OECD Skills Studies

Skills Matter

ADDITIONAL RESULTS FROM THE SURVEY OF ADULT SKILLS

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BETTER POLICIES FOR BETTER LIVES

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Foreword

The labour market is in a flux, affected by the deep and rapid digital transformation, as well as globalisation and demographic changes. Employers are demanding new skills and qualified workers, while many people are looking for a job. Promoting a good match between the rapidly changing demand for skills with workers' competences is crucial to harness the potential of these changes and ensure that no one is left behind. Governments need a clearer picture, not only of how labour markets are changing, but of how well-equipped their citizens are to participate in, and benefit from, increasingly knowledge-based economies. The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), provides that picture. It captures information about adults' proficiency in literacy, numeracy and problem-solving skills, and how much those skills are used on the job and throughout life.

Skills Matter: Additional Results from the Survey of Adult Skills expands on the data and analysis examined in *Skills Matter: Further Results from the Survey of Adult Skills* and in *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*. New data is included for six countries: Ecuador, Hungary, Kazakhstan, Mexico and Peru (that conducted the study for the first time) and the United States (that had previously collected data as part of the study's first round). The results show that poor skills severely limit people's access to more rewarding and productive jobs. The distribution of skills across the population also has significant implications for how the benefits of economic growth are shared within societies. Put simply, where large shares of adults have poor skills, it becomes difficult to introduce productivity-enhancing technologies and new ways of working, which in turn stalls improvements in living standards and tends to widen income inequality. In all countries, adults with lower skills are far more likely than those with better literacy skills to report poor health, to be less involved in political processes and to have less trust in others.

The report also finds that acquiring relevant skills is certainly key, but may not be enough to integrate successfully in the labour market. Workers must be given the opportunity to use their skills productively, but also to reap some of the tangible and intangible benefits of skills proficiency (such as wages and productivity at work) that contribute to adults' general well-being.

Going forward, the OECD is working with governments to support country-specific efforts that ensure that their citizens are equipped with the right skills for 21st-century economies and use those skills productively. We know that skills matter for both workers and employers; now it's time to get the balance right.

Stefano Scarpetta
Director, OECD Directorate for Employment,
Labour and Social Affairs

Andreas Schleicher
Director, OECD Directorate
for Education and Skills

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The International Consortium was responsible for developing the assessment instruments and preparing the underlying data under the direction of Irwin Kirsch and Claudia Tamassia.

The development and implementation of the project was steered by the PIAAC Board of Participating Countries. During the implementation of the 3rd round of the Survey of Adult Skills (2014 to 2019), the Board was chaired by Aviana Bulgarelli (Italy) from 2016, Patrick Bussière (Canada) from 2014 to 2015, Dan McGrath (the United States) from 2014 to 2016 and Ted Reininga (the Netherlands) from 2015.

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Reader's Guide

Data underlying the figures

Detailed data tables corresponding to the figures presented in the main body of the report can be found in Annex A. These figures and tables are numbered according to the corresponding chapters. Tables include an abbreviation in brackets to denote one of the three direct measures of skills for which there are data in the Survey of Adult Skills (PIAAC) – literacy (L), numeracy (N) and problem solving in technology-rich environments (P). As an example, Table A3.1 (L) denotes the first data table based on the literacy scale in Annex A corresponding to figures in Chapter 3 or cited in the main body of the chapter. Unless otherwise stated, the population underlying each of the figures and tables covers adults aged 16-65.

Web package

Figures included in the report and the corresponding data tables contained in Annex A present data for only one of the three direct measures of skills, either literacy (L), numeracy (N) or problem solving in technology-rich environments (P). A more complete set of data can be found at www.oecd.org/site/piaac/. This web package includes all the figures and tables included in the report as well as data tables for the other skills domains referred to but not examined in the report. The package consists of Excel® workbooks that can be viewed and downloaded by chapter.

StatLinks

A *StatLink* URL address is provided under each figure and table. Readers using the pdf version of the report can simply click on the relevant *StatLinks* url to either open or download an Excel® workbook containing the corresponding figures and tables. Readers of the print version can access the Excel® workbook by typing the *StatLink* address in their Internet browser.

Calculating international averages (means)

Most figures and tables presented in this report and in the web package include an OECD average in addition to values for individual countries or sub-national entities. The average in each figure or table corresponds to the arithmetic mean of the respective estimates for each of the OECD countries or sub-national entities included in the figure or table. In the calculation of the OECD average, England (United Kingdom) and Northern Ireland (United Kingdom) are treated as separate entities. The United States contributes to the average of OECD countries as one observation. This is calculated as the mean of the relevant statistic for the two US observations (i.e. in 2012/14 and 2017). Cyprus*, Ecuador, Kazakhstan, Peru, the Russian Federation** and Singapore are not included in the OECD averages presented in any of the figures or tables.

Standard error (S.E.)

The statistical estimates presented in this report are based on samples of adults, rather than values that could be calculated if every person in the target population in every country had answered every question. Therefore, each estimate has a degree of uncertainty associated with sampling and measurement error, which can be expressed as a standard error. The use of confidence intervals provides a way to make inferences about the population means and proportions in a manner that reflects the uncertainty associated with the sample estimates. In this report, confidence intervals are stated at 95% confidence level. In other words, the result for the corresponding population would lie within the confidence interval in 95 out of 100 replications of the measurement on different samples drawn from the same population.

Statistical significance

Differences considered to be statistically significant from either zero or between estimates are based on the 5% level of significance, unless otherwise stated. In the figures, statistically significant estimates are denoted in a darker tone.

Symbols for missing data and abbreviations

a	Data are not applicable because the category does not apply.
c	There are too few observations or no observation to provide reliable estimates (i.e. there are fewer than 30 individuals). Also denotes unstable marginal probabilities which may occur when probabilities are very close to 0 or 1.
m	Data are not available. The data are not submitted by the country or were collected but subsequently removed from the publication for technical reasons.
w	Data have been withdrawn at the request of the country concerned.
S.E.	Standard Error
S.D.	Standard Deviation
Score dif.	Score-point difference between x and y
% dif.	Difference in percentage points between x and y
Marg. Prob.	Marginal probability
(L)	Literacy domain
(N)	Numeracy domain
(P)	Problem solving in technology-rich environments domain
GDP	Gross Domestic Product
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations

Country coverage

This publication features data on 32 OECD countries (or regions within these countries): Australia, Austria, Canada, Chile, the Czech Republic, Denmark, England (United Kingdom), Estonia, Finland, Flanders (Belgium), France, Germany, Greece***, Hungary, Ireland, Israel, Italy, Japan, Korea, Lithuania, Mexico, the Netherlands, New Zealand, Northern Ireland (United Kingdom), Norway, Poland, the Slovak Republic, Slovenia, Spain, Sweden and the United States. In addition, seven countries that are not members of the OECD participated in the survey: Cyprus*, Ecuador, Jakarta (Indonesia), Kazakhstan, Peru, the Russian Federation** and Singapore.

The United States**** participated in the first and third rounds of the survey. Results for Jakarta (Indonesia) were published in OECD (2016[7]). Data for Jakarta (Indonesia) were subsequently withdrawn from public access and are not presented in this report.

The names of the countries participating in Round 3 of the Survey of Adult Skills are presented in blue in all figures and tables.

Rounding

Data estimates, including mean scores, proportions and standard errors, are generally rounded to one decimal place. Therefore, even if the value (0.0) is shown for standard errors, this does not necessarily imply that the standard error is zero, but that it is smaller than 0.05.

Education levels

The classification of levels of education is based on the International Standard Classification of Education (ISCED 1997). A revised version of ISCED (ISCED 2011) was adopted by the UNESCO General Conference at its 36th session in November 2011 (UIS, 2012[1]). Member States have applied ISCED 2011 in the reporting of their education statistics from 2014. Data on educational participation and attainment from Round 1 of the Survey of

Adult Skills were coded using the ISECD 1997 classification. To maintain comparability with the data from Round 1 and Round 2, data from Round 3 have also been coded using ISCED 1997.

Further documentation and resources

The details of the technical standards guiding the design and implementation of the Survey of Adult Skills (PIAAC) can be found at www.oecd.org/site/piaac/. Information regarding the design, methodology and implementation of the Survey of Adult Skills can be found in summary form in *The Survey of Adult Skills: Reader's Companion, Third Edition* (OECD, 2019[2]) and, in detail, in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[3]).

****Note regarding Cyprus***

Note by Turkey

The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Throughout this report, including the main body, boxes and annexes, Cyprus is accompanied by a symbol referring to this note.

*****Note regarding the Russian Federation***

The sample for the Russian Federation does not include the population of the Moscow municipal area. The data published, therefore, do not represent the entire resident population aged 16-65 in the Russian Federation but rather the population of the Russian Federation *excluding* the population residing in the Moscow municipal area. More detailed information regarding the data from the Russian Federation as well as that of other countries can be found in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[3]).

******Note regarding Greece***

The data for Greece include a large number of cases (1 032) in which there are responses to the background questionnaire but where responses to the assessment are missing. Proficiency scores have been estimated for these respondents based on their responses to the background questionnaire and the population model used to estimate plausible values for responses missing by design derived from the remaining 3 893 cases. More details can be found in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[3]).

******* Note regarding the United States***

The United States has collected three waves of data using the PIAAC instruments. It collected data as part of Round 1 of Cycle 1 of PIAAC in 2011-12. It then collected additional data for targeted population groups as part of a National PIAAC Supplement (Rampey et al., 2016[4]) in 2014 and participated in Round 3 of Cycle 1. Details of the PIAAC data collection in the United States can be found in the technical reports for the survey and the National PIAAC Supplement (Hogan et al., 2016[5]); (OECD, 2019[3]).

In this report, the results from the United States are reported using the combined data from 2012 and 2014, and the 2017 data collection conducted as part of Round 3.

Results are presented in the charts and tables as separated observations (*United States 2012/2014* and *United States 2017)* but the United States contributes to the OECD average as one observation (taking the mean of the two US observations).

The 2012/14 data set has been used as this is believed to provide a more accurate representation of the proficiency of the working-age population at that point in time than the original 2011-12 data reported in the first two international reports on PIAAC (OECD, 2013[6]; OECD, 2016[7]). In addition to the increased sample size, the 2012/14 data have been weighted to control totals related to the 2010 census whereas the 2011-12 data were weighted to totals related to the census in 2000.

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UIS (2012), *International Standard Classification of Education ISCED 2011,* UNESCO Institute for Statistics. [1]

Executive summary

Technological change, particularly the increasing presence of information and communications technology (ICT) in all areas of life, together with changes in the structure of employment has led to a growing demand for higher-level cognitive skills involving the understanding, interpretation, analysis and communication of complex information. Employment is shifting away from jobs involving routine cognitive and manual tasks and towards jobs involving expert thinking and complex communication. Governments need a clearer picture, not only of how labour markets are changing, but of how well-equipped their citizens are to participate in, and benefit from, increasingly knowledge-based economies. The Survey of Adult Skills, a product of the Programme for the International Assessment of Adult Competencies (PIAAC), helps provide that picture. The survey was designed to provide insights into how well adult populations can perform the key skills society needs, and how they are using them at work and at home. It assesses the proficiency among adults (16-65 year-olds) in three key information-processing skills: literacy, numeracy and problem solving in technology-rich environments.

This report represents the final phase of the first cycle of the Survey of Adult Skills with the release of results from the six countries participating in the third round of data collection: Ecuador, Hungary, Kazakhstan, Mexico, Peru and the United States. Five of these countries undertook the survey for the first time while the United States had also collected data as part of the first round in 2011-12. With the completion of Round 3 of the study, a total of 39 countries and economies have participated in the study. The results show substantial variation across countries and economies in terms of adults' average proficiency in the three domains assessed by the survey: some 100 score points separate the highest- and lowest-scoring countries in literacy and numeracy proficiency, although many countries score within a relatively narrow band. Proficiency scores in literacy and numeracy also vary considerably within countries: the average difference between the top and bottom 25% of adults was 61 score points in literacy and 68 score points in numeracy.

Low-skilled adults make up a significant share of the population in all participating countries and economies. On average across the OECD countries taking part in the survey, close to one-fifth of adults perform at or below Level 1 in literacy and numeracy. In some Round 3 countries like Ecuador, Mexico and Peru, more than half of adults score at or below these levels. Around one-quarter of adults in all participating countries have no or only limited experience with computers or lack confidence in their ability to use computers. In addition, nearly one in two adults are only proficient at or below Level 1 in problem solving in technology-rich environments. Adults at this level can only use familiar applications to solve problems that involve few steps and explicit criteria, such as sorting e-mails into pre-existing folders.

SKILLS PROFICIENCY AND DEMOGRAPHICS

The survey finds very large differences in proficiency between tertiary-educated adults and those without an upper secondary education in all countries and economies. Among the Round 3 countries, these differences are especially pronounced in Hungary, Peru and the United States, but smaller than average in Ecuador and Mexico. In most countries, the relationship between age and proficiency tends to follow an inverted U-shaped curve, with a peak between the mid-twenties and the early-thirties. In contrast, among Round 3 countries like Ecuador, Mexico and Peru, proficiency declines more or less steadily with increasing age. This age-skills profile is likely to reflect the fact that upper secondary completion rates in these countries have increased only very recently.

Parents' educational background, a proxy for socio-economic status, exerts a significant influence on adults' proficiency in literacy. On average across OECD countries, adults with at least one tertiary-educated parent scored on average 40 points more than adults from families in which neither parent attained upper secondary education. Gender gaps in proficiency – which are negligible in literacy proficiency and average around 10 score points in favour of men in numeracy – are more pronounced among older adults. This could reflect either the fact that gender gaps in educational attainment are wider among older adults, or that women's numeracy skills depreciate more over time, possibly because they are less involved in the labour market.

SKILLS USE IN EVERYDAY LIFE AND AT WORK

Besides providing an insight into the level and distribution of key information-processing skills in the adult population and the relationships between proficiency in these skills and their educational and social background, the Survey of Adult Skills also collects information about how often adults engage in tasks that require the use of literacy, numeracy and problem solving, both in everyday life and at work. These data indicate that the use of skills in everyday life and at work are highly, albeit imperfectly, correlated at the country level – countries ranking low for the use of numeracy skills in everyday life also rank low in use at work, while those ranking high for everyday use also rank high for their use at work.

Numeracy proficiency and how often and intensively people use numeracy skills are positively but weakly correlated at the country level among high-income countries. The correlation strengthens when the middle-income countries are included, particularly Ecuador, Mexico and Peru. In almost all countries and economies participating in PIAAC, men engage in numeracy practices more often than women, both at work and in everyday life. Across all countries and economies, 55-65 year-old workers engage in numeracy practices at work less intensively than 25-54 year-olds. Compared to those with an upper secondary education, tertiary-educated respondents engage in numeracy practices more intensively, while those without an upper secondary qualification use them less intensively. These patterns hold for both everyday life and at work. These gaps between these educational groups are wider in all Round 3 countries, but especially in Ecuador, Mexico and Peru.

PROFICIENCY AND THE LABOUR MARKET

Adults with greater proficiency in literacy, numeracy and problem solving in technology-rich environments tend to have better outcomes in the labour market than their less proficient peers. They are more likely to be employed and, if employed, to earn higher wages. On average, across the 39 countries and economies taking part in the Survey of Adult Skills, an increase of one standard deviation on the numeracy scale (around 57 score points) is associated with a 0.9 percentage-point increase in the likelihood of being employed rather than unemployed and a 7% increase in wages, when keeping years of education and other socio-demographic characteristics constant.

Results from the survey also show that mismatches between workers' qualifications and skills and what they report as required or expected in their jobs are pervasive in most participating countries and economies. On average across the OECD countries participating the Survey of Adult Skills, about 22% of workers report that they are overqualified – that they have higher qualifications than required to get their jobs – and 13% report that they are underqualified.

Proficiency in literacy, numeracy and problem solving in technology-rich environments is also positively associated with several aspects of well-being identified using PIAAC. On average in participating OECD countries, proficiency in information-processing skills is positively associated with trust, volunteering, political efficacy and self-assessed health. The relationships with political efficacy and self-assessed health hold even after accounting for a range of socio-demographic characteristics.

1

Overview

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

This report represents the final phase of the first cycle of the Survey of Adult Skills, with the release of results from the six countries participating in the third round of data collection: Ecuador, Hungary, Kazakhstan, Mexico, Peru and the United States. Five of these countries undertook the survey for the first time while one, the United States, had also collected data as part of the first round in 2011-12. With the completion of Round 3 of the study, a total of 39 countries and economies have participated in the study (see Box 1.1). The data from the survey provide an unprecedented insight into the level and distribution of key information-processing skills in the adult population and the relationships between proficiency in these skills and individuals' educational and social background, and labour-market experience, as well as the nature of their working arrangements and work tasks across a significant group of countries.

The results of the two previous rounds of the survey of Adult Skills can be found in the two summary international reports of the study (OECD, 2013[1]; OECD, 2016[2]). In addition, there are a number of other published studies analysing results from the survey. These include thematic reports and working papers published by the OECD as well as many national reports and academic papers (Maehler, Bibow and Konradt, 2018[3]).

The purpose of this report is primarily to present a summary of the results for the countries participating in Round 3 of the Survey of Adult Skills. It also presents data from countries and economies participating in earlier rounds of the survey as they serve as useful benchmarks and reference points in order to put the results from the Round 3 countries into context. In particular, the report references the average scores of OECD countries participating in PIAAC across the three rounds. However, the report does not contain detailed analysis of the results of countries or economies that participated in earlier rounds. Although the report generally follows the structure used in previous international reports, the analysis presented in Chapter 4 on skills offers a new presentation of these data, concentrating on the use of numeracy skills and the intensity with which adults engage in practices using these skills, both in everyday life and in the workplace.

WHAT IS THE SURVEY OF ADULT SKILLS?

The Survey of Adult Skills, a product of the Programme for the International Assessment of Adult Competencies (PIAAC), measures the proficiency of working-age adults (16-65 year-olds) in three key information-processing skills: literacy, numeracy and problem solving in technology-rich environments. These key skills are relevant to adults in many social contexts and work situations, and necessary for fully integrating and participating in the labour market, education and training, and social and civic life (see Box 1.1 for more information).

The survey provides a rich source of data for policy makers, analysts and researchers concerned with issues such as the development and maintenance of a population's skills, the relationships between the education system and the labour market, the efficiency of the labour market in matching workers and jobs, inequality, and the social and labour-market integration of certain subgroups of the population such as immigrants. Beyond offering an insight into the level and distribution of information-processing skills across the population as a whole and for key subgroups, it provides information on the benefits these skills provide in the labour market and in everyday life.

The interest of the results from Round 3 of the survey lies not just in the fact that additional countries have undertaken the survey but also in that:

- Four of the six participants – Ecuador, Kazakhstan, Mexico and Peru – are upper-middle income countries (see Box 1.2 for more details).
- Measures of the proficiency of the adult population in the United States are available from two different points of time, as it participated in the survey twice (see Box 1.4 and Annex 1.A1. Description of participation of the United States in PIAAC Cycle 1 for more details).

Most countries that have participated in the Survey of Adult Skills have been high-income countries: prior to the third round, only three middle-income countries (Indonesia, the Russian Federation and Turkey) had taken part. The additional middle-income countries taking part in the survey have added to its comparative dimension. In addition, the participation of these countries is evidence of the relevance of the data from PIAAC for policy makers and analysts in such countries as well as providing further evidence that it is feasible to collect data on literacy and numeracy in middle-income countries in the form of large-scale population assessments.

The measurement of literacy and numeracy among adults in low- and middle-income countries is an issue that has gained considerable importance in the context of the United Nations Sustainable Development Goals (SDGs) which includes a target (SDG Goal 4, Target 4.6) of ensuring that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy by 2030 (UNSD, 2018[4]). PIAAC represents the only currently operating international

assessment of adult literacy and numeracy. In the context of considering how to measure progress towards the SDGs, evidence on the relevance of the PIAAC measures and the feasibility of its implementation is important. The experience of the third round of the Survey of Adult Skills confirms the experience from earlier rounds, and the World Bank's Skills Towards Employment and Productivity (STEP) Skills Measurement Program, that the PIAAC instruments can be effectively administered in middle- and low-income countries. STEP is an initiative to measure skills in low- and middle-income countries that includes a version of the PIAAC literacy assessment [see Annex 1.A2. Skills Towards Employment and Productivity (STEP) Survey for further information]. At this point, 17 countries have participated in STEP.

Box 1.1 **Key facts about PIAAC**

What the survey measures

- The Survey of Adult Skills (PIAAC) assesses the proficiency of adults from the age of 16 to 65 years in literacy, numeracy and problem solving in technology-rich environments. These skills are key information-processing competencies that are relevant to adults in many social contexts and work situations, and necessary for full integration and participation in the labour market, education and training, and social and civic life.
- In addition, the survey collects a range of information on the reading- and numeracy-related activities of respondents, their use of information and communication technologies at work and in everyday life, and on a range of generic skills, such as collaborating with others and organising their time, required of individuals in their work.
- Respondents are also asked whether their skills and qualifications match their work requirements and whether they have autonomy over key aspects of their work.

Data collection

- The first cycle of the Survey of Adults Skills has been conducted over three rounds of data collection.
- The first round surveyed around 166 000 adults aged 16-65 years in 24 countries (or regions within these countries) in 2011-12. In Australia, Austria, Canada, Cyprus,[1] the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, the Slovak Republic, Spain, Sweden and the United States – the sample was drawn from the entire national population. In Belgium, the data were collected in Flanders; in the United Kingdom, the data were collected in England and Northern Ireland (data are reported separately for England and Northern Ireland in the report). In the Russian Federation,[2] the data do not cover the Moscow municipal area.
- Nine countries (or regions within these countries) took part in a second round of data collection in 2014-15: Chile, Greece, Jakarta (Indonesia), Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey. A total of 50 250 adults were surveyed. In all countries except Indonesia, the entire national population was covered. In Indonesia, the data were collected in the Jakarta municipal area only.
- The third round was conducted in 2017-18 in six countries: Ecuador, Hungary, Kazakhstan, Mexico, Peru and the United States. A total of 34 792 adults were surveyed. Note that the United States had already participated in Round 1 (see Box 1.4 for further details). This brought the number of participating countries and economies to a total of 39.

Key features of the sampling and survey administration

- Participating countries chose the language they used to administer the assessment. This was commonly the official language(s) of each participating country/economy, but in a few countries, the assessment was also conducted in widely spoken minority or regional languages.
- Three skills domains were assessed: literacy, numeracy and problem solving in technology-rich environments. In addition, a separate assessment of "reading components" was conducted, with the purpose of testing basic reading skills, such as vocabulary knowledge, understanding of the logic of sentences and fluency in reading passages of text.
- Five countries chose not to conduct the problem-solving assessment: Cyprus,[1] France, Italy, Jakarta (Indonesia) and Spain. Four countries (France, Finland, Japan and the Russian Federation) chose not to conduct the assessment of reading components.

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- The target population for the survey was the non-institutionalised[3] population of 16-65 year-olds residing in the country or region at the time of the data collection, irrespective of nationality, citizenship or language status. Sample sizes depended primarily on the number of cognitive domains assessed and the number of languages in which the assessment was administered. Some countries increased the size of the sample in order to have reliable estimates of proficiency for the residents of particular geographical regions and/or for certain subgroups of the population, such as indigenous inhabitants or immigrants. The national samples achieved ranged from a minimum of approximately 4 000 individuals to a maximum of nearly 27 300 individuals.
- The survey was administered under the supervision of trained interviewers either in the respondent's home or in a location agreed between the respondent and the interviewer. The background questionnaire was delivered in Computer-Aided Personal Interview (CAPI) format by the interviewer. Depending on the situation of the respondent, it took between 30 and 45 minutes to complete the questionnaire.
- After answering the background questionnaire, the respondent completed the assessment on a laptop computer (provided they showed sufficient computer skills). Adults lacking basic computer skills or experience, or refusing for other reasons to take the assessment on a computer, were administered a paper version of the assessment on printed test booklets. Respondents could take as much or as little time as needed to complete the assessment. All respondents taking the paper-based assessment also undertook the assessment of reading components. On average, respondents took 50 minutes to complete the cognitive assessment.
- Identical instruments were used in all countries in all rounds of the survey.

1. *Note by Turkey*: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

2. See note at the end of this chapter.

3. The target population excludes adults in institutional collective dwelling units (or group quarters) such as prisons, hospitals and nursing homes, as well as adults residing in military barracks and military bases. However, full-time and part-time members of the military who do not reside in military barracks or military bases are included in the target population.

Box 1.2 **Classifying countries by income level**

In this report, countries have been classified by income levels based on the methodology and taxonomy adopted by the World Bank (World Bank, 2019[5]). For the current 2019 fiscal year:

1. low-income economies are defined as those with a gross national income (GNI) per capita of USD 995 or less in 2017
2. lower middle-income economies are those with a GNI per capita between USD 996 and USD 3 895
3. upper middle-income economies are those with a GNI per capita between USD 3 896 and USD 12 055
4. high-income economies are those with a GNI per capita of USD 12 056 or more.

Details of the methodology used for calculating GNI and converting GNI in national currencies to US dollars can be found in the World Banks's comprehensive repository of documents (World Bank, 2019[5]).

The majority of countries that participated in the first cycle of the Survey of Adult Skills are high-income countries. The exceptions are the Russian Federation (Round 1); Indonesia and Turkey (Round 2); and Ecuador, Kazakhstan, Mexico and Peru (Round 3). All of these countries, with the exception of Indonesia (which is a lower-middle income economy), are upper-middle income countries under the World Bank classification. Round 3 of the Survey is notable for the fact that the majority of participants (four out of six) are upper-middle income countries. In interpreting the performance of adults in these countries, it is helpful to compare their performance with those in other countries of similar income levels participating in the study.

It is important to note here the difference between the measures of gross domestic product (GDP) per capita and GNI per capita (which are often used interchangeably). GDP per capita only counts income from domestic sources, i.e. it

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measures only the domestic residents' income received from domestic production of final goods and services. GNI per capita also includes income received from abroad i.e. it adjusts net income received by domestic residents from production abroad to their income from domestic production. For most nations, there is little difference between GDP and GNI, since the difference between incomes received by the country versus payments made to the rest of the world tends not to be significant. For instance, the United States' GNI was only about 1.01% higher than its GDP in 2016, according to the World Bank (World Bank, 2019[6]). For some countries, however, the difference is significant: GNI can be much higher than GDP if a country receives a large amount of foreign aid. It can be much lower if foreigners control a large proportion of a country's production, as is the case with Ireland, a low-tax jurisdiction where the European subsidiaries of several multinational companies (nominally) reside.

PROFICIENCY IN KEY INFORMATION-PROCESSING SKILLS

The average adult proficiency in information-processing skills varies considerably among the 39 countries and economies covered by the Survey of Adult Skills, although many of the average scores fall within a relatively limited range. The differences between countries and economies in the study partly reflect the different starting points and economic, educational and social development pathways that they have followed over the past half century, as well as current institutional arrangements and policies.

Among the countries participating in Round 3 of the study, adults in Hungary and the United States performed close to the average for the OECD countries and economies that participated in PIAAC over the three rounds in all three domains (see Figure 1.1 and refer to Chapter 2 for more details). More specifically, Hungary's numeracy scores were above average while its literacy scores were below average, albeit only slightly. The opposite was the case in the United States. In both these countries, the proportions of adults reaching Level 2 or 3 in problem solving in technology-rich environments were not significantly different from the OECD average. In contrast, adults in the Latin American middle-income countries from Round 3, Ecuador, Mexico and Peru, performed well below the average for OECD countries and were among the countries with the lowest average proficiency in absolute terms in the three domains assessed. The proficiency of working-age adults in these three countries is very similar to that observed in Turkey (another middle-income country) in Round 2. These results are in line with studies of school-age children in the Programme for International Student Assessment (PISA) which found that among economies with a per capita GDP below USD 20 000 (such as Chile, Mexico, Peru and Turkey), the greater the country's wealth, the higher its mean score on the PISA reading test. This indicates a positive relationship between per capita national income and performance, at least until a minimum threshold is reached (OECD, 2012[7]; OECD, 2018[8]).

Kazakhstan, despite also being a middle-income country, falls somewhere between these two groups of Round 3 countries. The proportion of adults scoring at the highest levels in literacy, numeracy and problem solving is below that seen in Hungary and the United States but above the share in Ecuador, Mexico and Peru. Close to half of the adult population in Kazakhstan performs at Level 2 in both the literacy and numeracy domains and the proportion of the population scoring at Level 1 and below is close to the OECD average.

