-squared	0.274	0.297	0.274	0.297

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.4d. Regression results, Sweden, IALS and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	-0.0109**	-0.0117***	-0.0110**	-0.0118***
	[0.004]	[0.004]	[0.004]	[0.004]
Years of schooling	0.0010	0.0150***	0.0020	0.0152***
	[0.004]	[0.005]	[0.004]	[0.005]
Years of schooling squared	0.0008***	0.0003	0.0008***	0.0003
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0613***	-0.0541***	-0.0585***	-0.0525***
	[0.006]	[0.008]	[0.006]	[0.008]
Age: 45-54	-0.0948***	-0.1237***	-0.0922***	-0.1211***
	[0.006]	[0.007]	[0.006]	[0.007]
Age: 55-64	-0.1607***	-0.1851***	-0.1584***	-0.1818***
	[0.007]	[0.010]	[0.007]	[0.010]
Parental immigration				
Immigrant mother			-0.0290**	-0.0200*
			[0.012]	[0.012]
Immigrant father			-0.0231*	-0.0126
			[0.012]	[0.012]
Cohort				
Cohort 2		0.0270***		0.0257***
		[0.008]		[0.008]
Cohort 3		0.0408***		0.0380***
		[0.008]		[0.008]
Cohort 4		0.1188***		0.1151***
		[0.010]		[0.010]
Constant	5.6312***	5.5207***	5.6251***	5.5205***
	[0.029]	[0.031]	[0.029]	[0.031]
Observations	3 737	3 737	3 737	3 737
R-squared	0.297	0.327	0.301	0.328

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

Table A.4e. Regression results, Belgium, IALS and PIAAC pooled

Variables	(1)	(2)	(3)	(4)
Female	-0.0171***	-0.0170***	-0.0173***	-0.0172***
	[0.005]	[0.005]	[0.005]	[0.005]
Years of schooling	0.0371***	0.0368***	0.0370***	0.0367***
	[0.001]	[0.001]	[0.001]	[0.001]
Years of schooling squared	-0.0003***	-0.0003***	-0.0003***	-0.0003***
	[0.000]	[0.000]	[0.000]	[0.000]
Age of respondent				
Age: 35-44	-0.0329***	-0.0432***	-0.0318***	-0.0423***
	[0.010]	[0.010]	[0.010]	[0.010]
Age: 45-54	-0.0554***	-0.0480***	-0.0546***	-0.0465***
	[0.010]	[0.011]	[0.010]	[0.011]
Age: 55-64	-0.0931***	-0.1037***	-0.0917***	-0.1011***
	[0.011]	[0.014]	[0.011]	[0.015]
Parental immigration				
Immigrant mother			-0.0371**	-0.0388**
			[0.015]	[0.015]
Immigrant father			0.0028	0.0007
			[0.016]	[0.016]
Cohort				
Cohort 2		-0.0213**		-0.0225**
		[0.010]		[0.010]
Cohort 3		-0.0006		-0.0023
		[0.012]		[0.012]
Cohort 4		-0.0365**		-0.0392**
		[0.016]		[0.016]
Constant	5.2553***	5.2719***	5.2558***	5.2735***
	[0.020]	[0.019]	[0.020]	[0.019]
Observations	4 096	4 096	4 096	4 096
R-squared	0.333	0.335	0.334	0.337

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Sources: OECD (2016); Statistics Canada (2005); Statistics Canada (1995).

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