As well as the differences observed across countries, there is considerable variation in proficiency in literacy and numeracy within the countries participating in Round 3. In Ecuador, Peru and the United States the difference between the top- and bottom-performing 25% of adults was 6-13 score points larger than OECD average in literacy and 7-23 score points larger than the OECD average in numeracy. In Mexico and Hungary the gap between the best and worst performers in both literacy and numeracy was close to the OECD average while in Kazakhstan, it was lower than the OECD average.

In line with their low average scores, Ecuador, Mexico and Peru have very large proportions of adults at the lowest levels of the proficiency scales. For example, in these three countries, more than 60% of adults scored at or below Level 1 in literacy and numeracy, meaning they would struggle to understand complex texts or perform numerical tasks involving several steps and mathematical information represented in different ways (see Box 1.3). However, despite the high proportions of adults in these three countries with very low literacy skills, there are, nevertheless, few adults who are actually illiterate.

As mentioned above, the Survey of Adult Skills includes an assessment of reading components designed to assess mastery of the basic components of reading comprehension – vocabulary knowledge (print vocabulary), understanding of the logic

of sentences (sentence processing) and reading fluency (passage comprehension) – for adults who failed to complete a set of very simple tasks correctly. Even in Ecuador, Mexico and Peru (which have very high proportions of adults performing at or below Level 1 on the literacy scale) those failing the core test in these countries correctly answered more than 77% of the items in the sentence processing elements of the reading components assessment, more than 74% of the passage-comprehension items and 92% of the print-vocabulary items.

Box 1.3 **Reporting the results**

In each of the three domains assessed, the results are represented on a scale from 0 to 500.

Each of the three proficiency scales is divided into "proficiency levels", defined by particular score-point ranges. Six proficiency levels are defined for literacy and numeracy (from below Level 1 to Level 5) and four for problem solving in technology-rich environments (from below Level 1 to Level 3).

The results for literacy and numeracy are presented in the form of mean proficiency scores for each country as well as by proportions of the population by proficiency level. For problem solving in technology-rich environments, given the very different levels of familiarity with computer applications in the countries and economies participating in the Survey of Adult Skills, the proportions of the population to which the estimates of proficiency in this domain refer vary widely among countries/economies. In other words, the populations for whom proficiency scores for problem solving in technology-rich environments are reported are not identical across countries. Proficiency scores relate only to the proportion of the target population in each participating country that was able to undertake the computer-based version of the assessment, and thus meets the preconditions for displaying competency in this domain. For this reason, the presentation of the results focuses on defining the proportions of the population at each proficiency level rather than on comparing mean proficiency scores.

The proficiency levels are designed so the scores represent degrees of proficiency in a particular aspect of the domain. Each level is associated with a certain number of items, with higher levels being associated with items of increasing difficulty. There are easier and harder tasks for each proficiency scale. The purpose of described proficiency scales is to facilitate the interpretation of the scores assigned to respondents. That is, respondents at a particular level not only demonstrate knowledge and skills associated with that level but also the proficiencies required at lower levels. Thus, respondents scoring at Level 2 are also proficient at Level 1, with all respondents expected to answer at least half of the items at that level correctly.

For more information on the proficiency levels in each domain and their descriptions, please refer to Chapter 2.

In all the countries participating in PIAAC, there were many adults with no experience using computers or who had extremely limited ICT skills, or who showed low levels of proficiency in the problem solving in technology-rich environments domain. Around one in four adults have no or only limited experience with computers or lack confidence in their ability to use computers. In addition, nearly half of all adults are only proficient at or below Level 1 in problem solving in technology-rich environments, which translates into being able to use only familiar applications to solve problems that involve few steps and explicit criteria, such as sorting e-mails into pre-existing folders.

Round 3 countries differ from each other significantly in the share of adults without basic ICT skills or who failed the core ICT test. While Hungary and Kazakhstan had a similar share to the OECD average of adults with no or little ICT experience (14.4% and 19.7% respectively), and the United States had an even smaller share at 7.4%, other countries participating in Round 3 stand out as having very large proportions of their adult populations with no prior computer experience or very poor ICT skills: 32.9% in Ecuador, 39.3% in Mexico and 43.6% in Peru. These countries are comparable to Turkey, where around 38% of adults have little or no ICT experience. These figures should be understood in the context of these countries' economic development and the level of ICT penetration. In 2017, only about one-third of the households in Ecuador (38.1%) and Mexico (36.9%) had a fixed line phone subscription, and the share in Peru was significantly lower (21.9%). Internet and computer access in these countries is also limited: only around 40% of households had access to a computer and functional Internet in Ecuador and Mexico in 2017 and the share of such households in Peru was even lower, at around 30% (ITU, 2019[9]). This is in stark contrast to many of the high-income OECD countries where more than two-thirds of the households have access to a computer, the Internet and a telephone line. The proportion of adults lacking computer experience or having very low ICT skills is therefore in line with expectations.

Figure 1.1 ▪ **Snapshot of performance in literacy, numeracy and problem solving**

Mean proficiency scores of 16-65 year-olds in literacy and numeracy, and the percentage of 16-65 year-olds scoring at Level 2 or 3 in problem solving in technology-rich environments

Not significantly different from the average
Significantly **above** the average
Significantly **below** the average

	Literacy	Numeracy	Problem solving in technology-rich environments
	Mean score	Mean score	% at Level 2 or 3
OECD countries and economies			
Australia	280	268	38
Austria	269	275	32
Canada	273	265	37
Chile	220	206	15
Czech Republic	274	276	33
Denmark	271	278	39
England (UK)	273	262	35
Estonia	276	273	28
Finland	288	282	42
Flanders (Belgium)	275	280	35
France	262	254	m
Germany	270	272	36
Greece	254	252	14
Hungary	264	272	28
Ireland	267	256	25
Israel	255	251	27
Italy	250	247	m
Japan	296	288	35
Korea	273	263	30
Lithuania	267	267	18
Mexico	222	210	10
Netherlands	284	280	42
New Zealand	281	271	44
Northern Ireland (UK)	269	259	29
Norway	278	278	41
Poland	267	260	19
Slovak Republic	274	276	26
Slovenia	256	258	25
Spain	252	246	m
Sweden	279	279	44
Turkey	227	219	8
United States 2012/2014	272	257	29
United States 2017	271	255	31
OECD average	**266**	**262**	**30**
Partners			
Cyprus[1]	269	265	m
Ecuador	196	185	5
Kazakhstan	249	247	16
Peru	196	178	7
Russian Federation[2]	275	270	26
Singapore	258	257	37

Note: Cyprus[1], France, Italy and Spain did not participate in the problem solving in technology-rich environments assessment.
1. See note 1 in Box 1.1.
2. See note at the end of this chapter.
Countries are listed in alphabetical order.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A2.2, A2.4 and A2.7.
StatLink https://doi.org/10.1787/888934019780

PROFICIENCY AND SOCIO-DEMOGRAPHIC CHARACTERISTICS

Within countries and economies, adults with different socio-demographic characteristics show considerable variation in their proficiency in information processing. In particular, proficiency is closely associated with age, educational attainment and parents' level of education, but only weakly associated with gender.

As expected, in all countries and economies there is a close association between adults' educational attainment and their proficiency in information-processing skills. This is likely to be because, on the one hand, adults with greater proficiency are more likely to participate in higher levels of education and, on the other, longer periods of study provide

the opportunity to develop greater levels of proficiency. Among 25-65 year-olds (i.e. adults who have generally completed formal education), proficiency is highest among those with tertiary qualifications and lowest among those whose highest qualification was below upper secondary education (see Figure 1.2 and refer to Chapter 3 for more details).

In Hungary, tertiary-educated adults scored higher than the average for tertiary-educated adults across participating OECD countries, by about 4 points in literacy and by about 18 points in numeracy. Hungary has also one of the highest share of tertiary-educated adults scoring at Level 4 and 5 in numeracy (33%, compared to 23% across the OECD; Sweden has the highest share, at 36%). Tertiary-educated adults in the United States have similar proficiency in literacy to their Hungarian counterparts, but they scored lower in numeracy, below the OECD average. There is a very small gap in the proficiency (in both literacy and numeracy) between tertiary-educated adults and adults with below upper secondary education in Kazakhstan. This is due to the fact that tertiary-educated adults score more than 30 points below the OECD average, in both domains, but adults without an upper secondary qualification scored above the average, by 6 points in literacy and by 16 points in numeracy. In Ecuador, Mexico and Peru, performance in literacy and numeracy is consistently below the corresponding OECD average for adults at each level of educational attainment.

Proficiency is especially low among adults without an upper secondary qualification in Peru: they averaged 157 score points in literacy and 127 in numeracy, well below average for similarly educated adults in other Latin American countries such as Chile (177 score points in literacy and 154 score points in numeracy), Ecuador (174 and 160 score points) and Mexico (201 and 189 score points).

In most countries, the relationship between age and proficiency tends to follow an inverted U-shaped curve, with a peak between the mid twenties and the early thirties. In contrast, among Round 3 countries like Ecuador, Mexico and Peru, proficiency declines more or less steadily with increasing age. As PIAAC is a cross-sectional survey, the age-skill relationship cannot be interpreted exclusively as the effect of ageing: differences in the age-skills profile are influenced by differences in educational attainment among different cohorts as countries underwent periods of economic development and the expansion of education at different times in their history.

In the United States, 55-65 year-olds are more likely to have a tertiary degree than in many other countries and the gap in educational attainment between 25-34 year-olds and these older adults is very small. Rates of completion of tertiary education for 55-65 year-olds in Kazakhstan are about half the rates observed among adults aged 25-34 (27% compared to 50%). The share of adults who have not attained an upper-secondary qualification is similar in the two age groups (14% for older adults, 11% for 25-34 year-olds), meaning that over time there has been an increasing share of adults who have progressed from a secondary to a tertiary qualification. This upgrade in educational attainment does not appear to have translated in a corresponding increase in the skills of the adult population, possibly because of a decline in the quality of education. The profile in Ecuador, Mexico and Peru is likely to reflect the fact that completion rates for upper secondary education in these countries have increased only very recently. On average across OECD countries, only 16% of 25-34 year-olds have not completed upper secondary education, compared to 50% in Mexico, 36% in Ecuador and 26% in Peru. Among those under 25, the share of respondents who have completed upper secondary is actually higher than the OECD average in Ecuador and Peru (52% and 68%, respectively, compared to an average of 49%), and is not very distant in Mexico (36%). As such, the age-skills profile in these countries is quite similar to that observed in more developed economies like Korea and Singapore, which have also only more recently expanded access to education.

The difference in literacy proficiency between men and women is negligible. Men have a more substantial advantage in numeracy, scoring about 10 score points higher than women on average. Hungary and Kazakhstan are among the few countries where there is no gender difference in numeracy proficiency. In Hungary, this is mainly due to the very strong performance of Hungarian women. In Kazakhstan both men and women score below the OECD average, with the gap being much less pronounced for women, at only 9 score points as opposed to men at 21 score points.

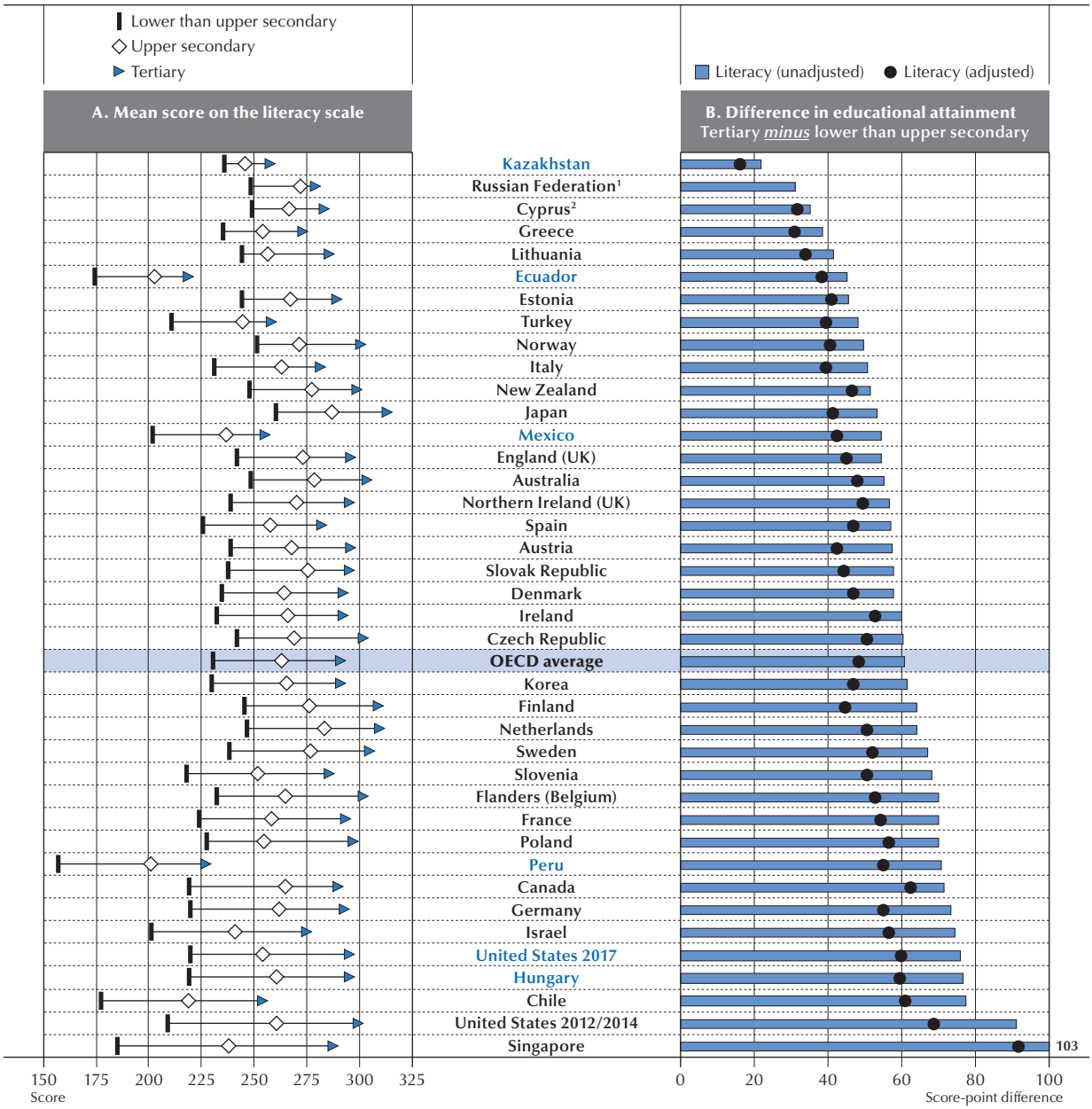
Gender gaps in proficiency are more pronounced among older adults (aged 45 years and over). This could either reflect the fact that gender gaps in educational attainment are wider among older adults, or that women's skills have declined more over time, possibly because they participate less in the labour market.

Parents' educational background also exerts a significant influence on adults' literacy proficiency. Having at least one parent with a tertiary qualification is associated with a 41 score-point advantage over adults who do not have a parent with an upper secondary education. Gaps related to family background are particularly pronounced in Hungary, Peru and the United States among the Round 3 countries (see Figure 3.12 in Chapter 3). The differences are very close to the OECD average in Ecuador and Mexico and they are much smaller (but still significant) in Kazakhstan. About half of

this difference is explained by other socio-demographic characteristics, most notably the fact that the children of highly educated parents are themselves more likely to attain higher levels of education. This is especially true in Mexico, where adjusting for individual characteristics strongly reduces the differences related to family background, and less true in Ecuador and Kazakhstan, where the adjustment has less of an effect.

Figure 1.2 ▪ **Differences in literacy proficiency, by educational attainment**

A. Mean literacy proficiency scores, by educational attainment (adults aged 25-65)
B. Difference in mean literacy score between low- and high-educated adults (adults aged 25-65)



Notes: All differences in Panel B are statistically significant. Unadjusted differences are the differences between the two means for each contrast category. Adjusted differences are based on a regression model and take account of differences associated with other factors: age, gender, immigrant and language background and parents' educational attainment. Only the score-point differences between two contrast categories are shown in Panel B, which is useful for showing the relative significance of educational attainment vis-a-vis observed score-point differences. Lower than upper secondary includes ISCED 1, 2 and 3C short. Upper secondary includes ISCED 3A, 3B, 3C long and 4. Tertiary includes ISCED 5A, 5B and 6. Where possible, foreign qualifications are included as the closest corresponding level in the respective national education systems. Adjusted difference for the Russian Federation is missing due to the lack of the language variables.

1. See note at the end of this chapter.
2. See note 1 in Box 1.1.

Countries and economies are ranked in ascending order of the unadjusted differences in literacy scores (tertiary minus lower than upper secondary).

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.1(L) and A3.2(L).

StatLink https://doi.org/10.1787/888934019799

Box 1.4 **PIAAC in the United States**

The United States has collected three waves of data using the PIAAC instruments. It collected data as part of Round 1 of Cycle 1 of PIAAC in 2011-12. It then collected additional data for targeted population groups as part of a National PIAAC Supplement (Rampey et al., 2016[10]) in 2014 and participated in Round 3 of Cycle 1. Details of the PIAAC data collection in the United States can be found in the technical reports for the survey and the National PIAAC Supplement (Hogan et al., 2016[11]; OECD, 2019[12]).

In this report, the United States is reported using 1) the combined data from 2012 and 2014; and 2) the 2017 data collection conducted as part of Round 3. The 2012/14 data set has been used as this is believed to provide a more accurate representation of the proficiency of the working-age population at that point in time than the original 2011-12 data reported in the first two international reports on PIAAC (OECD, 2013[1]; OECD, 2016[2]). In addition to the increased sample size, the 2012/14 data have been weighted to control totals related to the 2010 census whereas the 2011-12 data were weighted to totals related to the census in 2000.

Data from the United States are presented in the following way in this report:

- Results from 2012/14 and 2017 are presented as separate observations in tables and charts.
- The United States contributes to the average of OECD countries as one observation. This is calculated as the mean of the relevant statistic for the two US observations (i.e. in 2012/14 and 2017).
- In this report, all discussion of U.S. results refers to the year 2017, unless otherwise specified.

See Annex 1.A1. Description of participation of the United States in PIAAC Cycle 1 for further details on the sample size and the administration of the survey in the United States.

THE USE OF SKILLS AT WORK AND EVERYDAY LIFE

In addition to assessing proficiency in literacy, numeracy and problem solving in technology-rich environments, the Survey of Adult Skills (PIAAC) collects information on how often adults engage in tasks requiring the use of these skills, both in everyday life and at work – for example, reading different types of text, undertaking calculations and solving problems. The PIAAC background questionnaire collects information on the frequency of these practices for a number of reasons. First, engagement with written materials and the mathematical demands of adult life represents an important dimension of what it is to be literate and numerate in terms of the definitions of these constructs in the study. Second, practice is understood as a means by which individuals develop and maintain proficiency during their working life. Third, in the workplace, individual productivity and wages are determined both by workers' proficiency and the intensity with which they engage in practices that use their proficiency.

Generally, countries ranking low for the use of numeracy skills in everyday life also rank low for their use at work, while countries at the upper end of the distribution for one also rank high for the other. This suggests that the use of skills in everyday life and at work are highly, albeit imperfectly, correlated at the country level.

Based on an index of engagement in numeracy practices that reflects both the frequency and sophistication of their use (refer to Box 4.1 in Chapter 4), Ecuador, Kazakhstan, Mexico and Peru rank in the lower part of the distribution of engagement in numeracy practices. As such, they are similar to Chile from Round 2. Hungary, in contrast, displays lower intensity in engagement in numeracy practices at work than the average OECD country, and greater intensity in everyday life.

Numeracy proficiency and engagement in numeracy practices are positively but weakly correlated at the country level among high-income countries, i.e. higher average numeracy scores tend to correspond to higher average values for the index of numeracy use. The correlation strengthens when non-high income countries are also considered, in particular Ecuador, Mexico and Peru.

In almost all participating countries and economies, men engage in numeracy practices more frequently than women, both at work and in everyday life. Controlling for other personal and job-related characteristics reduces the gender gap, especially for the intensity of use in everyday life, but does not reverse it. In all participating countries, 55-65 year-old workers engage in numeracy practices at work less intensively than 25-54 year-olds. The youngest workers (16-24 year-olds) also use numeracy practices less intensively than 25-54 year-olds, except in Kazakhstan, Mexico, Peru and the Russian Federation.

Respondents with higher educational qualifications engage in numeracy practices more intensively than upper secondary graduates, while those without an upper secondary qualification engage less intensively. These patterns hold for the intensity of numeracy use in both everyday life and at work. The gaps in the intensity of practice across attainment levels are wider in all Round 3 countries (except the United States), but especially in Ecuador, Mexico and Peru. For these three countries, the adjusted gaps in numeracy use between adults with upper secondary education and those without are two to three times larger than the average for OECD countries. In Kazakhstan, conversely, individuals with below upper secondary education do not use numeracy less intensively than individuals with an upper secondary qualification, either at work or in everyday life.

A large part of the variation in the index of numeracy practices is explained by a worker's occupation, and by the human resource practices used in the workplace. These managerial and human relations practices involve aspects of work organisation – such as team work, autonomy, task discretion, mentoring, job rotation and applying new learning – as well as management practices such as employee participation, incentive pay, training practices and flexibility in working hours. They explain between 10% and 20% of the variation in skills use among individuals. This is in line with countries' efforts to promote better skills use through innovation in the workplace, for example through training.

THE OUTCOMES OF INVESTMENT IN SKILLS

Across the OECD countries taking part in the Survey of Adult Skills in any one of the three rounds, an individual who scores one standard deviation higher than another on the numeracy scale (around 56 score points) is 1.7 percentage points more likely to be employed than unemployed. An increase in one standard deviation in the number of years in formal education (around 3.3 years) is associated with a 2.4 percentage-point increase in the chances of being employed. A similar pattern holds for Hungary, where the likelihood of employment is positively associated with numeracy proficiency and educational attainment. In Ecuador, Kazakhstan, Mexico, Peru and the United States there are low or negative returns to proficiency and education, which in most cases are not statistically significant.

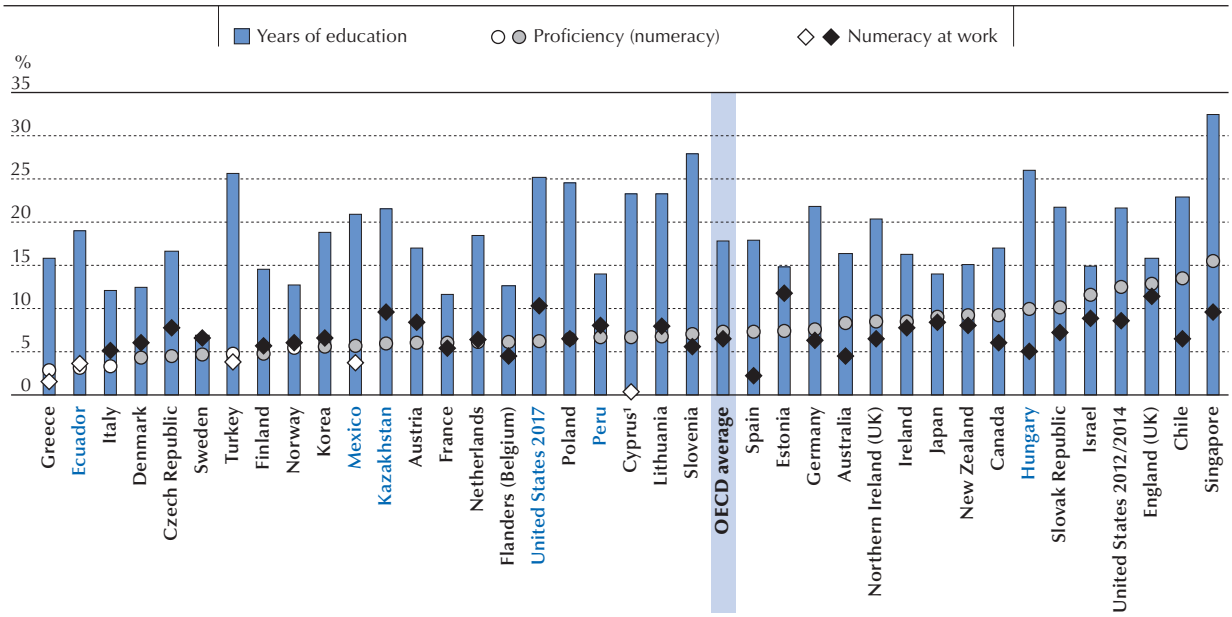
In most countries, educational attainment is a better predictor of employment than numeracy proficiency, which suggests that it is harder for employers to judge workers' actual numeracy proficiency and they are more likely to rely on readily available, albeit imperfect, signals such as educational qualifications. Meanwhile, the lack of a relationship between employment status and education and proficiency in Latin American counties is striking. It is, however, in line with previous studies on Latin American countries that have found a stronger correlation between cognitive skills and earnings than with employment status (Cunningham, Acosta and Muller, 2016[13]; Acosta, Muller and Sarzosa, 2017[14]). The absence of a strong social protection system in these countries can lead to the majority of adults dedicating themselves to any employment they can find, possibly in the informal sector (Ocampo and Gómez-Arteaga, 2017[15]). In other words, education and proficiency could have a more profound effect on the quality of employment than the quantity in Latin American countries compared to others.

Proficiency and schooling have significant and distinct effects on hourly wages (see Figure 1.3 and refer to Chapter 5 for more details). Across the OECD countries taking part in any of the three rounds of the Survey of Adult Skills, an increase in one standard deviation in numeracy proficiency is associated with a 7% increase in hourly wages, keeping years of education and other socio-demographic characteristics constant. An increase in years of education by one standard deviation brings about a bigger increase in hourly wages – about 18%, all else being equal. Returns to proficiency are above average in Hungary, while they are below average in Ecuador, Kazakhstan, Mexico, Peru and the United States. The relationship is weakest in Ecuador, where it is not statistically significant. Returns to years of education exceed the OECD average in all Round 3 countries, with the exception of Peru. Hungary shows the third highest returns to years of education of all participating countries, after Singapore and Slovenia.

Mismatches between workers' qualifications and skills and what they report as being required or expected in their jobs are pervasive in most countries participating in PIAAC. On average across the OECD countries that have taken part in the Survey of Adult Skills, about 22% of workers report that they are overqualified – that they have higher qualifications than required to get their jobs – and 12% report that they are underqualified – that they have lower qualifications than required to get their jobs. Moreover, 11% have higher literacy skills than those typically required in their job, while 4% are underskilled. Finally, 40% of workers are mismatched by field of study: they work in an occupation that is unrelated to their field of study. These forms of mismatch overlap; it is common for workers who are mismatched by field of study to also be overqualified, for example.

Figure 1.3 ■ **Impact of education, numeracy proficiency and numeracy use at work on wages**

Percentage change in wages associated with a change of one standard deviation in years of education, proficiency in numeracy and numeracy use at work



Notes: Hourly wages, including bonuses, in purchasing power parity-adjusted USD (2012). Coefficients from the ordinay least squares regression of log hourly wages on years of education, proficiency and use of numeracy skills at work, directly interpreted as percentage effects on wages. Coefficients adjusted for age, gender, foreign-born status and tenure. The wage distribution was trimmed to eliminate the 1st and 99th percentiles. One standard deviation in proficiency in numeracy is 56 points. One standard deviation in years of education is 3.3 years. One standard deviation in numeracy at work is 0.27 points.The analysis excludes the Russian Federation because wage data obtained through the survey do not compare well with those available from other sources. Hence further checks are required before wage data for this country can be considered reliable. Statistically significant values (at the 5% level) are shown in a darker tone.
1. See note 1 in Box 1.1.
Countries and economies are ranked in ascending order of the effect of numeracy proficiency on wages.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A5.2(N).
StatLink https://doi.org/10.1787/888934019818

The incidence of qualification mismatch varies significantly across countries. In all Round 3 countries except Ecuador and Kazakhstan, the overall qualification mismatch rate is lower than in the OECD average. Kazakhstan has an overall rate very close to the OECD average, although the composition is slightly different with overqualification playing a bigger role than on average. Ecuador has a relatively high overall rate and is one of only five PIAAC countries, where being underqualified is more common than being overqualified. This could reflect rapid growth in the demand for higher qualifications not matched by an equivalent increase in graduate numbers.

In Hungary, Kazakhstan and the United States, the overall incidence of skill mismatch is at or below the rate observed in the OECD on average. By contrast, Latin American countries stand out, with incidences that are well above average. This applies to Ecuador, Mexico and Peru from Round 3 but also to Chile from Round 2 and is mostly due to an above-average incidence of overskilling. Chile, Ecuador and Mexico, along with the United States, also have a relatively high incidence of mismatches by field of study: 10 percentage points higher than the OECD average in Chile, 17 percentage points in Ecuador, 12 percentage points in Mexico and 8 percentage points in the United States.

Qualification mismatch and skills mismatch may both have distinct effects on wages, even after adjusting for both qualification level and proficiency scores, because jobs with similar qualification requirements may have different skill requirements. This may occur because employers can evaluate qualifications but they cannot measure skills directly. When workers are compared with equally qualified and equally proficient well-matched counterparts, then being overqualified has a stronger negative association with real hourly wages than being over-skilled or having a field-of-study mismatch. On average, across countries, overqualified workers earn about 17% less than well-matched workers with the same qualification and proficiency levels and in the same field. The equivalent wage penalty for overskilling is 7% and that for field-of-study mismatch is 3% (Figure 1.4).

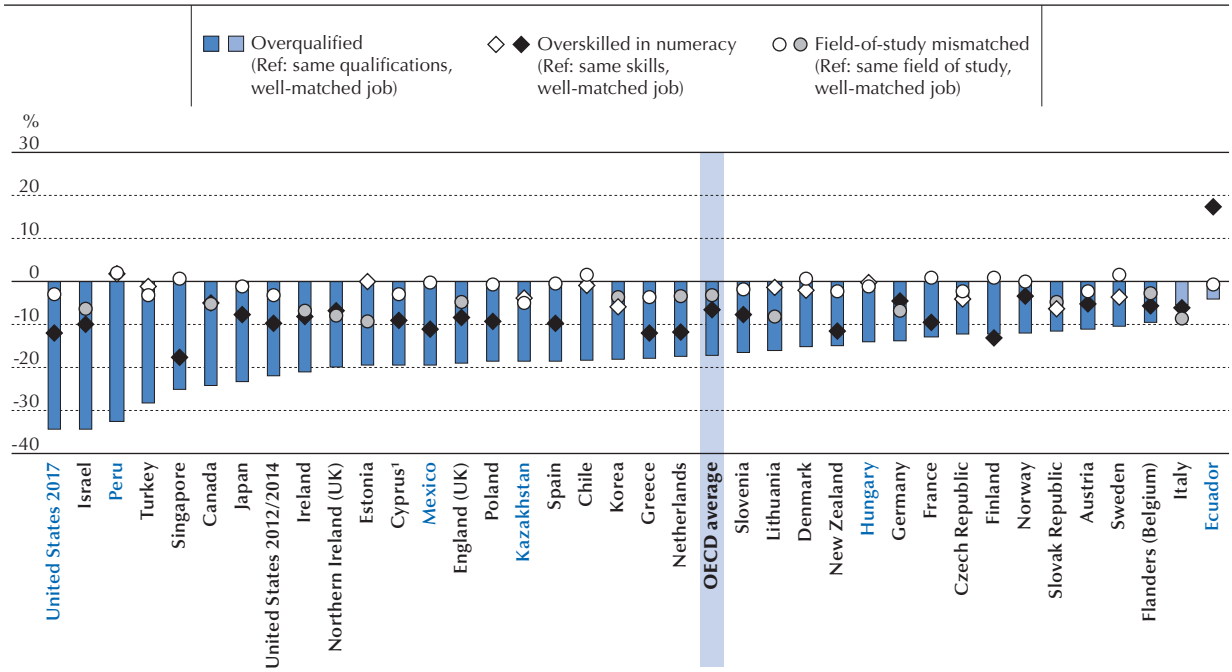
While the negative correlation between overqualification and wages is consistent and statistically significant across countries, this is not the case for over-skilling and field-of study mismatch. The picture for Hungary is similar to the OECD

average but in Kazakhstan, Mexico, Peru and the United States, the wage penalties related to overqualification are above average. This is particularly the case in Peru and the United States where the hourly wages of overqualified workers are more than 30% lower than the hourly wages of well-matched workers who have the same level and field of qualification and the same proficiency in numeracy.

Finally, proficiency in literacy, numeracy and problem solving in technology-rich environments is positively associated with several aspects of well-being identified using PIAAC. On average in OECD countries, proficiency in information-processing skills is positively associated with trust, volunteering, political efficacy and self-assessed health. The relationships with political efficacy and self-assessed health hold even after accounting for a range of socio-demographic characteristics, but not in the case of trust. The strength of these associations differ across countries. With the exception of Hungary and the United States, countries in Round 3 have weaker relationships overall between proficiency in numeracy and non-economic outcomes than most of the other countries included in PIAAC.

Figure 1.4 ▪ **Impact of mismatches in qualifications, numeracy and fields-of-study mismatch on wages**

Percentage difference in wages between overqualified, overskilled or field-of-study mismatched workers and their well-matched counterparts



Notes: Coefficients from ordinary least squares regression of log hourly wages on mismatch directly interpreted as percentage effects on wages. Coefficients adjusted for years of education, age, gender, marital status, working experience, tenure, foreign-born status, establishment size, contract type, hours worked, public sector dummy, proficiency in numeracy and numeracy use at work. The wage distribution was trimmed to eliminate the 1st and 99th percentiles. The regression sample includes only employees. The analysis excludes the Russian Federation because wage data obtained through the survey do not compare well with those available from other sources. Hence further checks are required before wage data for this country can be considered reliable. The analyses exclude Australia because the unavailability of ISCO 3-digit information for Australian workers in the Survey of Adult Skills (PIAAC) means field-of-study mismatch data were unavailable. Statistically significant values (at the 5% level) are shown in a darker tone.
1. See note 1 in Box 1.1.
Countries and economies are ranked in ascending order of the effect of overqualification on wages.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A5.7.
StatLink https://doi.org/10.1787/888934019837

SUMMARY

The completion of Round 3 of the Survey of Adult Skills brings the total of countries and economies that have participated in the study to 39. Six countries participated in Round 3 of the first cycle of the survey: Ecuador, Hungary, Kazakhstan, Mexico, Peru and the United States. Of these countries, five were undertaking the assessment for the first time, while the United States was repeating the survey, having also fielded the assessment in 2011-12 as part of Round 1 and also having administered the PIAAC instrument to an additional sample of unemployed adults, and young (16-34 year-olds) and older adults (66-74 year-olds) as well as prison inmates in 2012-14 to enhance its PIAAC Round 1 sample. Four of the six countries participating in Round 3 – Ecuador, Kazakhstan, Mexico and Peru – are upper middle-income countries.

Prior to Round 3, only three middle-income countries had participated in the survey: Indonesia, the Russian Federation and Turkey. The addition of four additional middle-income countries to the survey during the third round highlights its expanding coverage and its increasing relevance for shaping policy in such countries.

In broad terms, the results for the United States reflected very closely those observed in Round 1, as might be expected. Change in the overall proficiency of the adult population primarily results from the replacement of older cohorts exiting the target age range of the study by younger cohorts entering it. As around 2% of the target population is replaced every year, scope for major change over a five-year period is limited.

Hungary is notable for the fact that it has well above-average performance in numeracy but slightly worse than average performance in literacy. Ecuador, Mexico and Peru stand out for their very low average scores in literacy, numeracy and problem solving in technology-rich environments; the high proportions of their populations performing at Level 1 or below on the literacy and numeracy scales; and the large proportions of the population who did not undertake the assessment on computer. In this, they are similar to Turkey and Chile in Round 2.

Besides differences across countries, there was also substantial variation in proficiency observed within countries across different socio-demographic groups. In particular, proficiency is closely associated with age, educational attainment and parents' level of education, but only weakly associated with gender. With respect to the performance across groups from different backgrounds, Latin American countries in PIAAC tend to have lower performance across the board but they seem to have benefited from the recent expansion in terms of access to education, as the better educated youngest adults show higher proficiency than older adults. Adults in Hungary, on the other hand, tend to score roughly at the same level as the OECD average. Moreover, Hungary stands out as a country with no gender gap in numeracy because of the exceptionally high performance of Hungarian women in that domain.

Data on the frequency of skill use indicate that the use of skills in everyday life and at work are highly, albeit imperfectly, correlated at the country level i.e. countries and economies ranking low in the use of numeracy skills in everyday life also rank low in their use at work, while countries at the upper end of the distribution for use of skills in everyday life also rank high for their use at work. Numeracy proficiency and engagement in numeracy practices are positively but weakly correlated at the country level when high-income countries are considered. The correlation strengthens when non-high income countries are also included, particularly Ecuador, Mexico and Peru.

Adults with greater proficiency in literacy, numeracy and problem solving in technology-rich environments tend to have better outcomes in the labour market than their less-proficient peers. They have greater chances of being employed and, if employed, of earning higher wages. Among Round 3 countries, there is considerable disparity in these labour-market outcomes, however. Returns to proficiency with respect to wages are higher in Hungary on average while they are lower than the OECD average in Ecuador, Mexico and Peru. The relationship is weakest in Ecuador, where it is not statistically significant. In addition to economic outcomes, proficiency in information-processing skills is also positively associated with several aspects of well-being such as trust, volunteering, political efficacy and self-assessed health.

A final comment concerns proficiency in literacy, numeracy and problem solving in Ecuador, Mexico and Peru. On the one hand, the results show a gap between the proficiency of adults in these countries with those of adults in countries such as Japan, the Netherlands and Sweden. The high proportions of working-age adults with very low proficiency in information-processing skills represents a considerable economic and social challenge, particularly in the context of rapid technological change. On the other hand, PIAAC provides examples of countries (e.g. Korea and Singapore) that 50 years ago had working-age populations with very low proficiency, which have successfully increased the proficiency of successive generations to the point that the younger cohorts in these countries are among the highest performers in the study. Achieving sustainable improvement in the information-processing skills of the population is possible, but requires a concerted long-term commitment and effective ongoing investment in education and training.

Note

A note regarding the Russian Federation

The sample for the Russian Federation does not include the population of the Moscow municipal area. More detailed information can be found in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[12])

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ANNEX 1.A1. DESCRIPTION OF PARTICIPATION OF THE UNITED STATES IN PIAAC CYCLE 1

The United States has conducted three rounds of data collection using PIAAC instruments.

Round	Dates of data collection	Sample size and characteristics
PIAAC Round 1	August 2011-April 2012	5 010 completed cases. Representative sample of the resident population aged 16-65.
PIAAC National Supplement	August 2013-May 2014 (Household collection)	3 660 completed cases. Representative samples of 1) unemployed adults (aged 16-65); 2) young adults (aged 16-34); and 3) older adults (aged 66-74). Due to misclassification of employment sample, a small number of 35-65 year-olds were also included.
PIAAC Round 3	March – September 2017	3 800 completed cases. Representative sample of the resident population aged 16-74.

Round 1

The United States was one of the 24 countries that participated in the Round 1 of PIAAC which collected data in 2011-12. The data collection for the US Round 1 of PIAAC was undertaken as part of the international data collection managed by the OECD and followed the same procedures and standards as the other countries in Round 1. These are described in the study's Technical Report (OECD, 2019[12]) which also provides details of the United States' compliance with these standards and the quality of the data collected. Results for the United States were published in the international report of Round 1 (OECD, 2013[1]).

US data for Round 1 of PIAAC have been released as a public use file (PUF) by the OECD. A PUF including US national variables and restricted use file containing data at a more disaggregated level for some key variables are also available from the NCES website.

PIAAC National Supplement

The PIAAC National Supplement administered the PIAAC instruments to an additional sample of adults in order to enhance the PIAAC Round 1 sample in the United States. The National Supplement included a sample of adults from households not previously selected located in the 80 primary sampling units (PSUs) included in Round 1. The National Supplement household sample increased the sample size of two key subgroups of interest, unemployed adults (aged 16-65) and young adults (aged 16-34), and added a new subgroup of older adults (aged 66-74). The completed sample included 3 660 respondents: 1 064 unemployed adults, 1 545 young adults who were not unemployed and 749 older adults. In addition, there were 247 adults aged 35-65 who were not unemployed included in the final sample due to the initial misclassification of their employment status (Hogan et al., 2016[11]).The same procedures and instruments used during Round 1 collection were employed during the household data collection for the National Supplement.

The PIAAC National Supplement was a *national* project managed by US National Center for Education Statistics (NCES) and was conducted independently of the OECD. The procedures for data collection and reporting closely followed those of PIAAC Round 1. As it was a national project, the OECD was not involved in monitoring the compliance of the US data collection and subsequent data processing with the PIAAC standards or in the assessment of data quality. The technical details of the implementation of National Supplement are presented in the project's Technical Report (Hogan et al., 2016[11]).

The data from the US National Supplement have been released in the form of a national U.S. PUF and an OECD PUF for 2011(available on OECD website) combining data from the 2011-12 and 2014 data collections. An 2017 OECD PUF for the U.S. is planned to be released as well. Restricted-use versions of the files are also available to researchers.

It should be noted that the PIAAC 2012/14 data set was weighted to control totals from the 2012 American Community Survey (ACS) (a supplement to the population census) (Hogan et al., 2016[11]).The PIAAC 2012 data was weighted to the 2010 ACS (OECD, 2013[16]). The reweighting has some impact on the estimated proficiency of the population. The 2010 ACS was linked to the 2000 census whereas the 2012 ACS was based on the 2010 census. As it is weighted to more

up-to-date control totals (as well as being based on a larger sample), the combined PIAAC 2012/2014 data set for the US provides a more accurate representation of the proficiency of the US population (in the period 2011-14) than the 2012 data set. For this reason, data from the 2012-2014 US data set has been used in this report in place of the 2012 data set used in earlier reports.

Round 3

The US Round 3 data collection was also conducted as a *national* project managed by the NCES in conjunction with the Round 3 data collection managed by the OECD. It used the same instruments and followed similar procedures to the other countries participating in Round 3. Data collection was undertaken on a slightly different timetable to that of other participants. In the United States data were collected over March-September, 2017 compared to August 2017-April 2018 in other Round 3 countries. The United States deviated from the PIAAC Technical Standards (PIAAC, 2014[17]) in some areas. A field test was not undertaken. The sample size (a target of 3 800 cases) was less than the minimum sample size required by the PIAAC Standards and Guidelines (5 000 completed cases). Quality control activities were not the same in the United States as in other countries. In addition, the quality of the data for the United States was not reviewed by the PIAAC Technical Advisory Group (TAG) as was the case for the other five countries in Round 3. As in the case of the National Supplement, a full Technical Report has been released (Krenzke et al., 2019[18]). On the basis of the information in the Technical Report, the US data are considered to meet the PIAAC standards for publication.

The Round 3 data for the United States have been released in the form of a PUF and a restricted-use file.

ANNEX 1.A2. SKILLS TOWARDS EMPLOYMENT AND PRODUCTIVITY (STEP) SURVEY

The World Bank's Skills Towards Employment and Productivity (STEP) Skills Measurement Program (World Bank, 2019[19]) is an initiative to measure literacy skills in low and middle-income countries. It includes a household-based survey and an employer-based survey. The Program is a collaboration between the World Bank and the OECD in which the former used the PIAAC literacy assessment as part of its household-based survey.

The household-based survey uses three modules:

- a direct assessment of reading proficiency and related competencies scored on the same scale as the OECD's PIAAC Survey of Adult Skills
- self-reported information on personality, behaviour, and time and risk preferences
- self-reported questionnaire on the relevant skills that respondents possess or use in their job.

The employer-based survey has five modules which are designed to assess:

- the structure of the labour force
- the cognitive skills, behaviour and personality traits, and job-relevant skills that are currently being used, as well as skills employers look for when hiring new workers
- the provision of training and compensation by employers
- the level of satisfaction in the labour force with the education and skills training available.

The STEP collection (World Bank, 2019[19]) currently hosts data collected between March 2012 and August 2017 in Albania, Armenia, Azerbaijan, Bolivia, Bosnia and Herzegovina, Colombia, Georgia, Ghana, Kenya, Kosovo, Lao People's Democratic Republic, the Republic of North Macedonia, Serbia, Sri Lanka, Ukraine, Vietnam, and Yunnan Province in the People's Republic of China. In all countries, the target population is urban adults aged 15 to 64, whether employed or not.

It is important to note that this report, and other previous PIAAC reports, do not present results from STEP because the two surveys assess different target populations. The target population for the Survey of Adult Skills is the non-institutionalised population of 16-65 year-olds residing in the country or region at the time of the data collection, irrespective of nationality, citizenship or language status. The STEP target population is the population aged 15 to 64 inclusive, living in urban areas, as defined by each country's statistical office. Some STEP surveys had even narrower urban sampling. For example, in Yunnan Province (China) the sample covered only the urban areas of Kunming. Moreover, the Survey of Adult Skills also differs from STEP in terms of the sample size and the implementation standards used.

2

Adults' proficiency in key information-processing skills

This chapter describes the level and distribution of proficiency in the three information-processing skills assessed – literacy, numeracy and problem solving in technology-rich environments – among adults in the countries and economies participating in the Survey of Adult Skills. To help readers interpret the findings, it describes what the different levels of proficiency mean in concrete terms for each of these three domains. The chapter looks at the distribution in scores across countries and economies, and within participating countries, with particular focus on the six countries that participated in the third and final round of this cycle of data collection – Ecuador, Hungary, Kazakhstan, Mexico, Peru and the United States.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), assesses the proficiency of adults in literacy, numeracy and problem solving in technology-rich environments. These are considered to be key information-processing skills (OECD, 2019[1]) in that they are:

- necessary for fully integrating and participating in the labour market, education and training, and in social and civic life
- highly transferable, in that they are relevant to many social contexts and work situations
- "learnable" and, therefore, subject to the influence of policy.

Literacy and numeracy skills form a foundation for developing higher-order cognitive skills such as analytic reasoning and are essential for accessing and understanding specific domains of knowledge. In addition, they are relevant across a range of life contexts, from education and work to home, social life and interaction with public authorities. The capacity to manage information and solve problems in technology-rich environments is becoming a necessity as information and communications technology (ICT) applications permeate the workplace, the classroom and lecture hall, the home, and social interactions more generally. Adults who are highly proficient in the skills measured by the Survey of Adult Skills are likely to be able to make the most of the opportunities created by the technological and structural changes modern societies are going through. Those who struggle to use new technologies are at greater risk of losing out.

The skills assessed in the Survey of Adult Skills are each defined by a framework that guided the development of the assessment and that provides a reference point for interpreting results. Each framework defines the skills assessed in terms of:

- **Content** – the texts, artefacts, tools, knowledge, representations and cognitive challenges that constitute the corpus to which adults must respond or use when they read, act in a numerate way or solve problems in technology-rich environments.
- **Cognitive strategies** – the processes that adults must bring into play to respond to or use any given content in an appropriate manner.
- **Context** – the situations in which adults have to read, handle numerical information, and solve problems.

For an overview of the conceptual frameworks of each of the three domains, please consult the Reader's Companion (OECD, 2019[1]).

The main findings discussed in this chapter are:

- There is substantial variation in adults' average proficiency in the three domains assessed in the Survey of Adult Skills across countries and economies: some 100 score points separate the highest- and lowest-scoring countries in literacy and numeracy proficiency, although many countries score within a relatively narrow band. While overall proficiency differs across countries, it varies to a large extent even within countries: the average difference between the top and bottom 25% of adults was 61 score points in literacy and 68 score points in numeracy.
- Among the countries participating in Round 3 of the study, the average proficiency of adults in Hungary and the United States in all three domains was close to the OECD average, while in Ecuador, Mexico and Peru average proficiency was substantially below it. Average proficiency in Kazakhstan was somewhere between these two groups. The variation in scores between high- and low-performing adults also differed between the countries in Round 3. Peru, Ecuador and the United States displayed the greatest variation, with the score-point difference between the best- and worst-performing 25% of adults being greater than the OECD average. The variation between the top and bottom performers was similar to the average in Hungary and Mexico and below average in Kazakhstan.
- Low-skilled adults make up a significant share of the population in all participating countries and economies. On average across the OECD countries taking part in the survey, around one in five adults perform at or below Level 1 in either literacy or numeracy. In some Round 3 countries, like Mexico, Peru and Ecuador, more than half of adults scored at or below Level 1 in literacy and numeracy, while in Hungary and the United States, the shares were comparable to the OECD average. Even in high-performing countries like Japan, almost 10% of the adult population performed at the lowest levels of either literacy or numeracy.
- While many adults in all countries may have poor literacy skills, there are very few adults in the countries participating in PIAAC who could be regarded as illiterate. In most cases, adults with low proficiency performed well on the reading components module that assesses mastery of the basic building blocks of reading comprehension – vocabulary

knowledge, understanding the logic of sentences and reading fluency. In Ecuador, Mexico and Peru, which have very high proportions of adults performing at Level 1 or below for literacy, only around 8-20% of adults failed the literacy and numeracy core tests designed to identify the respondents who had the capacity to undertake the full assessment. In addition, those failing the core test in these countries correctly answered more than 77% of the items in the sentence-processing elements of the reading components assessment, more than 74% of the passage-comprehension items and 92% of the print-vocabulary items.

- Across OECD countries on average, around one in four adults have no or only limited experience with computers or lack confidence in their ability to use computers. In addition, nearly half of adults are proficient only at or below Level 1 in problem solving in technology-rich environments. This means they are able to use only familiar applications to solve problems that involve few steps and explicit criteria, such as sorting e-mails into pre-existing folders. Among the Round 3 countries, the share of adults with no or little ICT experience was similar to the OECD average of 16.3% in Hungary (14.4%) and Kazakhstan (19.7%) and below the average in the United States (7.4%). In contrast, Ecuador, Mexico and Peru stand out for the large proportions of their adult populations with no prior computer experience or very poor ICT skills: 32.9% in Ecuador, 39.3% in Mexico and 43.6% in Peru.

Box 2.1. **A historical context for cross-national comparisons of adult proficiency**

This report provides an overview of the results from the three rounds of the first cycle of the Survey of Adult Skills. Data collection in each of the rounds used the same survey instruments and was conducted under the same survey protocols. Round 1, which involved 24 countries and economies, took place in 2011-12; 9 additional countries participated in Round 2, which was conducted during 2014-15; and 6 countries participated in Round 3 (2017-18) including the United States, which had also collected data in Round 1.

The survey was designed to ensure that the cross-country comparisons of proficiency in literacy, numeracy and problem solving in technology-rich environments are as robust as possible and that the content of the assessment was equivalent in difficulty in each of the 28 language versions of the assessment. Care was taken to standardise implementation, including the sample design and field operations, in all participating countries and economies. The quality assurance and quality control procedures put in place are among the most comprehensive and stringent ever implemented for an international household survey. The details of the technical standards guiding the design and implementation of the survey can be found in the *Survey of Adult Skills: Reader's Companion, Third Edition* (OECD, 2019[1]) and in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[2]).

Interpreting differences in results among countries is nonetheless a challenging task, particularly as the Survey of Adult Skills covers adults born between 1946 and 1996 (for the countries included in Round 1), between 1948 and 1998 (in Round 2) and between 1951 and 2001 (in Round 3). These adults could have started their schooling at any time from the early 1950s to the early 2000s and entered the labour market from the early 1960s to the present day. The results observed for each participating country, at least at the aggregate level reported in this chapter, represent the outcomes of a period of history that extends as far back as the immediate post-war era, which has been marked by significant social, political and economic change. For this reason, the results of the Survey of Adult Skills should not be interpreted only, or even primarily, in light of current policy settings or those of the recent past, important as these may be. Adults in different countries and different age cohorts within countries will have faced different opportunities to develop, maintain and enhance the skills assessed, depending on the evolution of education and training systems and policies, the path of national economic development, and changes in social norms and expectations.

The countries and economies in the Survey of Adult Skills diverge both in terms of the timing and the rate of economic growth and educational expansion. By way of illustration, Figure 2.1 presents the evolution of gross domestic product (GDP) per capita since 1990 for the countries in Round 3 together with the average for OECD countries and some other comparator countries. The countries presented in the graph clearly started at relatively different levels of GDP per capita. All of the countries and economies included have experienced an overall increase

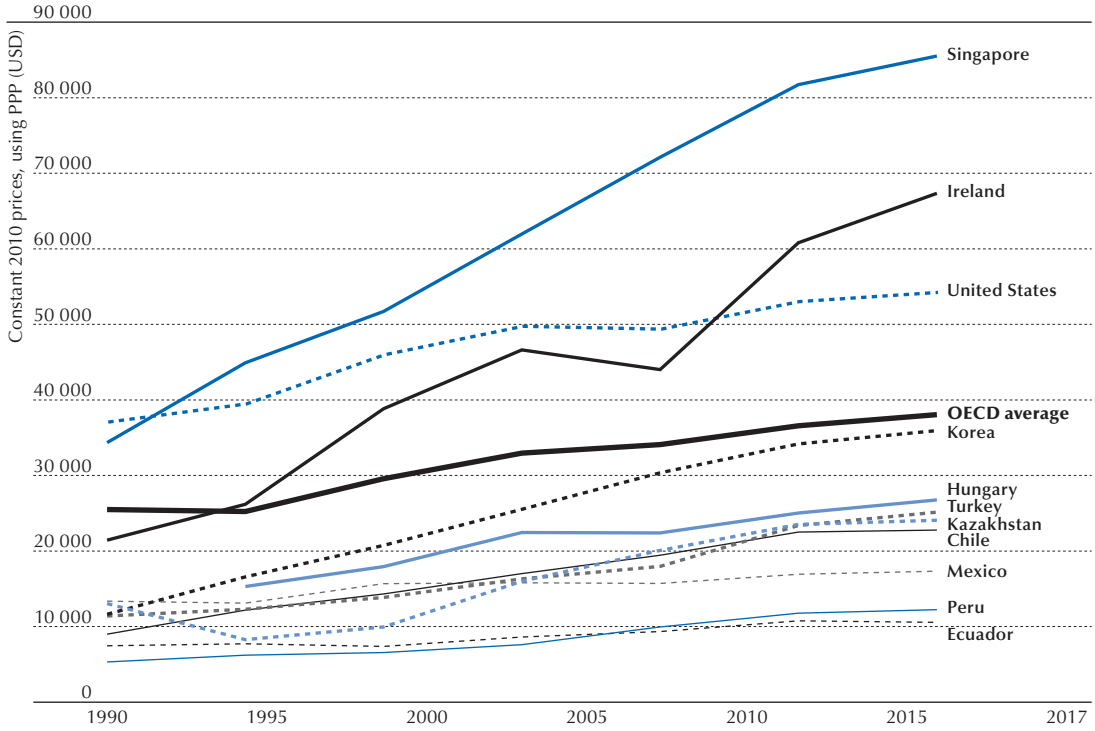
...

in per capita GDP since 1990, with Ireland, Korea and Singapore seeing particularly large increases in the past three decades. In other countries, GDP has not increased nearly as rapidly. Among Round 3 countries, per capita GDP increased by almost 60% in Peru between 2005 and 2017, compared to increases of around 23% in Ecuador and Hungary and around 10% in Mexico and the United States over the same period.

Comparing the levels of educational attainment among the older and younger cohorts taking part in the Survey of Adult Skills gives an idea of the different patterns of educational expansion that occurred among participating countries over the last half century. Some countries, such as Korea, Poland and Singapore, have seen rapid expansion in participation in higher education (Figure 2.2) from a relatively low starting point, reflected in the large differences in the rates of tertiary attainment between older and younger age groups. Others, such as Canada, Estonia, Israel, New Zealand, the Russian Federation and the United States, have had high levels of participation in tertiary education throughout the post-war period. In general, increases in tertiary participation have been accompanied by a fall in the proportion of adults who have completed less than a full secondary education. However, there is significant variation across countries. In countries such as Germany, Lithuania, the Russian Federation and the United States, the proportion of adults who have less than a full upper secondary qualification has remained stable over the post-war period, while in others, such as Italy, younger adults are much less likely to lack an upper secondary education than older adults. In Mexico and Turkey there are still significant proportions of both younger and older adults without an upper secondary education. These are also among the countries with the smallest proportions of adults, both younger and older, who have attained tertiary education.

Figure 2.1 ▪ **Per capita gross domestic product, USD**

Constant 2010 prices, using purchasing power parity (PPP)

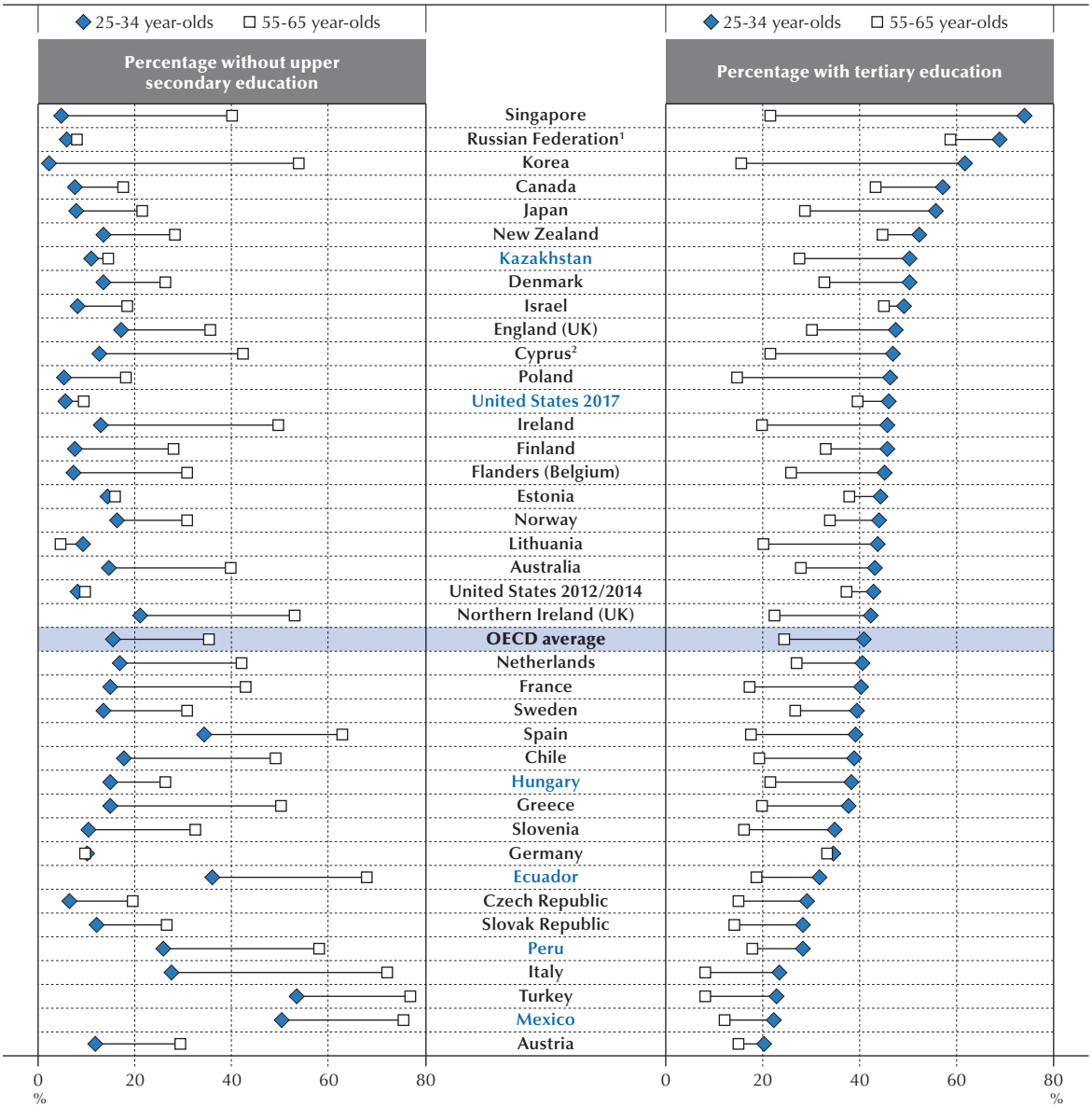


Source: World Bank (2019[3]), GDP per capita (constant 2010 US$), https://data.worldbank.org/indicator/NY.GDP.PCAP.KD; Table A2.12.

StatLink https://doi.org/10.1787/888934019856

Figure 2.2 ▪ **Share of low and highly-educated adults**

Percentage of the population without upper secondary or tertiary education, by age group



1. See note at the end of this chapter.
2. *Note by Turkey:* The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.
Countries and economies are ranked in descending order of the percentage of 25-34 year-olds with tertiary education.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A3.14.
StatLink https://doi.org/10.1787/888934019875

REPORTING THE RESULTS

In each of the three domains assessed, proficiency is considered to be a continuum of ability involving the mastery of information-processing tasks of increasing complexity. The results are represented on a scale ranging from 0 to 500. Each of the three proficiency scales is divided into "proficiency levels", defined by particular score-point ranges. The descriptors provide a summary of the types of tasks that can be successfully completed by adults with proficiency scores in a particular range. In

other words, they suggest what adults with particular proficiency scores in a particular skills domain can do. Six proficiency levels are defined for literacy and numeracy (from below Level 1 to Level 5) and four for problem solving in technology-rich environments (from below Level 1 to Level 3). The value ranges defining the levels and their respective descriptors are presented in Table 2.1, Table 2.2 and Table 2.3 in this chapter, and in the Reader's Companion to this report (OECD, 2019[1]).

Tasks (test items) vary in difficulty and are thus located at different points on the proficiency scales. For example, some tasks are easy and can be correctly solved by most respondents while others are difficult and can only be successfully completed by those with high proficiency. A person with a score in the middle of a certain proficiency level can successfully complete tasks located at this level around two-thirds of the time, a person with a score at the bottom of the level would successfully complete tasks at that level only about half the time, and someone with a score at the top of the level would successfully complete tasks at that level about 80% of the time.

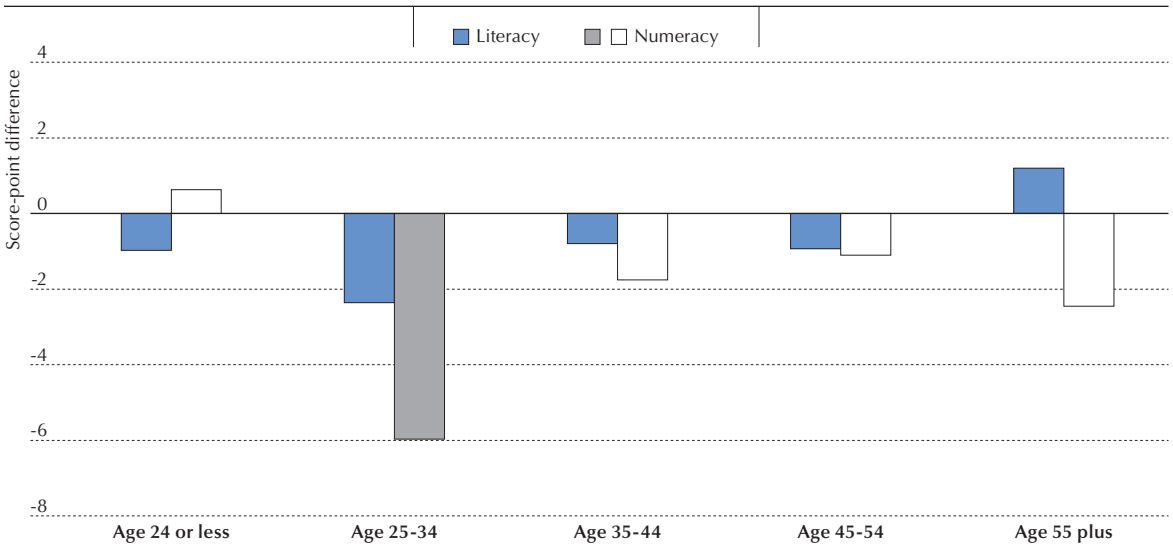
Box 2.2. **The evolution of skills proficiency in the United States**

The United States is the only country that has administered the PIAAC assessment to representative samples of its adult population more than once. This box briefly analyses the evolution of proficiency in literacy, numeracy and problem solving in technology-rich environment in the country between 2012-14 and 2017.

At first glance, very little has changed over this (short) time period. Average proficiency in literacy declined from 272 to 271 score points and in numeracy from 257 to 255, but these differences are not statistically significant, and are in any case negligible from a substantive point of view (see Tables A2.2 and A2.4 in Annex A). The share of adults who reported no prior computer experience declined from 5% to 3%, but the slight increase in the incidence of missing values and in the percentage of adults who failed the ICT core meant that the percentage of adults who were administered the problem-solving assessment did not change. Performance in the problem-solving assessment improved very marginally: the share of adults who scored at Level 2 and 3 increased from 29% to 31%, while the share scoring at or below Level 1 fell from 51% to 50% (see Table A2.7).

A few additional insights can be gained by breaking down the analysis for adults belonging to different age groups. Figure 2.3 shows that between 2012-14 and 2017 the numeracy proficiency of 25-34 year-olds declined by 6 points. For all other age groups, the differences are much smaller and are not statistically significant.

Figure 2.3 ▪ **The evolution of literacy and numeracy proficiency, by age**
Score-point difference between US cohorts assessed in 2012/2014 and 2017



Note: Statistically significant differences are marked in a darker tone.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.5(L) and A3.5(N).
StatLink https://doi.org/10.1787/888934019894

The most valuable aspect of the repeated administration of the PIAAC assessment lies in the opportunity to better assess the effect of ageing. Although PIAAC did not retest the same individuals, it is possible to follow a representative sample of the same birth cohorts over time: adults aged 25-29 in 2012-14 were (approximately) aged 30-34 in 2017, and so on.

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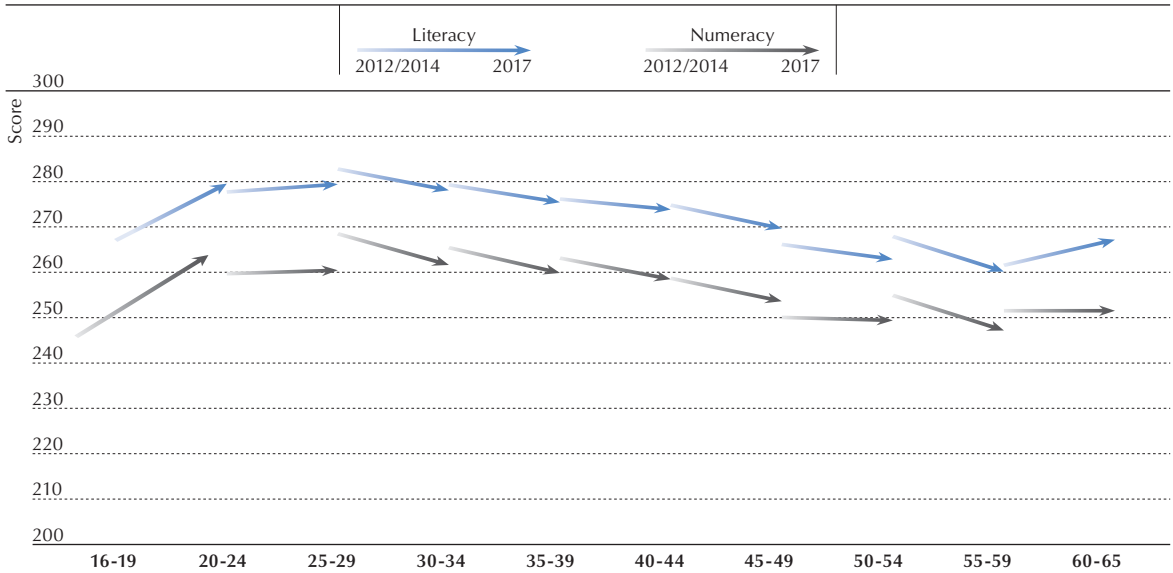
Figure 2.4 ■ **Age-proficiency profile in the United States**



Notes: Each segment in the graph shows the evolution of literacy and numeracy scores of one cohort of adults that participated in PIAAC both in 2012-14 and in 2017. The first segment connects the score of adults aged 16-19 in 2012-14 to the score of adults aged 20-24 in 2017. The second segment connects the score of adults aged 20-24 in 2012-14 to the score of adults aged 25-29 in 2017, and so on.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.5(L) and A3.5(N).
StatLink https://doi.org/10.1787/888934019913

Figure 2.4 shows that proficiency in literacy and numeracy tends to increase among younger adults, peaking in the early 30s and then gradually declining. This is roughly the same pattern that is observed in most countries where only one round of data collection was conducted (see Figure 3.6 in Chapter 3). The average scores of the cohorts that participated in both rounds of data collection (i.e. adults aged 16-59 in 2012-14 and adults aged 20-65 in 2017) declined, over this four-years period, by 1 point in literacy and by 2 points in numeracy.

The proficiency levels have a descriptive purpose. They are intended to aid in the interpretation and understanding of the reporting scales by describing the attributes of the tasks that adults with particular proficiency scores can successfully complete. It is emphasised that they have no normative element and should not be understood as "standards" or "benchmarks" in the sense of defining levels of proficiency appropriate for particular purposes (e.g. access to post-secondary education or fully participating in a modern economy) or for particular population groups. For ease of presentation, the figures showing the distribution of population by proficiency level have made a distinction between Level 2 and below and Level 3 and above in literacy and numeracy, and Level 2 and above and Level 1 or below in problem solving in technology-rich environments.

PROFICIENCY IN LITERACY

The Survey of Adult Skills defines literacy as the ability to understand, evaluate, use and engage with written texts in order to participate in society, achieve one's goals, and develop one's knowledge and potential. In the survey, the term "literacy" refers to reading written texts; it does not involve either comprehending or producing spoken language or producing text (writing). In addition, given the growing importance of digital devices and applications as a means of generating, accessing and storing written text, reading digital texts is an integral part of literacy measured in the Survey of Adult Skills (Box 2.3).

Digital texts are texts that are stored as digital information and accessed in the form of screen-based displays on devices such as computers and smart phones. Digital texts have a range of features that distinguish them from print-based texts: in addition to being displayed on screens, they include hypertext links to other documents, specific navigation features (e.g. scroll bars, use of menus) and interactivity. The Survey of Adult Skills is the first international assessment of adult literacy to cover this dimension of reading.

Box 2.3. **Reading on a screen or on paper: Does it affect proficiency in literacy?**

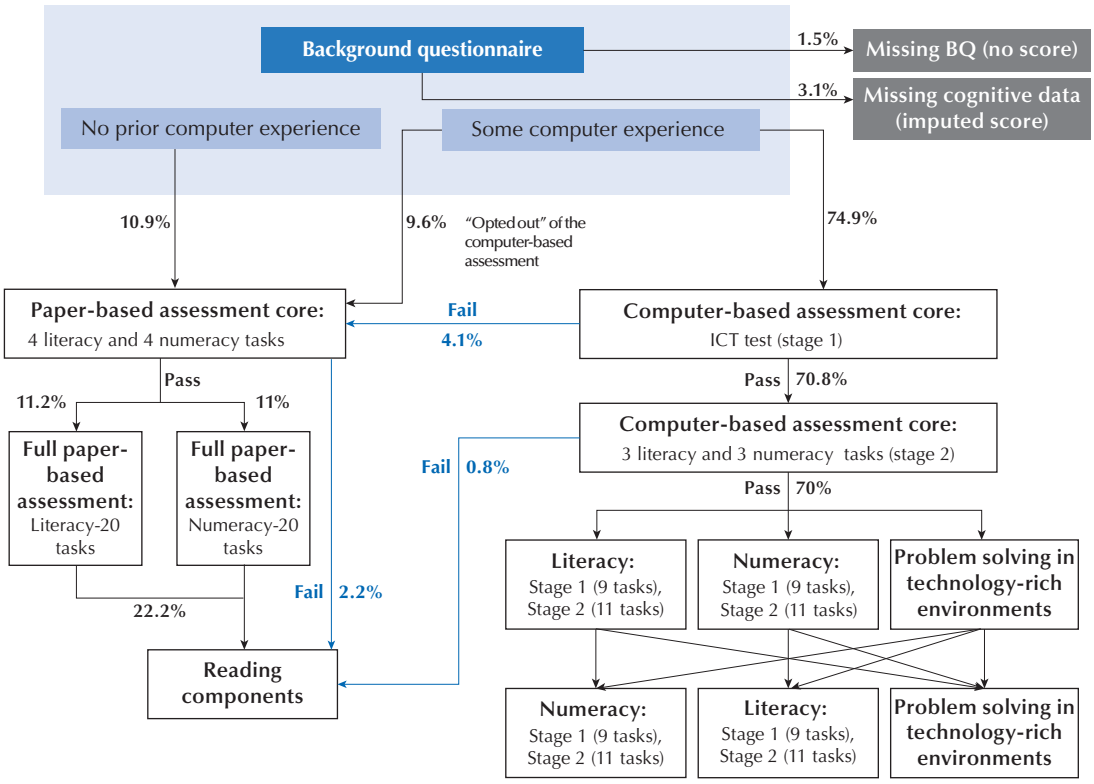
The assessment component of the Survey of Adult Skills was delivered in both a computer-based and a paper-based version. On average across OECD countries and economies 71% of respondents took the computer-based assessment and some 25% took the paper-based assessment as they had no or poor computer skills or expressed a preference to do so (Figure 2.5; see also Figure 2.15 and Table A2.11 in Annex A for further discussion).

Computer-based and paper-based assessments of literacy differ in two main ways. First, the paper-based assessment exclusively tests the reading of print texts whereas the computer-based version covers the reading of digital texts, such as simulated websites, results pages from search engines and blog posts, in addition to the reading of print texts presented on a screen. Thus, while the items that contain print text are common to both modes, a subset of items with digital text are used only in the computer-based assessment.

Second, the response modes differ. In the paper-based test, respondents provide written answers in paper test booklets. In the computer-based test, responding to the assessment tasks involves interacting with text and visual displays on a computer screen using devices, such as a keyboard and a mouse, and functions, such as highlighting and drag and drop.

In spite of these differences, most of the test items that were common to both versions were found to have equal difficulty and discrimination properties [for details, see OECD, (2019[2])]. In other words, their measurement properties are unaffected by the mode in which the test was taken and as such can be placed on the same scale. This means that the processes of understanding the meaning of a text are fundamentally the same for all types of text. Analyses of the results from the Survey of Adult Skills show that once socio-demographic factors (age, educational attainment, immigration background and gender) are taken into account, there are no systematic differences between the scores of adults who took the paper-based assessment and those who took the computer-based assessment (the differences across several variables between adults who took the paper-based assessment and those who took the computer-based assessment are shown in Table A2.13 in Annex A).

Figure 2.5 ▪ **Percentage of respondents taking different pathways in the Survey of Adult Skills**



Note: The percentages presented in this diagram are based on the average of the OECD countries/economies participating in the Survey of adult Skills (PIAAC).

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Levels of literacy proficiency across countries and economies

The literacy proficiency scale is divided into six levels: Levels 1 to 5 and below Level 1. The features of the tasks at these levels are described in detail in Table 2.1 and examples of literacy items are available in OECD (2013[4]) and the Reader's Companion to this report (OECD, 2019[1]). Figure 2.6 presents the percentage of adults in each participating country or economy who scored at each of the six levels of proficiency on the literacy scale.

Table 2.1 Description of the literacy proficiency levels

Level	Score range	Percentage of adults scoring at each level (OECD average)	Types of tasks completed successfully at each level of proficiency
Below Level 1	Below 176 points	4.8%	The tasks at this level require the respondent to read brief texts on familiar topics to locate a single piece of specific information. There is seldom any competing information in the text and the requested information is identical in form to information in the question or directive. The respondent may be required to locate information in short continuous texts. However, in this case, the information can be located as if the text were non-continuous in format. Only basic vocabulary knowledge is required, and the reader is not required to understand the structure of sentences or paragraphs or make use of other text features. Tasks below Level 1 do not make use of any features specific to digital texts.
1	176 to less than 226 points	15%	Most of the tasks at this level require the respondent to read relatively short digital or print continuous, non-continuous, or mixed texts to locate a single piece of information that is identical to or synonymous with the information given in the question or directive. Some tasks, such as those involving non-continuous texts, may require the respondent to enter personal information onto a document. Little, if any, competing information is present. Some tasks may require simple cycling through more than one piece of information. Knowledge and skill in recognising basic vocabulary determining the meaning of sentences, and reading paragraphs of text is expected.
2	226 to less than 276 points	34.3%	At this level, the medium of texts may be digital or printed, and texts may comprise continuous, non-continuous, or mixed types. Tasks at this level require respondents to make matches between the text and information, and may require paraphrasing or low-level inferences. Some competing pieces of information may be present. Some tasks require the respondent to: ▪ cycle through or integrate two or more pieces of information based on criteria ▪ compare and contrast or reason about information requested in the question ▪ navigate within digital texts to access and identify information from various parts of a document.
3	276 to less than 326 points	34.6%	Texts at this level are often dense or lengthy, and include continuous, non-continuous, mixed or multiple pages of text. Understanding text and rhetorical structures become more central to successfully completing tasks, especially navigating complex digital texts. Tasks require the respondent to identify, interpret or evaluate one or more pieces of information, and often require varying levels of inference. Many tasks require the respondent to construct meaning across larger chunks of text or perform multi-step operations in order to identify and formulate responses. Often tasks also demand that the respondent disregard irrelevant or inappropriate content to answer accurately. Competing information is often present, but it is not more prominent than the correct information.
4	326 to less than 376 points	9.5%	Tasks at this level often require respondents to perform multiple-step operations to integrate, interpret or synthesise information from complex or lengthy continuous, non-continuous, mixed, or multiple type texts. Complex inferences and application of background knowledge may be needed to perform the task successfully. Many tasks require identifying and understanding one or more specific, non-central idea(s) in the text in order to interpret or evaluate subtle evidence-claim or persuasive discourse relationships. Conditional information is frequently present in tasks at this level and must be taken into consideration by the respondent. Competing information is present and sometimes seemingly as prominent as correct information.
5	Equal or higher than 376 points	0.5%	At this level, tasks may require the respondent to search for and integrate information across multiple, dense texts; construct syntheses of similar and contrasting ideas or points of view; or evaluate evidence-based arguments. Application and evaluation of logical and conceptual models of ideas may be required to accomplish tasks. Evaluating the reliability of evidentiary sources and selecting key information is frequently a requirement. Tasks often require respondents to be aware of subtle, rhetorical cues and to make high-level inferences or use specialised background knowledge.

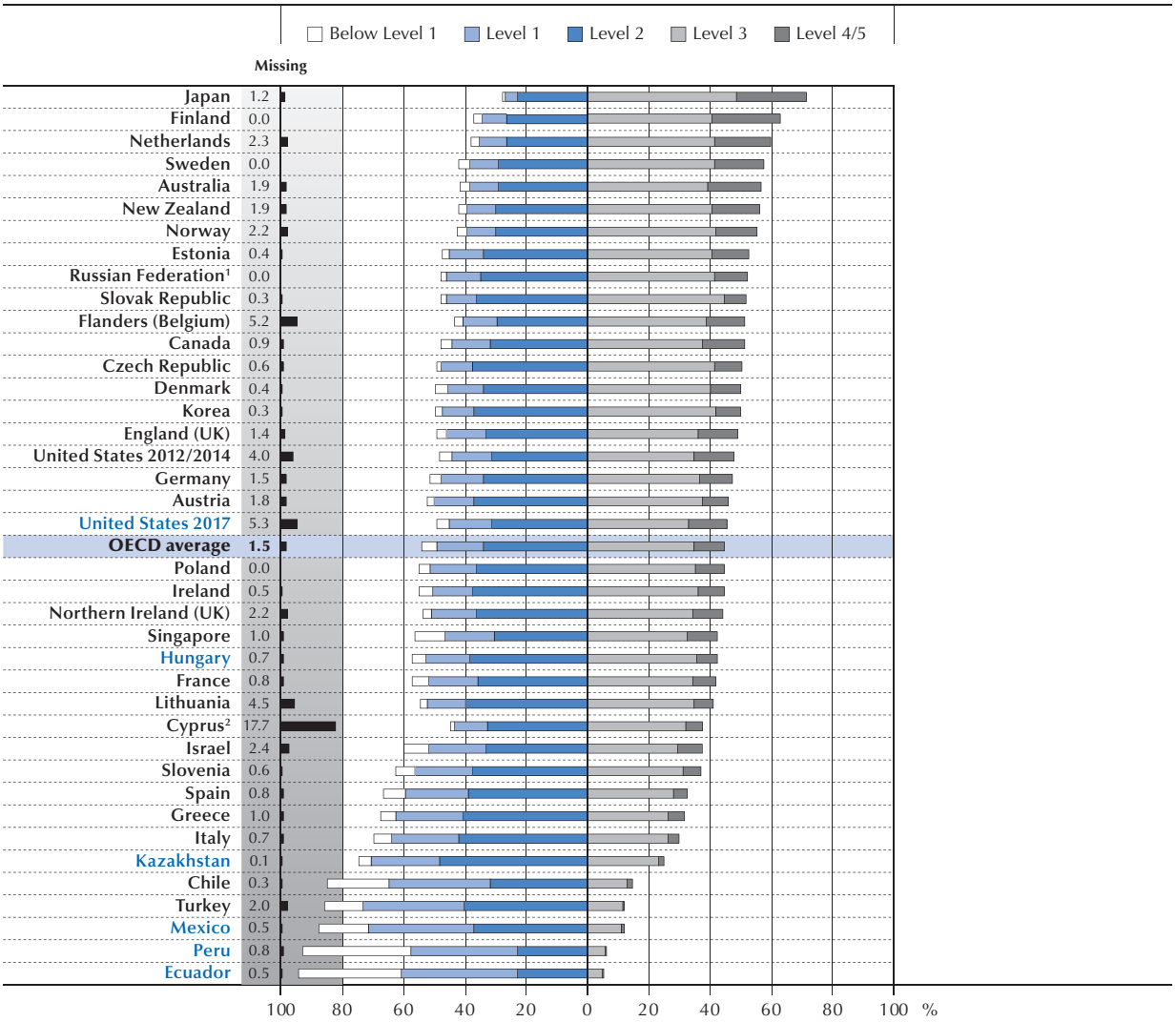
Note: The percentage of adults scoring at different levels of proficiency adds up to 100% when 1.5% of literacy-related non-respondents across countries/economies are taken into account. Adults in this category were not able to complete the background questionnaire due to language difficulties or learning and mental disabilities (see section on literacy-related non-response).

On average, across all OECD countries participating in the Survey of Adult Skills, one in ten adults (10.0%) scored at Level 4 or higher and one in three (34.6%) scored at Level 3. Overall, almost half of all adults (44.6%) scored at the three highest levels (Level 3, 4 or 5). Below these levels, around one in three adults (34.3%) performed at Level 2 and around one in five adults at Level 1 (15.0%) or below Level 1 (4.8%). Among countries participating in Round 3 of PIAAC, the proportions of adults scoring at the different levels in Hungary (42.1% at Level 3 and above; 38.7% at Level 2; 18.5% at Level 1 and below) and the United States (45.6% at Level 3 and above; 31.5% at Level 2; 17.6% at Level 1 and below) were close to the OECD average.

In contrast, less than one in eight adults performed at Level 3 or higher in Peru (6.1%), Mexico (11.7%) and Ecuador (5.2%). These proportions compare with those observed in other middle-income countries (see Box 1.2 in Chapter 1) such as Turkey (12.1%), one of the lowest performers from Round 2. These Round 3 Latin American countries were also among the countries and economies with the largest proportions of adults who scored at Level 1 or below. With more than half of their population scoring at these levels, Peru (70.2%), Ecuador (71.2%), Mexico (50.6%) are comparable to the other countries in the region which participated in the survey such as Chile which also had a significant proportion of low-performing adults (53.4%).

Figure 2.6 ▪ **Literacy proficiency among adults**

Percentage of adults scoring at each proficiency level in literacy



Note: Adults in the missing category were not able to provide enough background information to impute proficiency scores because of language difficulties, or learning or mental disabilities (referred to as literacy-related non-response).
1. See note at the end of this chapter.
2. See note 2 under Figure 2.2.
Countries and economies are ranked in descending order of the combined percentages of adults scoring at Level 3 and at Level 4/5.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.1.

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Kazakhstan, despite being a middle-income country itself, falls somewhere between these two groups of Round 3 countries. The proportion of adults scoring at Level 3 and above in Kazakhstan (25%) is smaller than in Hungary and the United States but higher than in Ecuador, Mexico and Peru. Close to half of the adult population in Kazakhstan performs at Level 2 (48.5%) and the proportion of the population scoring at Level 1 and below (26.3%) is only marginally higher than the corresponding OECD average (19.7%).

Literacy-related non-response

In all of the participating countries and economies, some adults were unable to complete the background questionnaire, as they were unable to understand or read the language of the assessment, had difficulty reading or writing, or had learning or mental disabilities. In the case of the background questionnaire, there was no one present (either the interviewer or another person) to translate into the language of the respondent or answer on behalf of the respondent.

In the case of these respondents, only their age, sex and, in some cases, educational attainment is known. In most countries, non-respondents represented less than 5% of the total population. This category is identified separately in Figure 2.6 as a patterned bar in each country (categorised as "missing"). While the proficiency of this group is likely to vary among countries, in most cases these individuals are likely to have low levels of proficiency (Level 1 or below) in the test language(s) of the country concerned.

Distribution of proficiency scores across and within countries and economies

Figure 2.7 shows the average score for each country or economy alongside a list of the other countries with average scores that are not statistically different from its own (see Box 2.4).

Box 2.4. Comparing results across countries/economies and population subgroups

The statistics in this report are estimates of national performance based on samples of adults from each country. Consequently, each estimate referring to the target population has an associated degree of uncertainty, which is expressed through a standard error. The use of confidence intervals provides a way to make inferences about the population means and proportions in a manner that reflects the uncertainty associated with the sample estimates. From an observed sample statistic, and assuming a normal distribution, it can be inferred that the result for the corresponding population would lie within the confidence interval in 95 out of 100 replications of the measurement on different samples drawn from the same population.

In many cases, readers are primarily interested in whether a given value in a particular country is different from a second value in the same or another country, e.g. whether women in a country perform better than men in the same country or whether adults in one country have higher average scores than adults in another country. In the tables and figures used in this report, differences are labelled as statistically significant when there is less than a 5% chance that an observed difference between two representative samples reflects random sample variation, rather than actual differences between these populations.

In addition to errors associated with sampling, there are a range of other possible sources of errors in sample surveys such as the Survey of Adult Skills, including errors associated with survey non-response (see Chapter 3 of the Reader's Companion to this report (OECD, 2019[1]) for a discussion of response rates and non-response bias). While the likely level of bias associated with non-response is assessed as minimal to low for most of the countries and economies participating in the study, the possibility of biases associated with non-response cannot be ruled out. Readers should therefore exercise caution in drawing conclusions from small score-point differences between countries or population groups, even if the differences concerned are statistically significant.

The average literacy score across the OECD countries and economies that participated in the assessment is 266 points, towards the top of Level 2 on the literacy scale. Among the Round 3 countries, the average proficiency of adults in Hungary (264 points) and the United States (271 points) was similar to the OECD average, that in Mexico (222 points), Peru (196 points) and Ecuador (196 points) was substantially below it and in Kazakhstan, the average proficiency of adults was between these two groups (249 points).

In addition to examining differences in average literacy proficiency between countries, it is also useful to explore differences in the distribution of scores within each country or economy. This can be done by identifying the score

below which 5%, 25%, 75% and 95% of adults perform. Comparing score-point differences among adults at different points in the distribution of proficiency measures the extent of variation in that distribution in each participating country or economy. Figure 2.8 presents the distribution of scores within countries and economies in addition to the mean score. A longer bar indicates greater variations in literacy proficiency within a country; a shorter bar indicates smaller variations.

Figure 2.7 ▪ **Comparison of average literacy proficiency**

Mean literacy proficiency scores of 16-65 year-olds

Significantly **above** the average
Not significantly different from the average
Significantly **below** the average

Mean	Comparison country	Countries whose mean score is NOT significantly different from the comparison country
296	**Japan**	
288	**Finland**	
284	**Netherlands**	
281	**New Zealand**	Australia, Sweden, Russian Federation[1]
280	**Australia**	New Zealand, Norway, Sweden, Russian Federation[1]
279	**Sweden**	Australia, New Zealand, Norway, Russian Federation[1]
278	**Norway**	Australia, Sweden, Russian Federation[1]
276	**Estonia**	Czech Republic, Flanders (Belgium), Russian Federation[1]
275	**Flanders (Belgium)**	Czech Republic, Estonia, Slovak Republic, Russian Federation[1]
275	**Russian Federation[1]**	Australia, Canada, Czech Republic, Denmark, England (UK), Estonia, Flanders (Belgium), Germany, Korea, New Zealand, Northern Ireland (UK), Norway, Slovak Republic, Sweden, United States 2012/2014, United States 2017
274	**Czech Republic**	Canada, England (UK), Estonia, Flanders (Belgium), Korea, Slovak Republic, United States 2012/2014, United States 2017, Russian Federation[1]
274	**Slovak Republic**	Canada, Czech Republic, England (UK), Flanders (Belgium), Korea, United States 2012/2014, Russian Federation[1]
273	**Canada**	Czech Republic, England (UK), Korea, Slovak Republic, United States 2012/2014, United States 2017, Russian Federation[1]
273	**England (UK)**	Canada, Czech Republic, Denmark, Korea, Northern Ireland (UK), Slovak Republic, United States 2012/2014, United States 2017, Russian Federation[1]
273	**Korea**	Canada, Czech Republic, England (UK), Northern Ireland (UK), Slovak Republic, United States 2012/2014, United States 2017, Russian Federation[1]
272	**United States 2012/2014**	Austria, Canada, Czech Republic, Denmark, England (UK), Germany, Korea, Northern Ireland (UK), Slovak Republic, United States 2017, Russian Federation[1]
271	**United States 2017**	Austria, Canada, Czech Republic, Denmark, England (UK), Germany, Korea, Northern Ireland (UK), United States 2012/2014, Cyprus[2], Russian Federation[1]
271	**Denmark**	Austria, England (UK), Germany, Northern Ireland (UK), United States 2012/2014, United States 2017, Russian Federation[1]
270	**Germany**	Austria, Denmark, Northern Ireland (UK), United States 2012/2014, United States 2017, Cyprus[2], Russian Federation[1]
269	**Austria**	Denmark, Germany, Northern Ireland (UK), United States 2012/2014, United States 2017, Cyprus[2]
269	**Cyprus[2]**	Austria, Germany, Ireland, Lithuania, Northern Ireland (UK), United States 2017
269	**Northern Ireland (UK)**	Austria, Denmark, England (UK), Germany, Ireland, Korea, Lithuania, Poland, United States 2012/2014, United States 2017, Cyprus[2], Russian Federation[1]
267	**Poland**	Ireland, Lithuania, Northern Ireland (UK)
267	**Lithuania**	Ireland, Northern Ireland (UK), Poland, Cyprus[2]
267	**Ireland**	Lithuania, Northern Ireland (UK), Poland, Cyprus[2]
266	**OECD average**	**Ireland, Lithuania, Northern Ireland (UK), Poland**
264	**Hungary**	France
262	**France**	Hungary
258	**Singapore**	Slovenia
256	**Slovenia**	Greece, Israel, Singapore
255	**Israel**	Greece, Slovenia
254	**Greece**	Israel, Slovenia, Spain
252	**Spain**	Greece, Italy
250	**Italy**	Spain, Kazakhstan
249	**Kazakhstan**	Italy
227	**Turkey**	
222	**Mexico**	Chile
220	**Chile**	Mexico
196	**Ecuador**	Peru
196	**Peru**	Ecuador

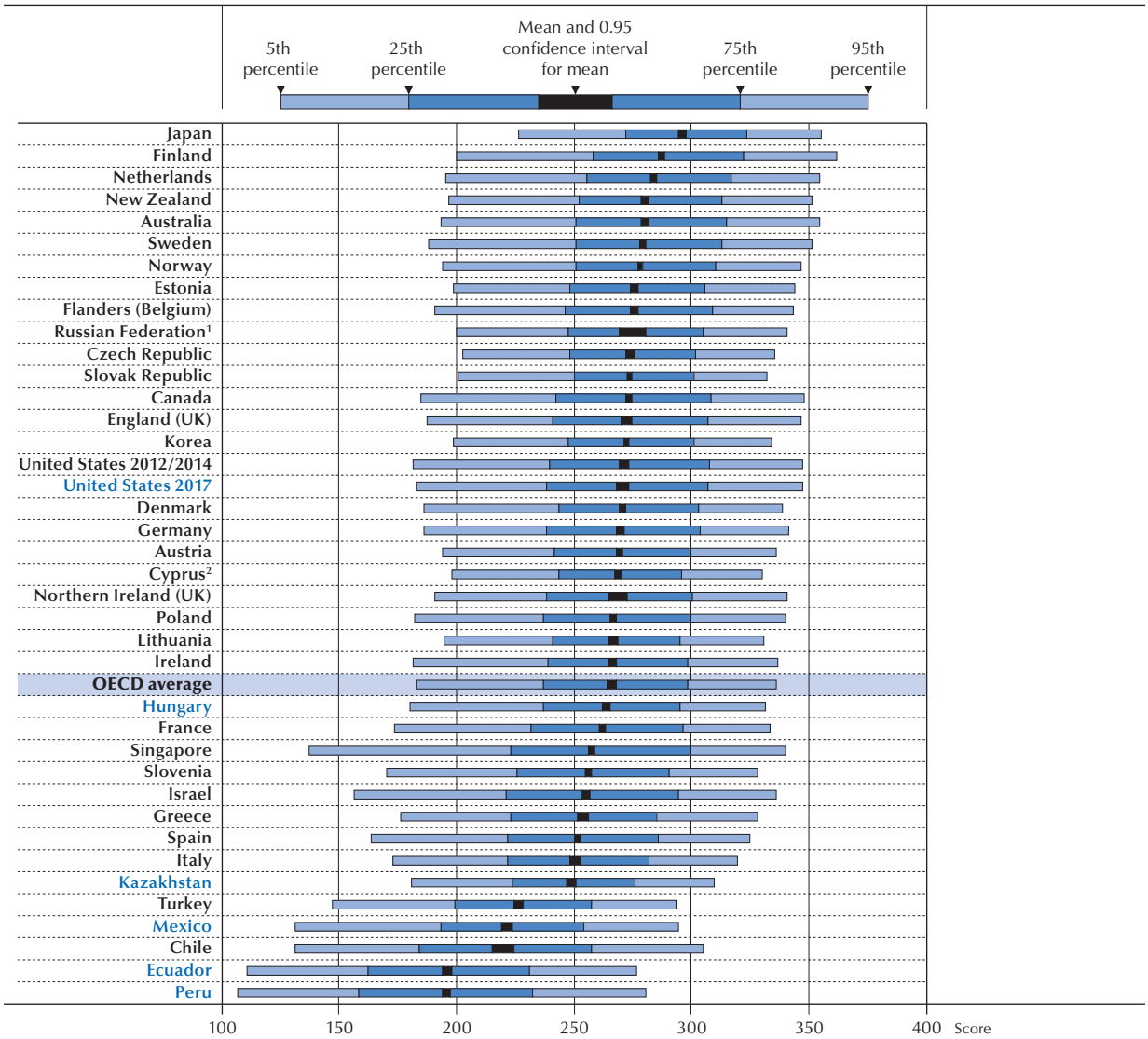
Note: Statistical significance is at the 5% level. Literacy-related non-response (missing) is excluded from the calculation of mean scores.
1. See note at the end of this chapter.
2. See note 2 under Figure 2.2.
Countries and economies are ranked in descending order of the mean score.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.2.
StatLink https://doi.org/10.1787/888934019970

On average among OECD countries, 61 score points separate the 25% of adults who attained the highest and lowest scores in literacy (a measure known as the interquartile range). Of the countries participating in Round 3, Peru has the widest variation in literacy scores with a gap of 74 score points between the top- and bottom-performing 25%. This is virtually identical to the gap observed in its Latin American counterpart from Round 2, Chile (73 score points) and slightly less than Singapore, the country with the widest gap (77 score points).

Among the other countries participating in Round 3, the gap in literacy scores between the top- and bottom-performing 25% of adults in Ecuador (68 points) and the United States (69 points) is wider than the OECD average. In Mexico (61 points) and Hungary (58 points), the variation in scores is close to the OECD average, while in Kazakhstan, it is lower than the OECD average (52 points).

Figure 2.8 ▪ **Distribution of literacy proficiency scores**

Mean literacy proficiency and distribution of literacy scores, by percentile



Notes: Mean scores are shown with a 0.95 confidence interval. Literacy-related non-response (missing) is excluded from the calculation of mean scores.
1. See note at the end of this chapter.
2. See note 2 under Figure 2.2.
Countries and economies are ranked in descending order of the mean score.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.2.

StatLink https://doi.org/10.1787/888934019989

PROFICIENCY IN NUMERACY

The Survey of Adult Skills defines numeracy as the ability to access, use, interpret and communicate mathematical information and ideas in order to engage in and manage the mathematical demands of a range of situations in adult life. A numerate adult is one who responds appropriately to mathematical content, information and ideas represented in various ways in order to manage situations and solve problems in a real-life context. While performance on numeracy tasks is, in part, dependent on the ability to read and understand text, numeracy involves more than applying arithmetical skills to information embedded in text.

Levels of numeracy proficiency across countries and economies

As with the literacy scale, the numeracy proficiency scale is divided into six proficiency levels: Levels 1 to 5 and below Level 1. The features of the tasks located at these levels are described in detail in Table 2.2 and examples of numeracy items are available in OECD (2013[4]).

Table 2.2 Description of the numeracy proficiency levels

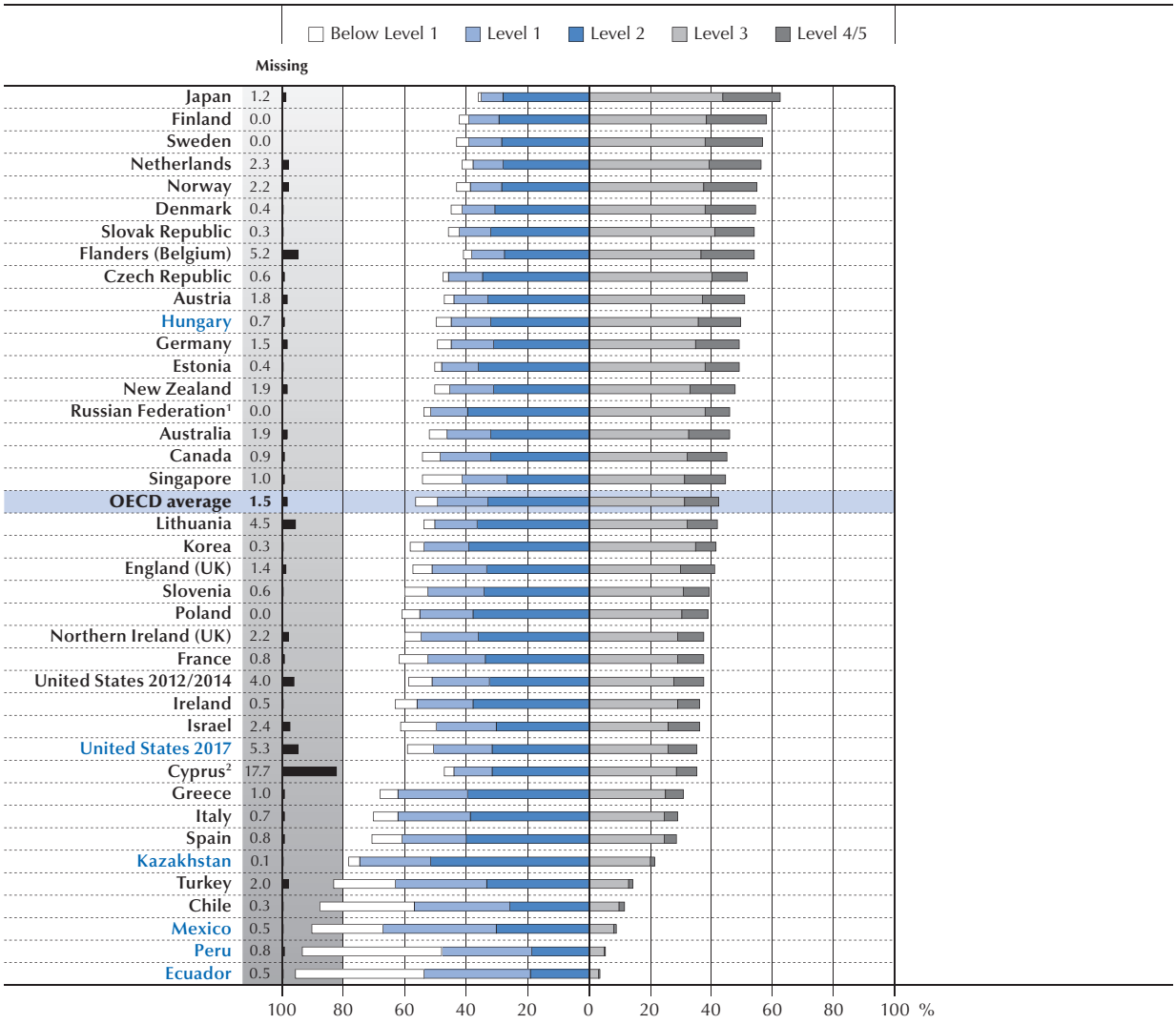
Level	Score range	Percentage of adults scoring at each level (OECD average)	Types of tasks completed successfully at each level of proficiency
Below Level 1	Below 176 points	7.1%	Tasks at this level require the respondents to carry out simple processes, such as counting, sorting, performing basic arithmetic operations with whole numbers or money, or recognising common spatial representations in concrete, familiar contexts where the mathematics content is explicit with little or no text or distractors.
1	176 to less than 226 points	16.4%	Tasks at this level require the respondent to carry out basic mathematical processes in common, concrete contexts where the mathematical content is explicit, with little text and minimal distractors. Tasks usually require one-step or simple processes involving counting, sorting, performing basic arithmetic operations, understanding simple percentages, such as 50%, and locating and identifying elements of simple or common graphical or spatial representations.
2	226 to less than 276 points	33.0%	Tasks at this level require the respondent to identify and act on mathematical information and ideas embedded in a range of common contexts where the mathematics content is fairly explicit or visual with relatively few distractors. Tasks tend to require the application of two or more steps or processes involving calculation with whole numbers and common decimals, percentages and fractions; simple measurement and spatial representation; estimation; and interpretation of relatively simple data and statistics in texts, tables and graphs.
3	276 to less than 326 points	31.2%	Tasks at this level require the respondent to understand mathematical information that may be less explicit, embedded in contexts that are not always familiar and represented in more complex ways. Tasks require several steps and may involve the choice of problem-solving strategies and relevant processes. Tasks tend to require the application of number sense and spatial sense; recognising and working with mathematical relationships, patterns and proportions expressed in verbal or numerical form; and interpretation and basic analysis of data and statistics in texts, tables and graphs.
4	326 to less than 376 points	10.0%	Tasks at this level require the respondent to understand a broad range of mathematical information that may be complex, abstract or embedded in unfamiliar contexts. These tasks involve undertaking multiple steps and choosing relevant problem-solving strategies and processes. Tasks tend to require analysis and more complex reasoning about quantities and data; statistics and chance; spatial relationships; and change, proportions and formulas. Tasks at this level may also require understanding arguments or communicating well-reasoned explanations for answers or choices.
5	Equal or higher than 376 points	1.0%	Tasks at this level require the respondent to understand complex representations and abstract and formal mathematical and statistical ideas, possibly embedded in complex texts. Respondents may have to integrate multiple types of mathematical information where considerable translation or interpretation is required; draw inferences; develop or work with mathematical arguments or models; and justify, evaluate and critically reflect upon solutions or choices.

Note: The proportion of adults scoring at different levels of proficiency adds up to 100% when the 1.5% of numeracy-related non-respondents across countries/economies are taken into account. Adults in the missing category were not able to provide enough background information to impute proficiency scores because of language difficulties, or learning or mental disabilities (see section on literacy-related non-response above).

Figure 2.9 presents the percentage of adults who scored at each of the six proficiency levels on the numeracy scale in each participating country. On average across participating OECD countries/economies, two in five adults scored at Level 3 and above (42.2%) in numeracy (see Table A2.3 in Annex A). Of the countries participating in Round 3, Hungary had the highest proportion of adults performing at this level (49.4%), slightly above the OECD average and close to the proportion observed in countries such as Austria, Germany, the Czech Republic and Estonia. In the United States, 35.4% of adults were proficient at Level 3 and above (well below the OECD average). Very small shares of the population performed at this level in Mexico (8.9%), Peru (5.6%) and Ecuador (3.6%). In this, these countries were similar to Chile (11.9%) and Turkey (14.5%) in Round 2. The proportion of adults performing at these levels in Kazakhstan was higher than that of other Round 3 middle-income countries but lower than that of Hungary and the United States. With 21.4% of adults performing at the three highest levels of numeracy proficiency, Kazakhstan is similar to countries like Italy and Spain.

Figure 2.9 ▪ **Numeracy proficiency among adults**

Percentage of adults scoring at each proficiency level in numeracy



Note: Adults in the missing category were not able to provide enough background information to impute proficiency scores because of language difficulties, or learning or mental disabilities (referred to as literacy-related non-response).
1. See note at the end of this chapter.
2. See note 2 under Figure 2.2.
Countries and economies are ranked in descending order of the combined percentages of adults scoring at Level 3 and at Level 4/5.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.3.
StatLink https://doi.org/10.1787/888934020008

On average, across all OECD countries participating in the Survey of Adult Skills, around one in three adults scored at Level 2 (33.0%) and around one in four adults (23.5%) scored at the two lowest levels of numeracy proficiency (16.4% at Level 1 and 7.1% below Level 1). Of the countries taking part in Round 3, the share of adults in the United States at Level 2 and below was similar to the OECD average, while Hungary again performed better than the average with 17.7% of its adults at the lowest proficiency levels (Level 1 and below). In Kazakhstan, as in the case of literacy, around half the adult population performed at Level 2 and the share of adults at the lowest proficiency levels was 26.8%, close to the OECD average. Around three-quarters of the adult population in Ecuador (76.8%) and Peru (74.8%) were only proficient at Level 1 or below in numeracy. In Mexico, this was true of 60.1% of adults. Prior to Round 3, the countries with the largest proportions of adults scoring at Level 1 and below in numeracy were Chile (61.9%) and Turkey (50.2%).

Literacy-related non-response

As noted above, in all countries and economies there were some adults who could not complete the background questionnaire as they were unable to understand or read the language of the assessment, have difficulty reading or writing, or have a learning or mental disability. This category is identified separately in Figure 2.9 as a patterned bar in each country (categorised as "missing"). In most cases, these persons will have low proficiency (Level 1 or below) in numeracy when assessed in the test language(s) of the country concerned.

Distribution of proficiency scores across and within countries and economies

Figure 2.10 shows the average score for each country and economy alongside a list of the other countries with average scores that are not statistically different from its own. For example, the mean score among adults in Hungary (272 points) is not statistically different from that of adults in Estonia (273 points), Germany (272 points), New Zealand (271 points) and the Russian Federation (270 points), but is significantly different from those of adults in other countries or economies at the 95% confidence level (see Box 2.4).

The average numeracy score across the OECD countries and economies that participated in the assessment is 262 points. Among countries participating in Round 3, the average numeracy proficiency of adults in Hungary (272 points) was significantly higher than the OECD average, while the average in the United States and Kazakhstan was significantly lower (255 and 247 points respectively). Latin American countries, three of which participated in Round 3, recorded the lowest average scores across all participating countries/economies – Ecuador (185 points), Peru (179 points), Chile (206 points) and Mexico (210 points).

As the literacy and numeracy scales measure different constructs, scores on the two scales cannot be compared directly. However, it is interesting to examine the extent to which countries perform differently in literacy and numeracy relative to other countries and the OECD average. With some exceptions, the relative performance of countries is similar for literacy and numeracy. Among the Round 3 countries, Hungary and the United States stand out as going against the general pattern. Adults in Hungary scored close the OECD average in literacy, but significantly above average in numeracy. In contrast, adults in the United States performed above the OECD average in literacy, but well below the average in numeracy (see Figure 2.16 below).

Figure 2.11 shows the variation in numeracy proficiency observed within countries, giving the distribution of scores in addition to the mean score. A longer bar indicates greater variations in numeracy proficiency within a country or economy; a shorter bar indicates smaller variations.

On average across OECD countries, the gap between the highest and lowest 25% of performers in numeracy is 68 score points. Among the countries participating in Round 3, Peru, Ecuador and the United States all have a larger gap in scores between these groups than the OECD average (91 points for Peru, 74 points for Ecuador and 76 points for the United States), while in Hungary and Mexico, the gap is similar to the average, at 67 points for both. The score gap is much lower than the OECD average in Kazakhstan and at 48 points is relatively similar to the gap found in the Russian Federation, a country that is comparable to the former in terms of its middle-income status and socio-demographic characteristics. Peru has the widest distribution of numeracy proficiency among all the countries and economies participating in the first cycle of PIAAC.

Figure 2.10 ▪ **Comparison of average numeracy proficiency**

Mean numeracy proficiency scores of 16-65 year-olds

Significantly **above** the average
Not significantly different from the average
Significantly **below** the average

Mean	Comparison country	Countries whose mean score is NOT significantly different from the comparison country
288	**Japan**	
282	**Finland**	Flanders (Belgium), Netherlands
280	**Flanders (Belgium)**	Denmark, Finland, Netherlands, Norway, Sweden
280	**Netherlands**	Finland, Flanders (Belgium), Norway, Sweden
279	**Sweden**	Denmark, Flanders (Belgium), Netherlands, Norway
278	**Norway**	Denmark, Flanders (Belgium), Netherlands, Sweden
278	**Denmark**	Flanders (Belgium), Norway, Sweden
276	**Slovak Republic**	Austria, Czech Republic
276	**Czech Republic**	Austria, Slovak Republic
275	**Austria**	Czech Republic, Estonia, Slovak Republic, Russian Federation[1]
273	**Estonia**	Austria, Germany, Hungary, New Zealand, Russian Federation[1]
272	**Hungary**	Estonia, Germany, New Zealand, Russian Federation[1]
272	**Germany**	Estonia, Hungary, New Zealand, Russian Federation[1]
271	**New Zealand**	Estonia, Germany, Hungary, Russian Federation[1]
270	**Russian Federation[1]**	Australia, Austria, Canada, Estonia, Germany, Hungary, Lithuania, New Zealand, Cyprus[2]
268	**Australia**	Canada, Lithuania, Russian Federation[1]
267	**Lithuania**	Australia, Canada, Cyprus[2], Russian Federation[1]
265	**Canada**	Australia, Lithuania, Cyprus[2], Russian Federation[1]
265	**Cyprus[2]**	Canada, Korea, Lithuania, Russian Federation[1]
263	**Korea**	England (UK), Cyprus[2]
262	**OECD average**	**England (UK), Northern Ireland (UK)**
262	**England (UK)**	Korea, Northern Ireland (UK), Poland
260	**Poland**	England (UK), Northern Ireland (UK), Slovenia, United States 2012/2014
259	**Northern Ireland (UK)**	England (UK), Ireland, Poland, Slovenia, United States 2012/2014, United States 2017, Singapore
258	**Slovenia**	Ireland, Northern Ireland (UK), Poland, United States 2012/2014, United States 2017, Singapore
257	**Singapore**	Ireland, Northern Ireland (UK), Slovenia, United States 2012/2014, United States 2017
257	**United States 2012/2014**	Ireland, Northern Ireland (UK), Poland, Slovenia, Singapore
256	**Ireland**	France, Northern Ireland (UK), Slovenia, United States 2012/2014, United States 2017, Singapore
255	**United States 2017**	France, Greece, Ireland, Northern Ireland (UK), Slovenia, United States 2012/2014, United States 2017, Singapore
254	**France**	Ireland, United States 2017
252	**Greece**	Israel, United States 2017
251	**Israel**	Greece
247	**Italy**	Spain, Kazakhstan
247	**Kazakhstan**	Italy, Spain
246	**Spain**	Italy, Kazakhstan
219	**Turkey**	
210	**Mexico**	Chile
206	**Chile**	Mexico
185	**Ecuador**	
178	**Peru**	

Note: Statistical significance is at the 5% level. Literacy-related non-response (missing) is excluded from the calculation of mean scores.
1. See note at the end of this chapter.
2. See note 2 under Figure 2.2.
Countries and economies are ranked in descending order of the mean score.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.4.
StatLink https://doi.org/10.1787/888934020027

ADULTS WITH LOW PROFICIENCY AND THE READING COMPONENTS ASSESSMENT

In almost all countries and economies that took part in the Survey of Adult Skills, a sizable proportion of adults have low proficiency in either literacy or numeracy. In most countries, between 15% and 38% of 16-65 year-olds are proficient at Level 1 or below in either literacy or numeracy (see Figure 2.12). As described above, at Level 1, individuals can usually successfully complete simple reading and numeracy tasks, such as locating information in a short text or performing simple one-step arithmetic operations but they have trouble extracting information from longer and more complex texts or performing numerical tasks involving several steps and mathematical information represented in different ways. Individuals who perform below Level 1 are not only unable to locate information in complex texts but they experience difficulty doing so even with simple texts. Similarly, they struggle to complete simple numerical tasks.

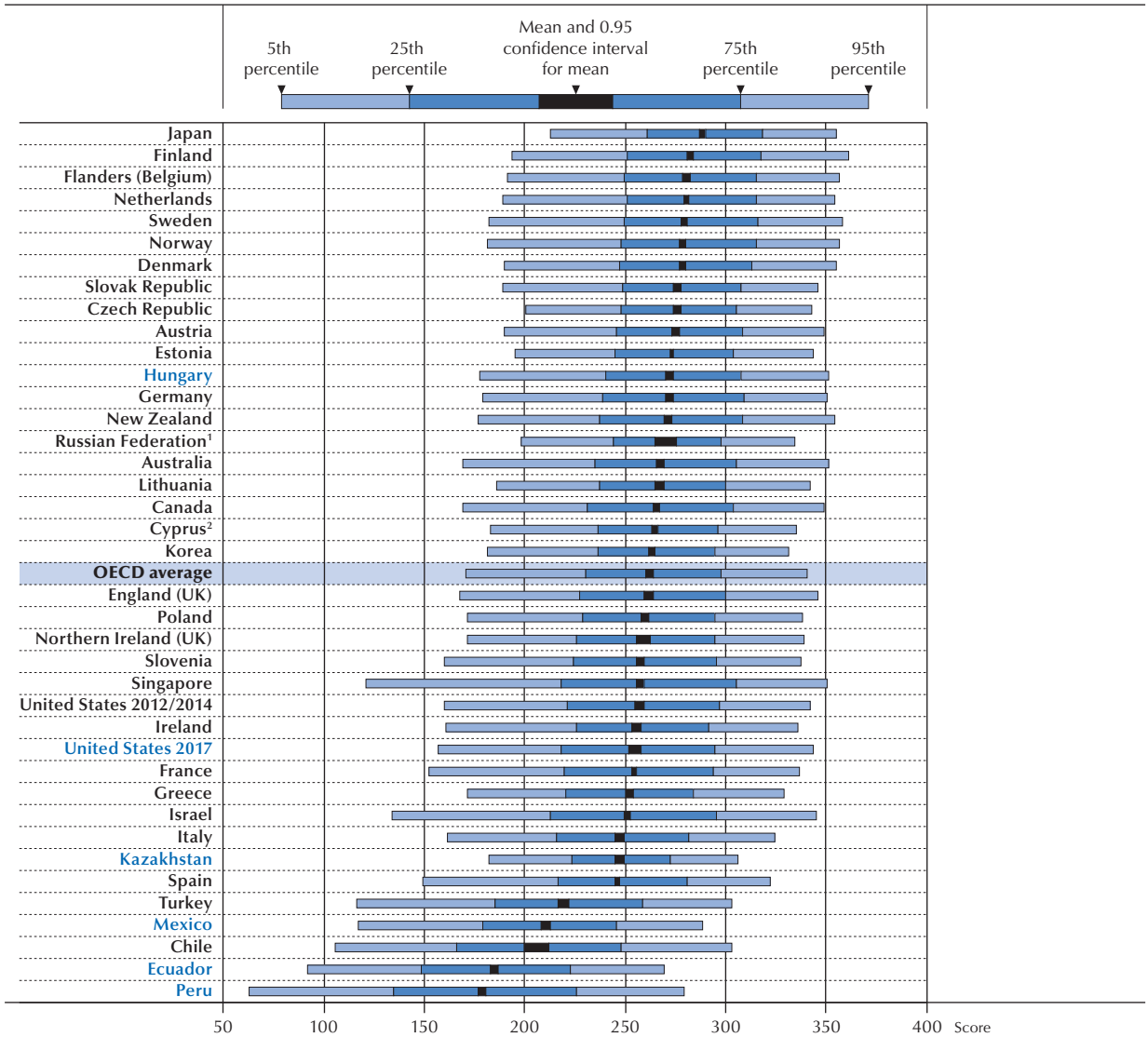
Five countries stand out as having very large shares of adults who are only proficient at Level 1 or below in literacy or numeracy, including three of the Round 3 countries: Turkey (56.9%), Mexico (64.7%), Chile (67.1%), Peru (80.1%) and Ecuador (82.2%).

In order to provide more information about the skills of adults with poor reading proficiency, the Survey of Adult Skills includes an assessment of reading components. The reading components assessment was designed to assess three skills considered to be an essential precondition for understanding the meaning of written texts: knowledge of print vocabulary (word recognition), the ability to evaluate the logic of sentences (sentence processing) and fluency in reading passages of text (passage comprehension).[1] Skilled readers are able to undertake these types of operations automatically. Chapter 1 of the Reader's Companion to this report (OECD, 2019[1]) presents samples of the reading components tasks. The reading components assessment was implemented in all countries except Finland, France, Japan and the Russian Federation.

The assessment of reading components was taken by respondents who failed the literacy and numeracy core assessment in the computer-based version of the assessment, and by all respondents taking the paper version of the assessment (Box 2.3).

Figure 2.11 ▪ **Distribution of numeracy proficiency scores**

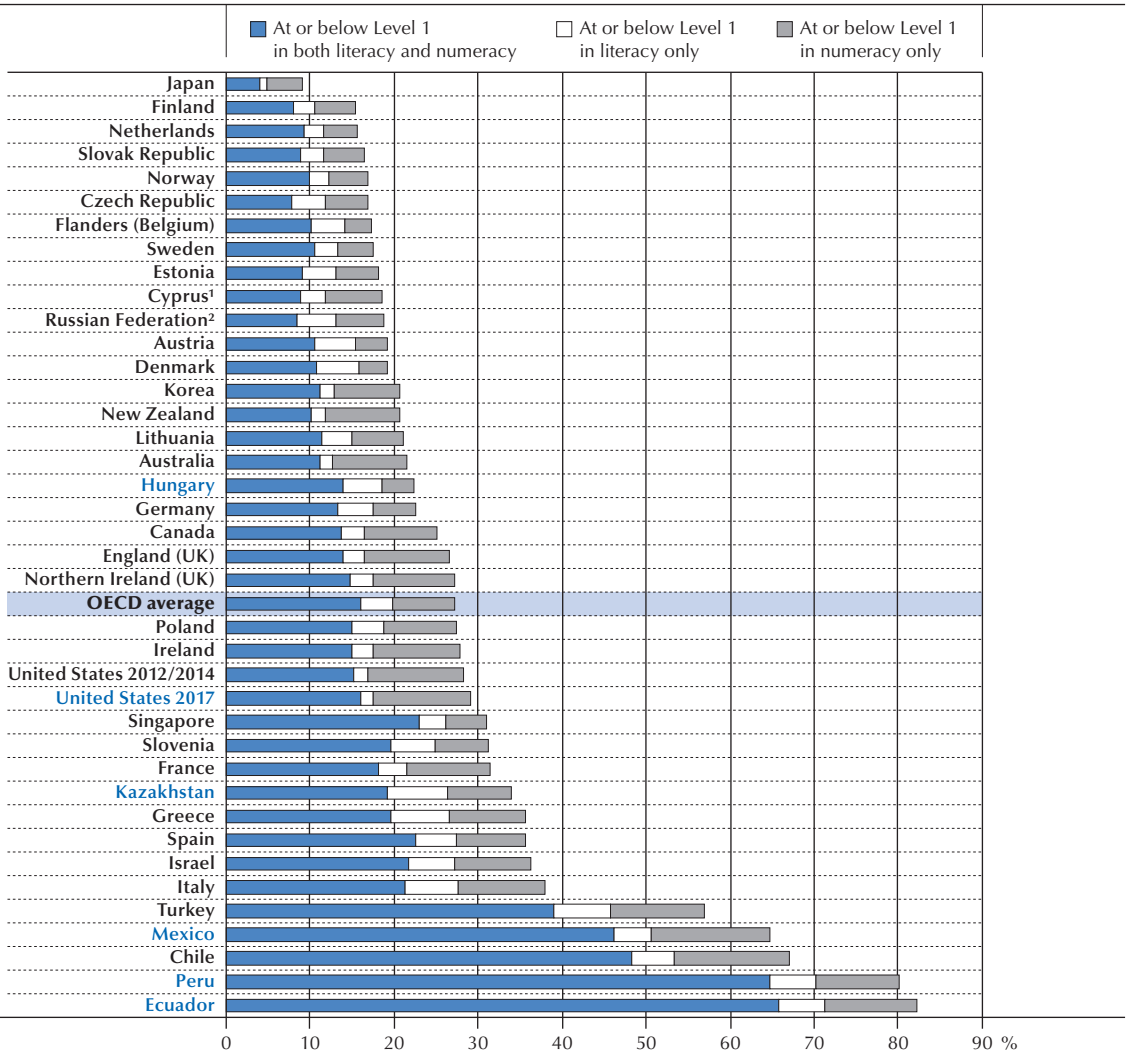
Mean numeracy proficiency and distribution of numeracy scores, by percentile



Note: Mean scores are shown with a 0.95 confidence interval. Literacy-related non-response (missing) is excluded from the calculation of mean scores.
1. See note at the end of this chapter.
2. See note 2 under Figure 2.2.
Countries and economies are ranked in descending order of the mean score.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.4.
StatLink https://doi.org/10.1787/888934020046

Figure 2.12 ▪ **The proportion of adults who are low performers**

Percentage of adults who score at or below Level 1 in literacy and/or numeracy

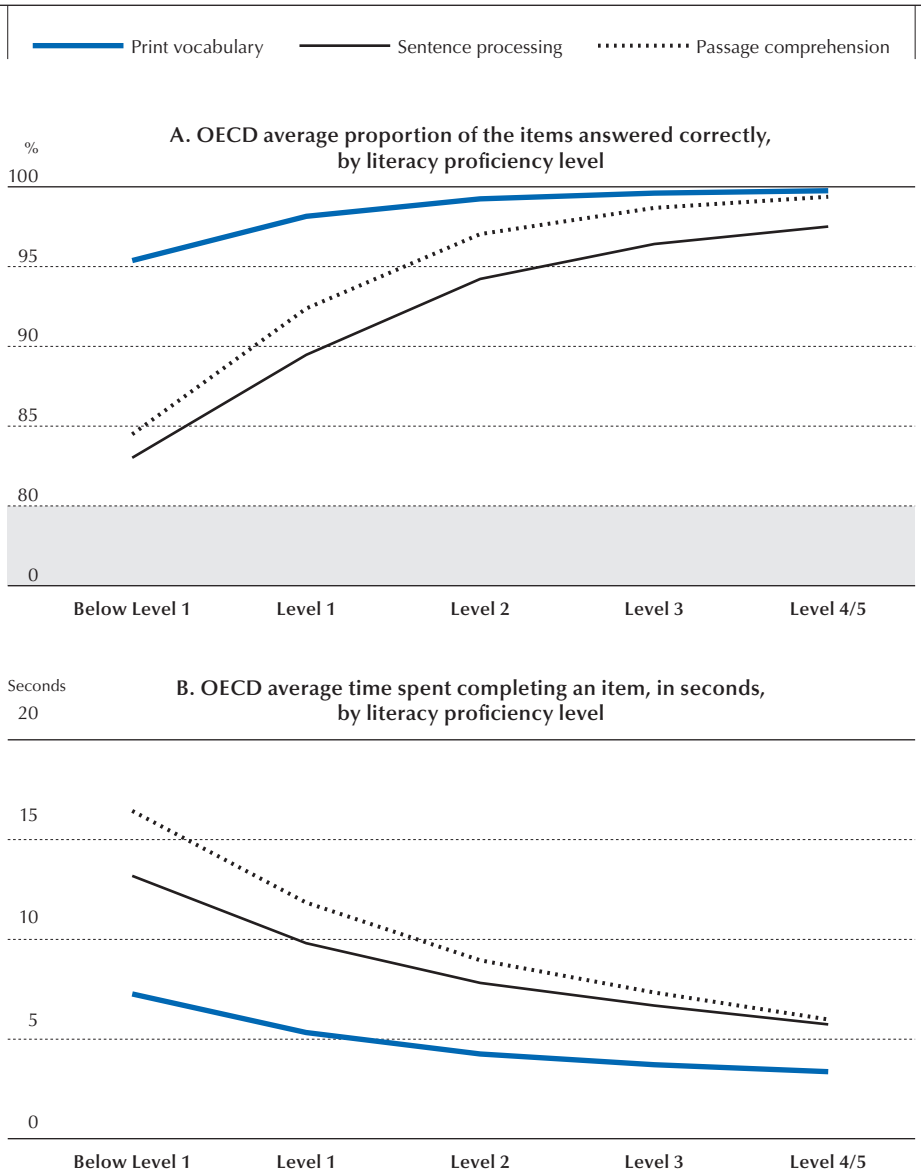


Note: Low-performing adults are defined as those who score at or below Level 1 in either literacy or numeracy.
1. See note 2 under Figure 2.2.
2. See note at the end of this chapter.
Countries and economies are ranked in ascending order of the combined percentages of adults scoring at or below Level 1 in literacy and/or numeracy.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.5.
StatLink https://doi.org/10.1787/888934020065

Figure 2.13 presents information about two dimensions of performance in the reading components assessment: the proportion of items that were correctly answered by respondents and the time taken to complete the assessment. The first panel shows the relationship between literacy proficiency and the percentage of items answered correctly (accuracy); the second panel shows the relationship between literacy proficiency and the time taken (in seconds) to complete an item (speed). Both accuracy and speed increase with greater proficiency in all three components, with the gains in both accuracy and speed tapering off markedly among adults who are proficient at Level 2 or higher.

There is little difference across countries and economies in the average proportion of correct answers in the print-vocabulary component, with the proportion varying between 93.1% in Singapore and 99.6% in the Czech Republic among those scoring at Levels 1 and below. Greater variation is observed in the case of passage comprehension among low-performing adults. The largest variation occurs in the sentence-processing component, where the proportion of correct answers varies between 76.2% in Singapore and 92.7% in the Czech Republic.

Figure 2.13 ■ **Relationship between literacy proficiency and performance in reading components**



Notes: The results for each country can be found in the tables mentioned in the source below. Finland, France and Japan did not participate in the reading components assessment.

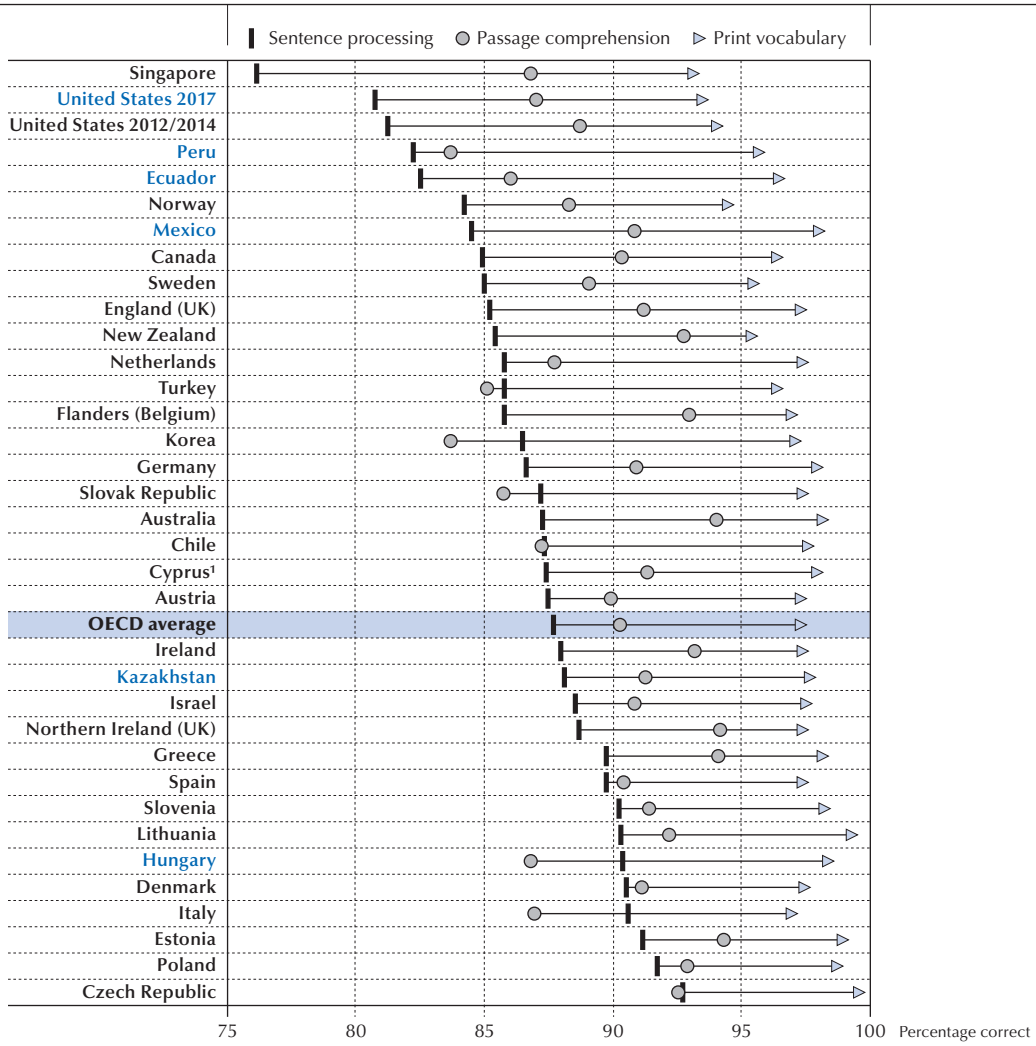
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.6.

StatLink https://doi.org/10.1787/888934020084

The results suggest that while there are many adults in most of the countries participating in the Survey of Adult Skills who have poor reading skills, there are very few who are illiterate in the sense of not being able to read at all. This is as true of countries such as Chile, Ecuador, Mexico, Peru and Turkey, in which the majority of adults are proficient at Level 1 and below on the literacy scale, as it is of countries with far smaller proportions of adults at this level (see Figure 2.14). In Ecuador, Mexico and Peru, which have very high proportions of adults performing at Level 1 or below for literacy, only around 8-20% of adults failed the literacy and numeracy core tests designed to identify the respondents who had the capacity to undertake the full assessment. Those failing the core test in these countries also correctly answered more than 77% of the items in the sentence-processing elements of the reading components assessment, more than 74% of the passage-comprehension items and 92% of the print-vocabulary items. A more detailed analysis of reading components results is presented in Grotlüschen et al. (2016[5]).

Figure 2.14 ▪ **Performance in reading components across countries**

Average proportion of items answered correctly, adults who score at or below Level 1 in literacy proficiency



1. See note 2 under Figure 2.2.

Countries and economies are ranked in descending order of the mean proportion of items answered correctly in sentence processing.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.6.

StatLink https://doi.org/10.1787/888934020103

PROFICIENCY IN PROBLEM SOLVING IN TECHNOLOGY-RICH ENVIRONMENTS

The Survey of Adult Skills defines problem solving in technology-rich environments as "using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks" (PIAAC Expert Group in Problem Solving in Technology-Rich Environments, 2009[6]). It focuses on "the abilities to solve problems for personal, work and civic purposes by setting up appropriate goals and plans, and accessing and making use of information through computers and computer networks" (OECD, 2012[7]).

Problem solving in technology-rich environments does not measure the cognitive skills required to solve problems in isolation. It measures both problem-solving and basic computer literacy skills (i.e. the capacity to use ICT tools and applications). This is done by assessing how well adults can use ICT tools and applications to assess, process, evaluate and analyse information in a goal-oriented way. For more details about the characteristics and some examples of problem solving tasks, see OECD (2013[4]).

A prerequisite for displaying proficiency in problem solving in technology-rich environments is having some rudimentary skills in the use of computer tools and applications. Given the very different levels of familiarity with computer applications in the countries and economies participating in the Survey of Adult Skills, the share of the population to which the

estimates of proficiency in this domain refer thus vary widely. In other words, the populations for which proficiency scores for problem solving in technology-rich environments are reported are not identical across countries. Proficiency scores relate only to the share of the target population who were able to undertake the computer-based version of the assessment, and thus meet the preconditions for displaying competency in this domain. For this reason, the presentation of the results focuses on defining the proportions of the population at each proficiency level, rather than on comparing mean proficiency scores.[2]

The survey provides two different, albeit related, pieces of information about the capacity of adults to manage information in technology-rich environments. The first is the proportion of adults who are familiar enough with computers to use them to perform information-processing tasks. The second is the proficiency levels among adults with at least some ICT skills in solving the types of problems commonly encountered in their roles as workers, citizens and consumers in a technology-rich world.

Levels of proficiency in problem solving in technology-rich environments across countries and economies

The scale of problem solving in technology-rich environments is divided into four levels of proficiency (Levels 1 to 3 plus below Level 1). The features of the tasks at these levels are described in detail in Table 2.3 [some examples of problem-solving items are available in OECD (2019[1]) and OECD (2013[4])]. Figure 2.15 presents the proportion of adults across all participating countries and economies in each of the four proficiency levels for this domain. On average, across the OECD countries participating in the Survey of Adult Skills, around one-third of adults (29.7%) are proficient at the two highest levels (Level 2 or 3). Only one in ten adults or less in Ecuador (5.2%), Peru (6.6%), and Mexico (10.2%) achieved these levels, comparable to other middle-income economies like Turkey (where 7.8% of adults scored at Level 2 and 3). Just as in the case of literacy and numeracy, the proportions of adults performing at Level 2 or 3 in Hungary (28.5%) and the United States (31.2%) are close to the OECD average, while the share in Kazakhstan (16.2%) is below the OECD average but larger than the proportion in the Latin American Round 3 participants.

Across all participating OECD countries and economies, 43% of adults scored at Level 1 and below on this measure. Among the Round 3 countries, 42.6% of adults in Hungary and 49.8% in the United States only reached the lowest proficiency levels, both similar to the OECD average. These shares were higher than similar proportions observed in Mexico (32.1%) and Peru (37.8%) which are among the countries that have recorded the lowest performance in other domains across all survey participants. However, these anomalies could be explained by the large shares of adults in these Latin American countries who either failed the ICT core test or had no computer experience (see section below). In other words, smaller shares of adults might be scoring at Level 1 and below in countries like Peru and Mexico because these countries had large proportions of adults who were unable to display enough proficiency in problem solving to have scored at even the lowest levels.

The proportion of adults without basic information and communications technology skills

Each participating country and economy had a substantial proportion of adults who were unable to display any proficiency in problem solving in technology-rich environments since they took the assessment in the paper-based format. Three separate groups of adults fall in this category: those with no computer experience, those who failed the ICT core test and thus did not have basic computer skills needed for the computer-based assessment, and those who opted to take the paper-based version of the assessment even though they reported having ICT experience.

Overall, around one in ten adults (11.7%) reported having no prior computer experience and a further 4.7% of adults did not have the basic ICT skills that were assessed by the ICT core test, such as the capacity to use a mouse or scroll through a web page. Together with Turkey (38%), the Round 3 countries Ecuador (32.9%), Mexico (39.2%) and Peru (43.6%) stand out for the very large proportion of their adult populations who have no prior computer experience or very poor ICT skills. These results should be understood in context, however. The share of adults without basic ICT skills or computer experience reflect these countries' level of economic development and ICT penetration. In 2017, only about one-third of households in Ecuador (38.1%) and Mexico (36.9%) had a fixed line phone subscription, while the share was significantly lower in Peru (21.9%). Internet and computer access in these countries are also limited: only around 40% of households had access to a computer and functional Internet in Ecuador and Mexico in 2017 and the share of such households in Peru stood even lower at around 30% (ITU, 2019[8]). This is in stark contrast to many of the high-income OECD countries where more than two-thirds of the households have access to a computer, Internet and a telephone line.

Table 2.3 Description of the problem solving in technology-rich environments proficiency levels

Level	Score range	Percentage of adults scoring at each level (average)	Types of tasks completed successfully at each level of proficiency
No computer experience	Not applicable	11.7%	Adults in this category reported having no prior computer experience; therefore, they did not take part in the computer-based assessment but took the paper-based version of the assessment, which did not include the problem solving in technology-rich environment domain.
Failed ICT core	Not applicable	4.7%	Adults in this category had prior computer experience but failed the ICT core test, which assesses the basic ICT skills, such as the capacity to use a mouse or scroll through a web page, needed to take the computer-based assessment. Therefore, they did not take part in the computer-based assessment, but took the paper-based version of the assessment, which did not include the problem solving in technology-rich environment domain.
Opted out of taking the computer-based assessment	Not applicable	10.0%	Adults in this category opted to take the paper-based assessment without first taking the ICT core assessment, even if they reported some prior experience with computers. They also did not take part in the computer-based assessment, but took the paper-based version of the assessment, which did not include the problem solving in technology-rich environment domain.
Below Level 1	Below 241 points	14.6%	Tasks are based on well-defined problems involving the use of only one function within a generic interface to meet one explicit criterion without any categorical or inferential reasoning, or transforming of information. Few steps are required and no sub-goal has to be generated.
1	241 to less than 291 points	28.3%	At this level, tasks typically require the use of widely available and familiar technology applications, such as e-mail software or a web browser. There is little or no navigation required to access the information or commands required to solve the problem. The problem may be solved regardless of the respondent's awareness and use of specific tools and functions (e.g. a sort function). The tasks involve few steps and a minimal number of operators. At the cognitive level, the respondent can readily infer the goal from the task statement, the problem resolution requires the respondent to apply explicit criteria, and there are few monitoring demands (e.g. the respondent does not have to check whether he or she has used the appropriate procedure or made progress towards the solution). Identifying content and operators can be done through simple matches. Only simple forms of reasoning, such as assigning items to categories, are required; there is no need to contrast or integrate information.
2	291 to less than 341 points	24.7%	At this level, tasks typically require the use of both generic and more specific technology applications. For instance, the respondent may have to make use of a novel online form. Some navigation across pages and applications is required to solve the problem. The use of tools (e.g. a sort function) can facilitate the resolution of the problem. The task may involve multiple steps and operators. The goal of the problem may have to be defined by the respondent, although the criteria to be met are explicit. There are higher monitoring demands. Some unexpected outcomes or impasses may appear. The task may require evaluating the relevance of a set of items to discard distractors. Some integration and inferential reasoning may be needed.
3	Equal to or higher than 341 points	5.1%	At this level, tasks typically require the use of both generic and more specific technology applications. Some navigation across pages and applications is required to solve the problem. The use of tools (e.g. a sort function) is required to make progress towards the solution. The task may involve multiple steps and operators. The goal of the problem may have to be defined by the respondent, and the criteria to be met may or may not be explicit. There are typically high monitoring demands. Unexpected outcomes and impasses are likely to occur. The task may require evaluating the relevance and reliability of information in order to discard distractors. Integration and inferential reasoning may be needed to a large extent.

Note: The proportion of adults scoring at different levels of proficiency adds up to 100% when 1.8% of literacy-related non-respondents across countries/economies are taken into account. Adults in the missing category were not able to provide enough background information to impute proficiency scores because of language difficulties, or learning or mental disabilities (see section on literacy-related non-response above).

Not all Round 3 countries have large proportions of adults with no or poor computer skills, however. In contrast to Ecuador, Mexico and Peru, the proportion of adults without basic ICT skills or computer experience in Kazakhstan (19.7%), Hungary (14.4%) and the United States (7.4%) was much lower.

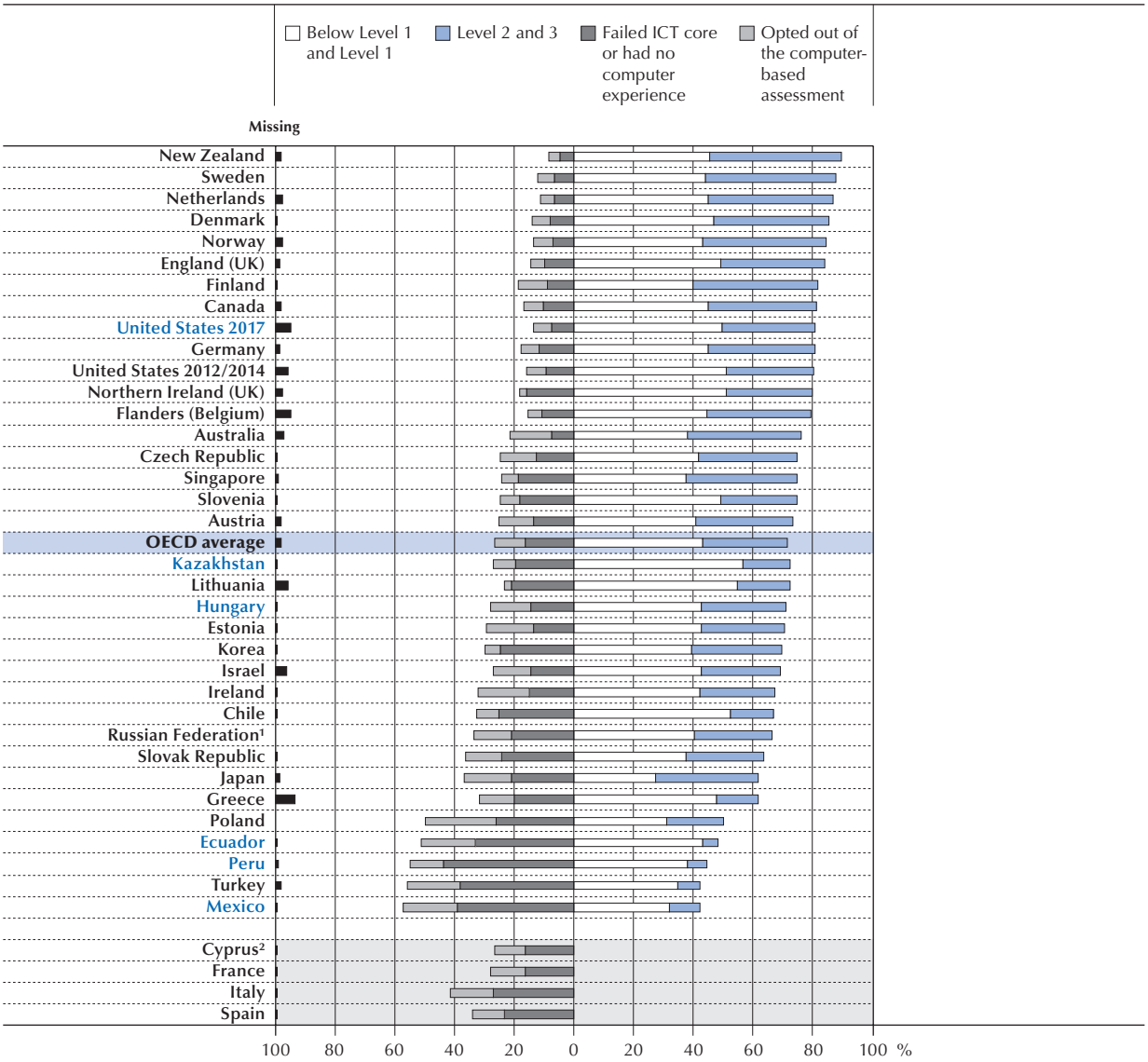
Some adults preferred not to use a computer in the assessment, despite reporting some prior experience with computers. On average, one in ten adults (10.0%) opted to take the paper-based version of the assessment without first taking the ICT core test (Box 2.3). Among the Round 3 countries, large proportions of adults in Ecuador (18.1%) and Mexico (17.8%) opted out of the computer-based assessment. While these proportions were similar to those observed in other countries

with a similar performance in the survey such as Turkey (17.7%), they were also comparable to proportions in relatively better-performing countries like Poland (23.8%) and Ireland (17.4%). Other Round 3 participants had smaller shares of adults opting out: in Hungary (13.7%) and Peru (11.1%) the shares were similar to the OECD average, and the share was significantly lower in the United States (6.3%) and Kazakhstan (7.5%).

No information was collected on why people chose to take the paper-based assessment. However, information regarding the characteristics of these people and their patterns of ICT use is available and can be used to make inferences about their likely level of ICT skills and/or comfort with using a computer in a test situation (see Chapter 3).

Figure 2.15 ▪ **Proficiency in problem solving in technology-rich environments among adults**

Percentage of 16-65 year-olds scoring at each proficiency level



Notes: Adults included in the missing category were not able to provide enough background information to impute proficiency scores because of language difficulties, or learning or mental disabilities (referred to as literacy-related non-response). The missing category also includes adults who could not complete the assessment of problem solving in technology-rich environments because of technical problems with the computer used for the survey. Cyprus[2], France, Italy and Spain did not participate in the problem solving in technology-rich environments assessment.

1. See note at the end of this chapter.
2. See note 2 under Figure 2.2.

Countries and economies are ranked in descending order of the combined percentages of adults scoring at Level 2 and 3.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A2.7.

StatLink https://doi.org/10.1787/888934020122

SUMMARISING PERFORMANCE ACROSS COUNTRIES AND ECONOMIES

Figure 2.16 summarises the proficiency of adults in participating countries and economies in each of the three domains assessed. It provides an overview of the average proficiency in each participating country and economy relative to the average in each domain. It also indicates whether the mean scores are statistically significantly greater than, equal to or less than the average across participating OECD countries and economies. In the case of problem solving in technology-rich environments, the average proficiency is not presented because of variations in the proportions of respondents who did not take the computer-based version and were not assessed in the problem-solving domain. Instead, the figure shows the proportion of the total population performing at Level 2 or 3 on this scale.

Figure 2.16 ▪ **Summary of proficiency in key information-processing skills**

Mean proficiency scores of 16-65 year-olds in literacy and numeracy, and the percentage of 16-65 year-olds scoring at Level 2 or 3 in problem solving in technology-rich environments

Not significantly different from the average
Significantly **above** the average
Significantly **below** the average

	Literacy	Numeracy	Problem solving in technology-rich environments
	Mean score	Mean score	% at Level 2 or 3
OECD countries and economies			
Australia	280	268	38
Austria	269	275	32
Canada	273	265	37
Chile	220	206	15
Czech Republic	274	276	33
Denmark	271	278	39
England (UK)	273	262	35
Estonia	276	273	28
Finland	288	282	42
Flanders (Belgium)	275	280	35
France	262	254	m
Germany	270	272	36
Greece	254	252	14
Hungary	264	272	28
Ireland	267	256	25
Israel	255	251	27
Italy	250	247	m
Japan	296	288	35
Korea	273	263	30
Lithuania	267	267	18
Mexico	222	210	10
Netherlands	284	280	42
New Zealand	281	271	44
Northern Ireland (UK)	269	259	29
Norway	278	278	41
Poland	267	260	19
Slovak Republic	274	276	26
Slovenia	256	258	25
Spain	252	246	m
Sweden	279	279	44
Turkey	227	219	8
United States 2012/2014	272	257	29
United States 2017	271	255	31
OECD average	**266**	**262**	**30**
Partners			
Cyprus[1]	269	265	m
Ecuador	196	185	5
Kazakhstan	249	247	16
Peru	196	178	7
Russian Federation[2]	275	270	26
Singapore	258	257	37

Note: Cyprus[1], France, Italy and Spain did not participate in the problem solving in technology-rich environments assessment.
1. See note 2 under Figure 2.2.
2. See note at the end of this chapter.
Countries and economies are listed in alphabetical order.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A2.2, A2.4 and A2.7.

StatLink https://doi.org/10.1787/888934020141

Among the Round 3 countries, Peru and Ecuador had scores that were statistically significantly below average in numeracy and literacy along with the smallest proportion of adults at Level 2 or 3 in problem solving in technology-rich environments. Although it performed slightly better, Mexico also reported extremely low levels of proficiency in all three domains. In this respect, these countries were similar to Chile, Greece, Israel, Slovenia and Turkey.

Hungary's numeracy scores were above average while its literacy scores were below average, albeit only slightly. The opposite was true for the United States. For both these countries, the share of adults at Level 2 or 3 in problem solving in technology-rich environments were not significantly different from the average across OECD countries, while the remaining countries had mixed results. Kazakhstan, despite also being a middle-income country, recorded higher performances than its Round 3 middle-income counterparts, Ecuador, Mexico and Peru, but performed below Hungary and the United States.

SUMMARY

The results from the third (and final) round of data collection in Cycle 1 of PIAAC further expand the coverage of the study and knowledge about the proficiency of adults in key information processing skills globally. In total, 39 countries and economies participated in the study, most of which are high-income countries. However, with the addition of Ecuador, Kazakhstan, Mexico and Peru in Round 3, some seven middle-income countries have now been included. In addition, the Round 3 data collection in the United States means that PIAAC now has two measures of the proficiency of adults in literacy, numeracy and problem solving in technology-rich environments in the United States.

In summary, Hungary is notable for the fact that it performed well above average in numeracy but slightly below average in literacy. The results for the United States have changed little during the five years separating the first and third rounds of the study. This is in line with expectations, as changes in the overall proficiency of the adult population primarily results from the replacement of older cohorts by younger ones. As only around 10% of the target population will have been replaced over five years, there has been limited scope for major changes in this period.

The middle-income Latin American countries that participated in Round 3, Ecuador, Mexico and Peru, stand out as having low overall proficiency in all three of the domains assessed in PIAAC. Ecuador and Peru had the lowest mean scores of the countries participating in the first cycle of the study and the largest proportions of working-age adults performing at the lowest proficiency levels. Their performance reflects a range of factors such as the quality of the schooling system, their level of economic development and historical levels of educational participation. These results are also in line with studies of school-age children in the Programme for International Student Assessment (PISA) which found that among economies with a per capita GDP below USD 20 000 (such as Chile, Mexico, Peru and Turkey), the greater the country's wealth, the higher its mean score on the PISA reading test until that threshold is reached (OECD, 2018[9]; OECD, 2012[10]). In Kazakhstan, the fourth and last middle-income country participating in Round 3, the proportion of adults scoring at the highest levels in literacy, numeracy and problem solving is smaller than in Hungary and the United States but larger than in Ecuador, Mexico and Peru. Close to half of the adult population in Kazakhstan performs at Level 2 in both the literacy and numeracy domains and the proportion of the population scoring at Level 1 and below is close to the OECD average.

The low levels of proficiency in information-processing skills among working-age adults represent challenges for governments in these countries. Some commentators claim that middle-income countries might lack the absorptive capacity for digital technologies compared to high-income countries, making the demand and supply of ICT skills in the former group different from the latter. Moreover, to some extent, take up of new technologies, particularly digital technologies, depends on the educational levels of the population, including their information-processing skills, as does the roll out of digitally based services. At the same time, PIAAC provides examples of very high-income countries with large proportions of adults with low proficiency in literacy and numeracy (e.g. Singapore and the United States) as well as examples of countries (Korea and Singapore) that have, over the last half century, successfully increased the proficiency of successive generations from a similar starting point to where Ecuador and Peru currently find themselves.

Notes

1. The print-vocabulary tasks required test takers to select the word corresponding to a picture of an object from a selection of four alternative words. The sentence-processing tasks required test takers to identify whether a sentence made logical sense, given the properties of the real world. The passage-comprehension tasks entailed reading a prose text. At certain points in the text, test takers were given a choice of two words and required to select the word that made the most sense in the context of the passage.

2. This can be better understood by means of a hypothetical example: a country where around 50% of the population opts to sit the problem-solving assessment or knows how to use computers or passes the ICT core test might have a higher score in problem solving than a country where these three groups account for 80% of the population. These differences among countries in the proportions of the population for which problem-solving skills are measured at all makes it difficult to compare countries based on average scores in the domain of problem solving in technology-rich environments.

A note regarding the Russian Federation

The sample for the Russian Federation does not include the population of the Moscow municipal area. More detailed information can be found in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[2]).

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3

The socio-demographic distribution of key information-processing skills

This chapter examines differences in skills proficiency between different groups of individuals, defined by age, gender, socio-economic status, and educational attainment. The chapter considers literacy and numeracy proficiency as well as problem solving in technology-rich environments. It outlines the overall picture for all countries and economies participating in the Survey of Adult Skills, with a particular focus on the differences found among the countries that have participated in this latest round of data gathering.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

This chapter analyses the levels of proficiency of different subgroups of the population taking part in the Survey of Adult Skills (PIAAC), defined in terms of educational attainment, age, gender and socio-economic background. This information will be especially useful for policy makers wanting to design better and more informed policies. For instance, they could target policies better towards adults with low information-processing skills, in order to reduce disparities and improve human capital. The results could also be used to better understand the strengths and weaknesses of current and past policies, as to a large extent the current level of skills of adults in different age groups, or with different levels of educational attainment, reflect the outcomes of policies that were in place when those adults were attending education.

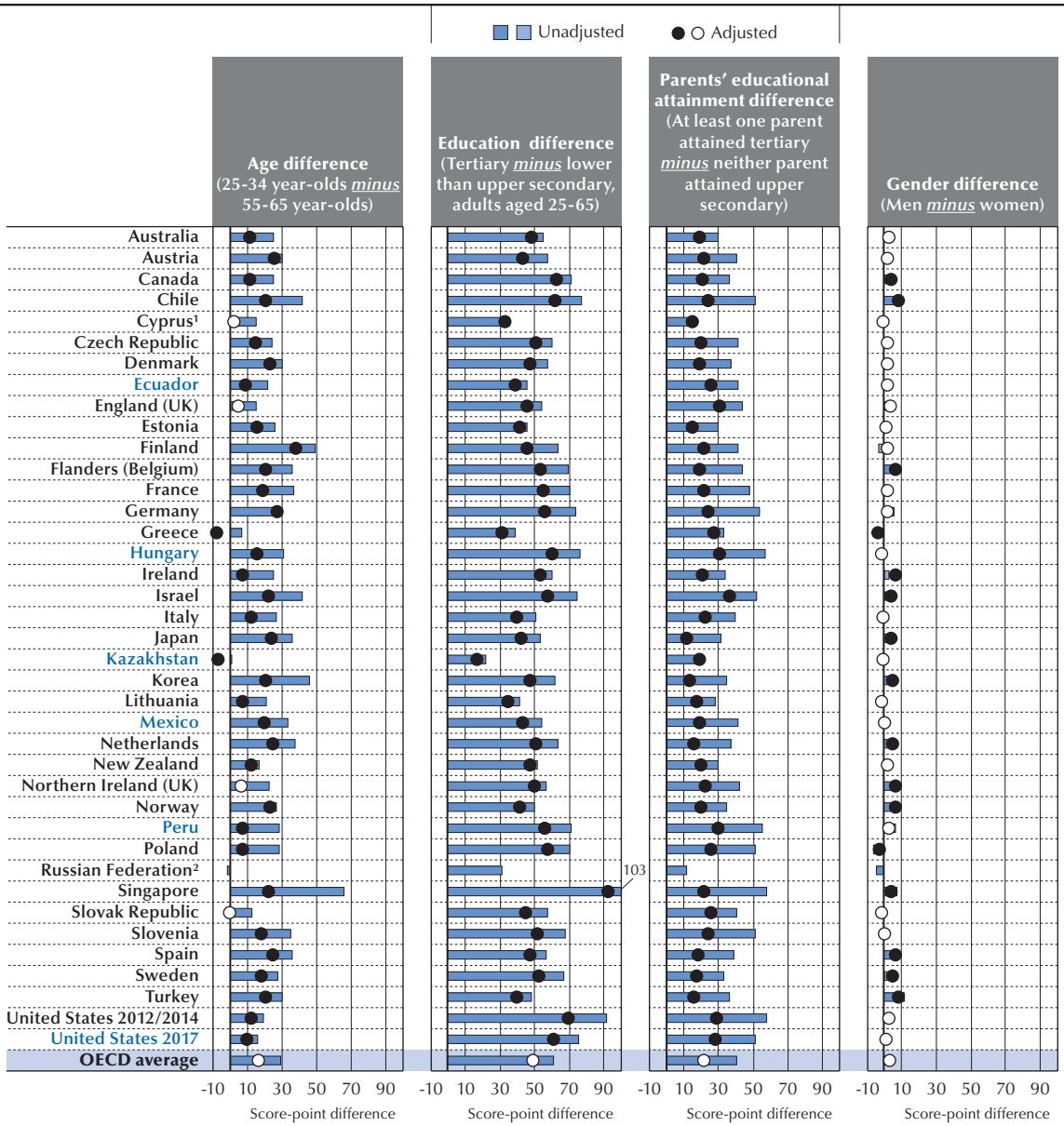
Figure 3.1 presents an overview of proficiency differences associated with belonging to these different population subgroups. The bars show raw (unadjusted) differences, while the dots represent estimated (adjusted) differences that take into account the role of other background characteristics.[1]

The main findings discussed in this chapter are:

- The differences in proficiency between tertiary-educated adults and those who have not attained an upper secondary education are very large in all countries and economies. Among the countries that participated in Round 3, the differences are especially pronounced in Hungary, Peru and the United States, while they are smaller than the average in Ecuador, Kazakhstan and Mexico.
- The literacy and numeracy proficiency of tertiary-educated adults in Hungary is among the highest of all countries and economies that have participated in the Survey of Adult Skills. In Mexico, adults who have not completed tertiary education – both those with upper secondary education and those without – have higher proficiency levels than their similarly educated peers in other Latin American countries taking part in PIAAC.
- In Ecuador and Peru, early school leavers (i.e. young adults who are not in education and who have not attained upper secondary education) have very low levels of literacy proficiency. This is of particular concern, given the relatively large size of this group (19% of all 16-24 year-olds in Ecuador and 13% in Peru).
- Older adults typically have lower proficiency in literacy and numeracy. This is partly due to ageing, and partly to the fact that younger cohorts are often more highly educated. Indeed, differences between age groups tend to be larger in countries that have more recently expanded access to education, such as Korea and Singapore, and smaller in countries where this process has taken place in the more distant past, such as Germany and the United States.
- The age-proficiency profile observed in Ecuador, Mexico and Peru is consistent with this interpretation. In these countries, upper secondary attainment rates have increased only very recently and consequently proficiency tends to decline linearly with age, being highest among 16-24 year-olds. In most other countries proficiency peaks among those aged 25-34.
- In Kazakhstan, the increase in tertiary completion rates has not translated into a corresponding increase in the proficiency of the adult population. Proficiency among older adults – aged 55-65 – is almost identical to those of younger adults aged 25-34, in spite of the fact that a much larger share of adults in the latter group have attained a tertiary qualification. This also explains Kazakhstan's relatively small gap between tertiary-educated adults and those who have not attained an upper-secondary qualification.
- Gender gaps in literacy proficiency are small, but they are wider in numeracy, a domain in which men tend to outperform women. Notable exceptions are Hungary and Kazakhstan, which have no numeracy gender gap. The numeracy proficiency of women in Hungary is particularly strong compared with other countries and economies that participated in the Survey of Adult Skills.
- Because proficiency is related to educational attainment, and in many countries and economies women had tended to attain lower levels of education than men in the past, gender gaps are more pronounced among older cohorts. This is particularly evident in Ecuador, Mexico and Peru, where gender gaps in numeracy are much smaller among younger adults than they are among older adults.
- Adults with more highly educated parents tend to have higher proficiency. Gaps related to family background are particularly pronounced in Hungary, Peru and the United States. Most of these differences are accounted for by individual characteristics, as people with highly educated parents also tend to attain higher levels of education themselves. This is especially true in Mexico, where adjusting for individual characteristics strongly reduces the differences related to family background, but less true in Ecuador and Kazakhstan, where the adjustment has a smaller effect on the size of the gap.

Figure 3.1 ▪ **Socio-demographic differences in literacy proficiency**

Adjusted and unadjusted difference in literacy scores between contrast categories within various socio-demographic groups



Notes: Statistically significant differences are marked in a darker tone. Unadjusted differences are the differences between the two means for each contrast category. Adjusted differences are based on a regression model and take account of differences associated with the following variables: age, gender, education, immigrant and language background and parents' educational attainment. Only the score-point differences between two contrast categories are shown, which is useful for showing the relative significance of each socio-demographic variable with regard to observed score-point differences. All adjusted differences for the Russian Federation are missing due to the lack of language variables.

1. *Note by Turkey:*

The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

2. See note at the end of this chapter.

Countries and economies are listed in alphabetical order.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.1(L), A3.2(L), A3.5(L), A3.8(L) and A3.11(L).

StatLink https://doi.org/10.1787/888934020160

DIFFERENCES IN SKILLS PROFICIENCY RELATED TO EDUCATIONAL ATTAINMENT

Standardised large-scale assessments are popular because they provide comparable cross-country measures of the skills of respondents. This is their main advantage over more traditional (and easier to collect) indicators such as the number of completed years of schooling. Indeed, the Survey of Adult Skills shows large differences in literacy and numeracy proficiency among adults with the same level of education, especially among people who have completed their schooling in different countries.

This is not to downplay the importance of information on educational attainment. As formal schooling is the main (although not the only) vehicle for educating and building the skills of a country's population, joint analysis of these two sources of information provides essential insights for policy makers who wish to assess the state of their educational systems.

Care should be taken, however, not to interpret differences as the causal effect of education on skills. Even after accounting for a range of observable characteristics, it is likely that some unobservable trait (such as innate ability) influences both proficiency in the PIAAC assessment and educational attainment. The direction of causality would then partly run from skills to education, rather than from education to skills.

Cross-country comparisons should also always be interpreted with some care. As educational systems vary widely, both across countries and over time, the correct interpretation of the relationship between education and skills often requires supplementary information about the history of educational policies in different countries. This issue is made even more complicated by the fact that different countries and economies participated in PIAAC in different years. For a given age group, respondents in the countries participating in Round 3 would have been born and attended education about five years later than adults in countries participating in the first round.

Finally, in order to account for the fact that many of the youngest participants in PIAAC are still in education, the analysis here is mainly restricted to adults aged 25-65 years.

Proficiency in literacy and numeracy among low- and high-educated adults

In all countries and economies, more highly educated adults perform better in the PIAAC assessment (see Figure 3.2). Among the OECD countries and economies that participated in PIAAC, the average difference between tertiary-educated adults and adults with below upper secondary education is 61 score points in literacy and 70 score points in numeracy. Among the countries that participated in Round 3, the differences in both literacy and numeracy proficiency are larger than the OECD average in Hungary, Peru and the United States, and smaller in Ecuador, Kazakhstan and Mexico.

In Hungary, tertiary-educated adults on average scored about 4 points higher in literacy than the average for that level of education across participating OECD countries, and about 18 points higher in numeracy. Hungarians with an upper secondary education also scored higher than the OECD average in numeracy, while the average numeracy score for those without an upper secondary qualification is not statistically different from the OECD average. Hungary has one of the highest shares of tertiary-educated adults scoring at Level 4/5 in numeracy (33%, compared to 23% across the OECD; Sweden has the highest share, at 36%).

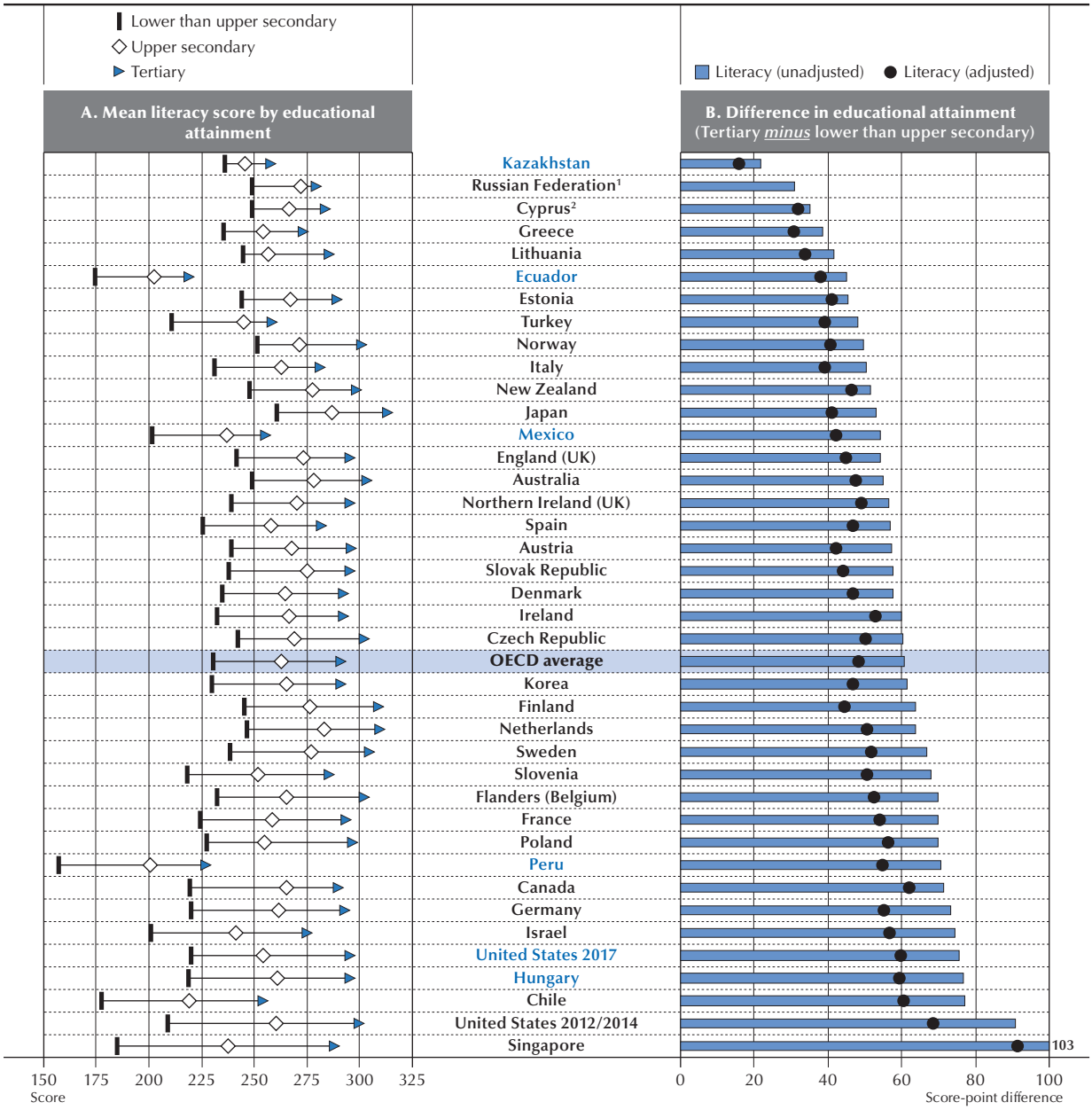
Tertiary-educated adults in the United States have similar proficiency in literacy to their Hungarian counterparts, but they scored lower in numeracy, at 284 points, which is below the OECD average of 291 points.

The very small gap between tertiary-educated adults and adults with below upper secondary education observed in Kazakhstan (in both literacy and numeracy) is due to two reasons. First, tertiary-educated adults scored more than 30 points below the OECD average, in both domains. Second, adults without an upper secondary qualification scored above the average, by 6 points in literacy and by 16 points in numeracy.

In Ecuador, Mexico and Peru, performance in literacy and numeracy is consistently below the corresponding OECD average for all levels of educational attainment. Proficiency is especially low among adults without an upper secondary qualification in Peru: their average score was 157 in literacy and 127 in numeracy. This is well below the level registered by similarly educated adults in other Latin American countries that participated in PIAAC, such as Chile (177 score points in literacy and 154 score points in numeracy), Ecuador (174 and 160 score points) and Mexico (201 and 189 score points). Reflecting their low average score, 67% of adults in Peru without an upper secondary qualification scored below Level 1 in literacy and 78% in numeracy, by far the largest share among all countries participating in PIAAC, while Ecuador came second with 50% below Level 1 in literacy and 61% in numeracy.

Figure 3.2 ■ **Differences in literacy proficiency, by educational attainment**

A. Mean literacy proficiency scores, by educational attainment (adults aged 25-65)
B. Difference in mean literacy score between low- and high-educated adults (adults aged 25-65)



Notes: All differences in Panel B are statistically significant. Unadjusted differences are the differences between the two means for each contrast category. Adjusted differences are based on a regression model and take account of differences associated with other factors: age, gender, immigrant and language background and parents' educational attainment. Only the score-point differences between two contrast categories are shown in Panel B, which is useful for showing the relative significance of educational attainment with regard to observed score-point differences. Lower than upper secondary includes ISCED 1, 2 and 3C short. Upper secondary includes ISCED 3A, 3B, 3C long and 4. Tertiary includes ISCED 5A, 5B and 6. Where possible, foreign qualifications are included as the closest corresponding level in the respective national education systems. The adjusted difference for the Russian Federation is missing due to the lack of the language variables.

1. See note at the end of this chapter.
2. See note 1 under Figure 3.1.

Countries and economies are ranked in ascending order of the unadjusted differences in literacy scores (tertiary minus lower than upper secondary).

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.1(L) and A3.2(L).

StatLink https://doi.org/10.1787/888934020179

On the other hand, tertiary-educated adults in Peru have greater literacy and numeracy proficiency than tertiary-educated adults in Ecuador although in both countries they still performed significantly worse than their peers in Chile and Mexico. Adults in Mexico with upper secondary education or below have the highest proficiency in literacy and numeracy among Latin America countries taking part in PIAAC, while the scores for tertiary-educated adults in Mexico are in line with those of tertiary-educated adults in Chile.

Accounting for differences in other socio-demographic characteristics like age, gender and socio-economic background (using parents' educational attainment as a proxy) reduces education-related differences in proficiency in all countries and economies, although not by a large amount. The reduction is more pronounced in Hungary, Peru and the United States than in most other participating countries.

Proficiency in problem solving in technology-rich environments among low- and high-educated adults

Differences in proficiency related to educational attainment are even larger in the domain of problem solving in technology-rich environments (Figure 3.3). In most countries and economies, a large share of low-educated adults (those without upper secondary education) lacked even the very basic proficiency in the use of information and communications technology (ICT) needed to sit the problem-solving assessment, such as being able to operate a mouse. As a result, 41% of low-educated respondents across OECD countries did not receive a score in this domain. The share not receiving scores was even larger in middle-income countries, approaching 70% in Ecuador and Mexico and surpassing 85% in Peru. This share was only slightly above the OECD average in Hungary, at 47%, in line with the average in Kazakhstan, and much smaller in the United States, at 30%.

Low-educated adults who undertook the problem-solving assessment performed rather poorly. As a result, the overall share of low-educated adults scoring at Level 2 or 3 is very small, averaging 7% across OECD countries. The share is negligible in a large number of countries, including most Round 3 countries with the exception of Hungary and the United States (where about 3% of low-educated adults scored at Level 2) and Kazakhstan (where 6% of low-educated adults scored at Level 2).

Adults with upper secondary education were much more likely to possess the basic ICT skills needed to participate in the assessment: the share who failed the ICT core or had no ICT experience was below 20% in most Round 3 countries. It was substantially higher only in Kazakhstan (at 28%) and in Peru (at 40%). Performance on the assessment, however, was still relatively poor. Among Round 3 countries, only Hungary and the United States approached (but did not reach) the OECD average of 20% of adults with upper secondary education scoring at Level 2 or 3.

Basic ICT skills are nearly universal among tertiary-educated adults and across OECD countries only 4% of adults in this group were not able to participate in the problem-solving assessment. The shares were slightly higher in Ecuador and Mexico (7%), Kazakhstan (9%) and Peru (12%). The differences between countries and economies were larger when it came to demonstrating proficiency in the assessment itself: while on average 48% of tertiary-educated adults across OECD countries scored at Level 2 or 3 in the problem-solving assessment, this share was much lower in many Round 3 countries, including Ecuador (12%), Peru (14%), Kazakhstan (24%) and Mexico (26%). These performances were also below those of other middle-income countries that have participated in previous rounds of PIAAC, such as Chile (where 30% of tertiary-educated adults scored at Level 2 or 3 in problem solving). In contrast, 52% of tertiary-educated adults scored at Level 2 or 3 in problem solving in Hungary and 49% in the United States.

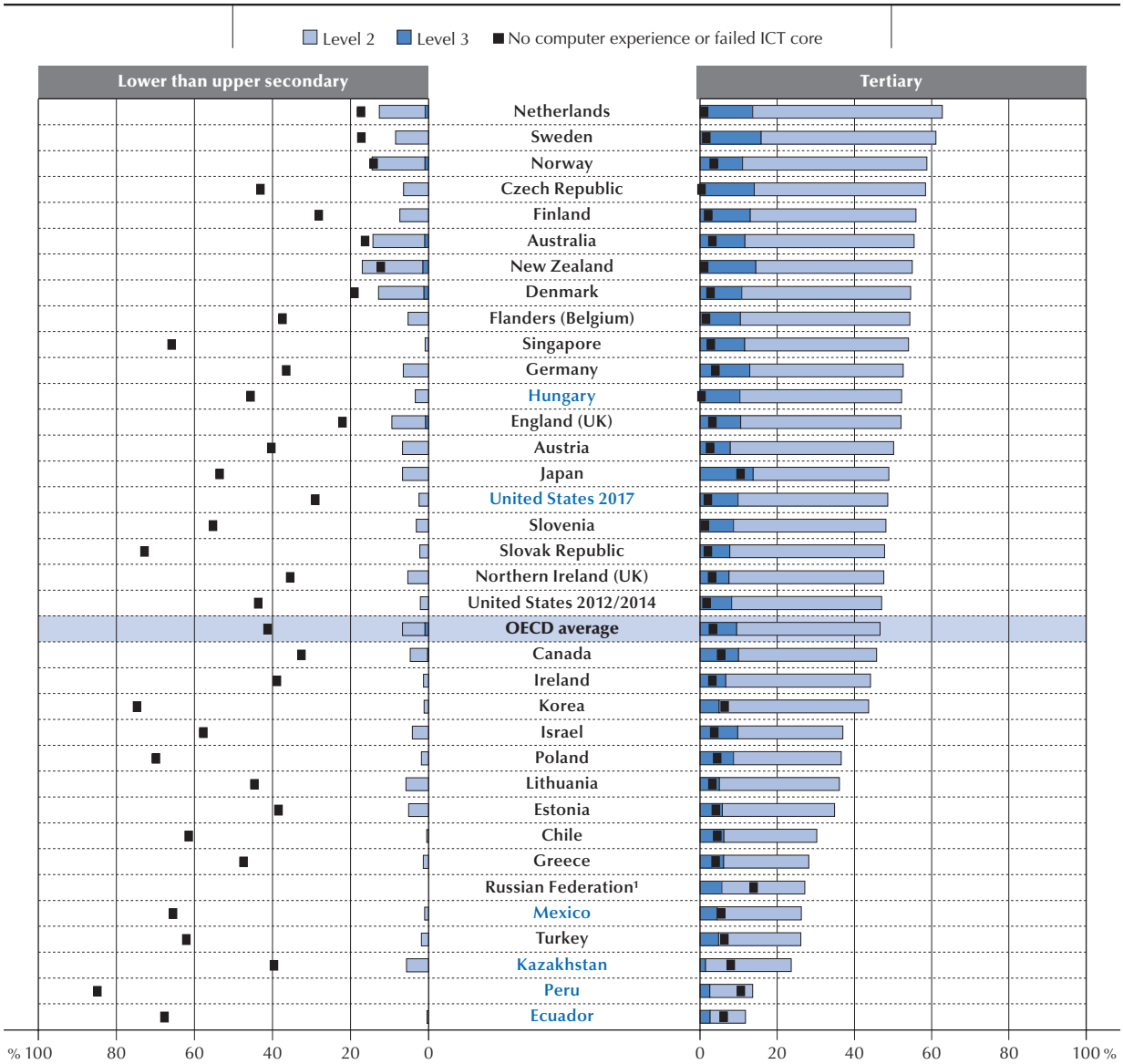
Skills and education among younger adults

The previous analysis has focused on respondents aged 25 and over because younger adults might be still in education or have not yet made important educational choices. As a result, they are hardly comparable to older adults in terms of their highest completed level of education, and deserve a separate analysis.

For the purposes of this analysis, young adults are classified into three groups, defined in terms of the key transition points in the "typical" pathways throughout the education system. The first group is composed of so-called "early school leavers", i.e. young adults who left formal education without achieving an upper secondary qualification. The second is composed of those who completed upper secondary education, but decided not to enrol in tertiary education. The third group is composed of young adults who are enrolled in tertiary education or who have already completed a tertiary qualification. In the case of this latter group, the analysis is restricted to respondents aged 20 to 24 years, because country differences in the typical age at which students graduate from upper secondary school would generate large (and artificial) differences across countries in the share of 16-19 year-olds who are enrolled in tertiary education.

Figure 3.3 ■ **Problem-solving proficiency, by educational attainment**

Percentage of low- and high-educated adults scoring at Level 2 or 3 in problem solving in technology-rich environments or having no computer experience (adults aged 25-65)



Notes: For the purpose of computing the percentages presented in the graph, adults participating in PIAAC has been classified in one of the following mutually exclusive categories: opted out of the computer-based assessment; no computer experience; failed the ICT core test; below Level 1, at Level 1, at Level 2, at Level 3 (of the problem solving in technology-rich environments scale). For more detailed results for each category see the corresponding source table below. Lower than upper secondary includes ISCED 1, 2 and 3C short. Upper secondary includes ISCED 3A, 3B, 3C long and 4. Tertiary includes ISCED 5A, 5B and 6. Where possible, foreign qualifications are included as the closest corresponding level in the respective national education systems. Cyprus[2], France, Italy and Spain did not participate in the problem solving in technology-rich environments assessment.

1. See note at the end of this chapter.

2. See note 1 under Figure 3.1.

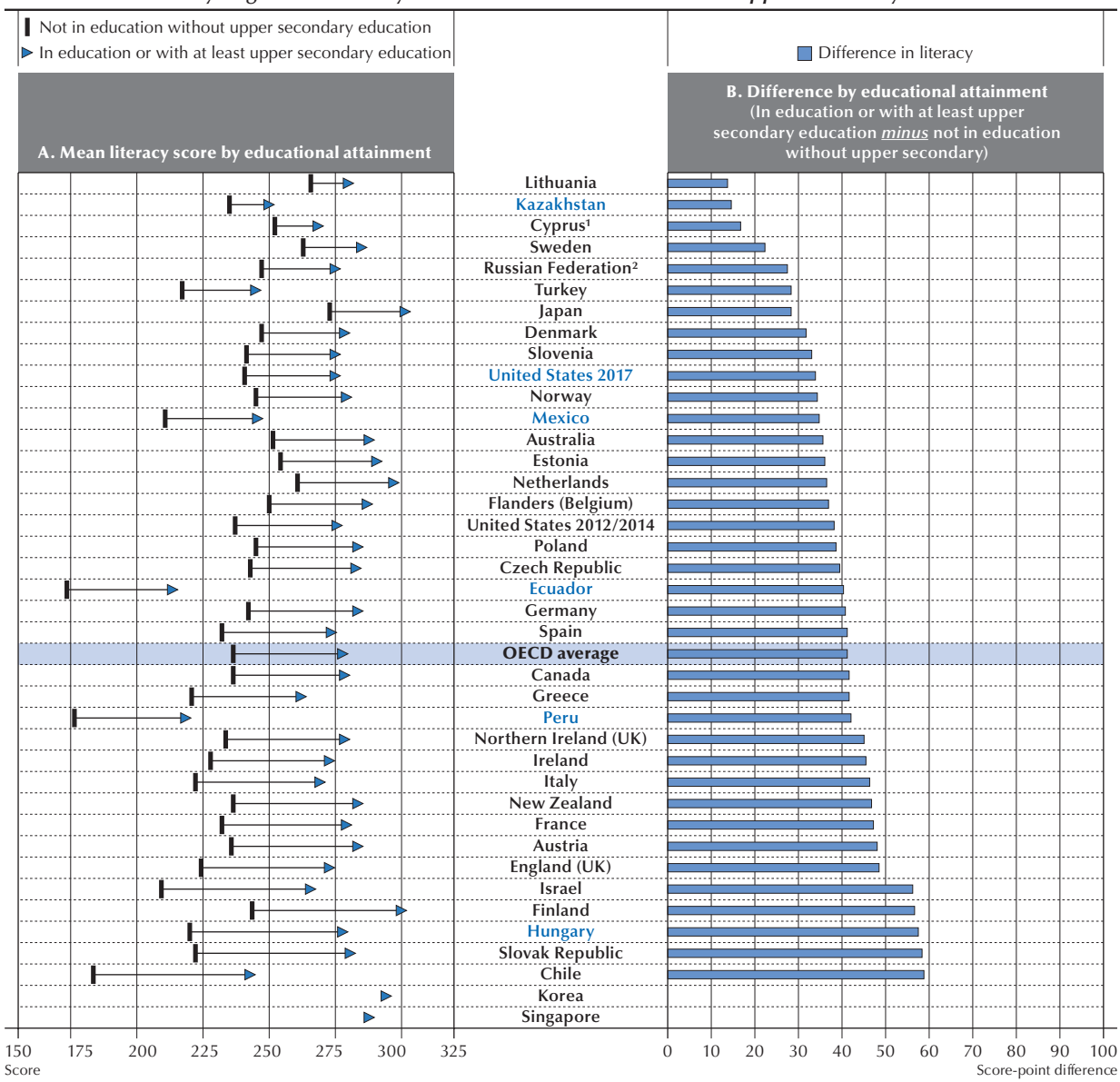
Countries and economies are ranked in descending order of the combined percentages of adults with tertiary attainment scoring at Levels 2 or 3.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A3.3(P).

StatLink https://doi.org/10.1787/888934020198

Figure 3.4 ■ **Differences in literacy proficiency by educational attainment, young adults aged 16-24**

A. Mean literacy proficiency scores of 16-24 year-olds, by educational attainment
B. Difference in mean literacy score between 16-24 year-olds in education or with at least upper secondary degree and 16-24 year-olds not in education without upper secondary education



Notes: All differences in Panel B are statistically significant. Estimates based on a sample size of less than 30 are not shown in Panels A and B (Korea and Singapore). Lower than upper secondary includes ISCED 1, 2 and 3C short. Upper secondary includes ISCED 3A, 3B, 3C long and 4. Tertiary includes ISCED 5A, 5B and 6. Where possible, foreign qualifications are included as the closest corresponding level in the respective national education systems.
1. See note 1 under Figure 3.1.
2. See note at the end of this chapter.
Countries and economies are ranked in ascending order of the differences in literacy scores (In education or with at least upper secondary education minus not in education without upper secondary).
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A3.4(L).
StatLink https://doi.org/10.1787/888934020217

Figure 3.4 shows a large gap in literacy proficiency between early school leavers and other young adults, on average equal to 41 score points across OECD countries. This proficiency gap is close to the OECD average in all the countries participating in Round 3, with two exceptions: Hungary, where it is 58 score points (the second highest among all countries and economies participating in PIAAC, after Chile at 59 points), and Kazakhstan, where it is at 15 score points (the second smallest, after Lithuania at 14 points). The large gap in Hungary is due to the below-average performance of early school leavers (220 points, against an OECD average of 236); on the other hand, the performance of young adults

still in education or who have attained an upper secondary qualification is in line with the OECD average, at 278 score points. In contrast, the small gap in Kazakhstan is due to the below-average performance of young adults still in education, whose score of 250 is well below the OECD average (278 points); the performance of early school leavers in Kazakhstan is in line with the OECD average, at 235 score points.

The literacy proficiency of young early school leavers in Ecuador and Peru is the lowest among all participating countries and economies, at 173 and 176 score points respectively, slightly below the average score registered in Chile (184 score points). Early school leavers in Mexico also performed below the OECD average, at 211 score points, while their proficiency in the United States is slightly above the average, at 241 score points. In practice, the relevance of this gap depends on the size of the population of early school leavers. Mexico stands out in this respect, as 36% of its 16-24 year-olds can be classified as early school leavers. Leaving school early is less widespread in Ecuador (19% of 16-24 year-olds), Hungary and Peru (both at 13%), although still above the OECD average of 11%. In the United States the share is lower than average, at 9% (see Table A3.14 in Annex A).

Young adults currently enrolled in tertiary education or with a tertiary qualification have higher levels of proficiency than respondents in the same age group with at most an upper secondary qualification and not enrolled in tertiary education (see Figure 3.5). The average gap in literacy proficiency between these two groups is 35 score points across OECD countries. The gap is larger than the average in all Round 3 countries with two exceptions: the United States (32 score points), and Kazakhstan (15 score points, the lowest among all countries and economies participating in PIAAC). This small gap observed in Kazakhstan is mainly due to the low performance of young adults enrolled in tertiary education or with a tertiary qualifications, who score almost 40 points below the OECD average (257 compared to 295 score points).

The gap is especially pronounced in Hungary (at 45 score points), where young adults enrolled in tertiary education or with a tertiary degree scored above the OECD average, at 300 score points) while those who did not go on to tertiary education scored below the average (255 compared to 260 score points). In Ecuador and in Peru the proficiency of both groups is the lowest among all participating countries and economies. Young adults enrolled in tertiary education averaged 236 score points in Peru, compared to 232 in Ecuador, while the picture is reversed for young adults not enrolled at tertiary level: 194 score points in Peru compared to 195 in Ecuador.

DIFFERENCES IN SKILLS PROFICIENCY RELATED TO AGE

One of the primary objectives of the Survey of Adult Skills is to shed light on the mechanisms that drive the evolution of skills over people's lifetimes. This is not an easy task, as proficiency is simultaneously influenced by a variety of factors that are not easily distinguishable. These factors can be classified in three broad categories: 1) investments in skills, in the form for instance of formal education or adult training; 2) biological processes that drive cognitive functioning; and 3) life experiences, such as employment status or personal interests, that lead to more or less intense practice of skills at work or in daily life. Importantly, these factors are likely to be interdependent: education can affect labour-market opportunities and, therefore, the use of skills at work, and even the biological process of ageing can have different consequences depending on life circumstances and the intensity of skills use.

In cross-sectional data like those collected in the Survey of Adult Skills, observed differences in proficiency by age are inevitably the combined result of age effects (i.e. the consequences of growing older), cohort effects (i.e. the consequences of being born in a particular year, and therefore being exposed to experiences such as a particular type of education), and period effects (i.e. shocks that take place at a given point in time and affect all cohorts in the same way). Controlling for observable differences across individuals born in different years (notably for differences in the level of education) can help to identify age effects, assuming that the quality of education does not change over time. While there is some evidence that this assumption might not hold (Paccagnella, 2016[1]; Paccagnella, 2016[2]), in most countries the observed cross-sectional differences are likely to provide a reasonable approximation of the underlying age effects.

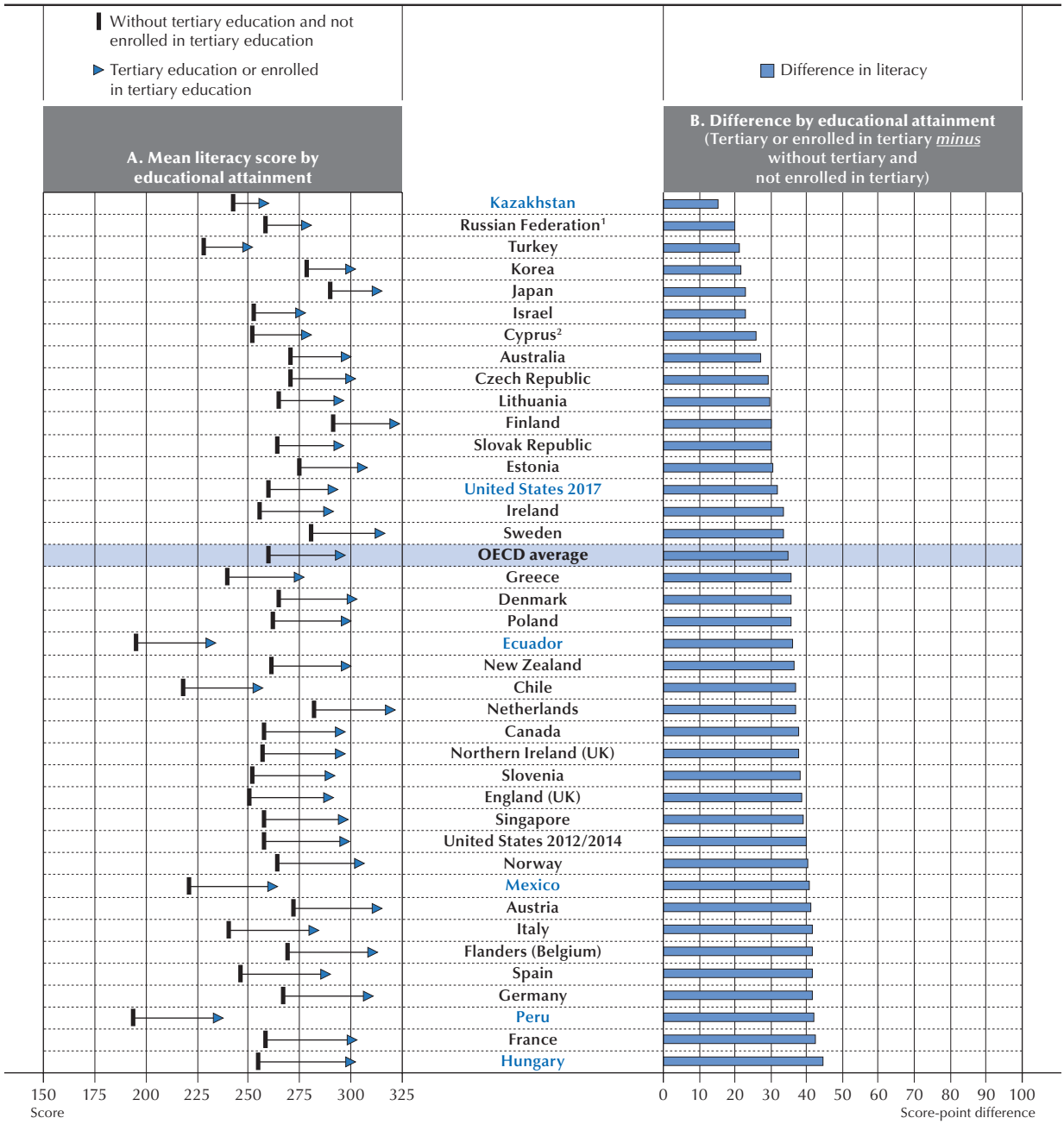
This conclusion, however, is necessarily country specific. Cross-sectional differences are in fact greatly influenced by the timing and speed of a country's expansion of educational attainment. This is a process that is common to most countries in the world, but that has occurred in different countries at different times. This is especially relevant when analysing data from countries at different stages of economic development (see also Chapter 3 of OECD (2016[3])).

Figure 3.6 shows the relationship between age and proficiency for the Round 3 countries as well as for the average of all countries and economies that have participated in the Survey of Adult Skills. There is a clear negative correlation between age and proficiency, which is present in all countries, with the partial exception of Kazakhstan and the United States. A

possible explanation for this is that the expansion of educational attainment took place much earlier in the United States than in the other Round 3 countries. Indeed, 55-65 year-olds in the United States are more likely than in many other countries to have a tertiary degree, and the gap in educational attainment between 25-34 year-olds and these older adults is very small (see Figure 2.2 in Chapter 2).

Figure 3.5 ■ **Differences in literacy proficiency by educational attainment, young adults aged 20-24**

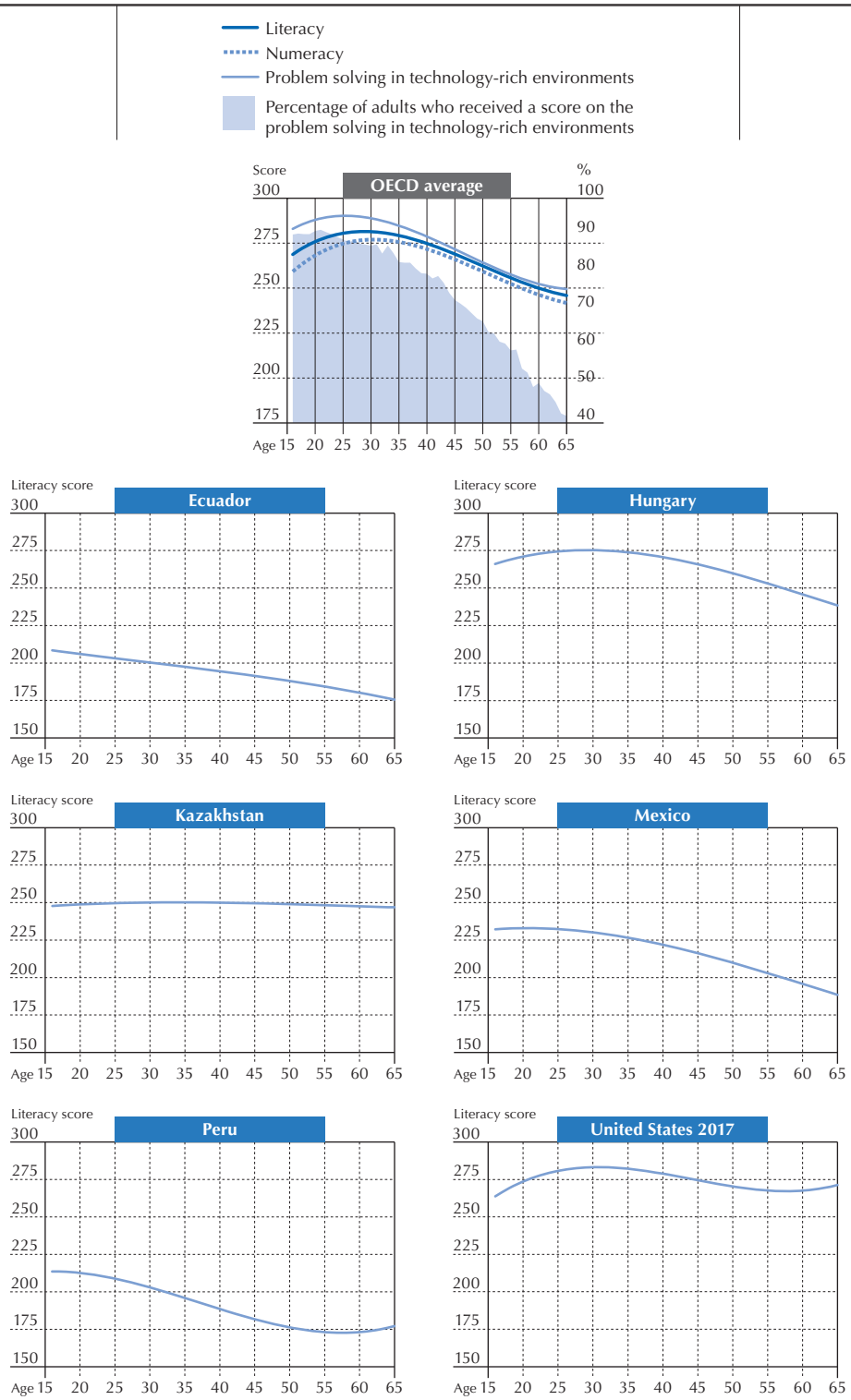
A. Mean literacy proficiency scores of 20-24 year-olds, by educational attainment
B. Difference in mean literacy score between 20-24 year-olds in education or with at least upper secondary degree and 20-24 year-olds not in education without upper secondary education



Notes: All differences in Panel B are statistically significant. Tertiary includes ISCED 5A, 5B and 6. Where possible, foreign qualifications are included as the closest corresponding level in the respective national education systems.
1. See note at the end of this chapter.
2. See note 1 under Figure 3.1.
Countries and economies are ranked in ascending order of the differences in literacy scores (Tertiary or enrolled in tertiary minus witout tertiary and not enrolled in tertiary).
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A3.4(L).
StatLink https://doi.org/10.1787/888934020236

Figure 3.6 ▪ **The relationship between skills proficiency and age**

Trend scores by age, foreign-born adults excluded



Note: A cubic specification of the trend curves is found to be most accurate in reflecting the distribution of scores by age in most countries. Unadjusted and adjusted results account for cross-country differences in OECD average scores by age cohort. Foreign-born adults are excluded from the analysis. See the tables mentioned in the source for regression parameters and significance estimates. Only countries participating in the third round of the survey are shown. Similar results for the countries participating in the first and second rounds are available in OECD (2013[4]) and OECD (2016[3]).

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.6(L), A3.6(N) and A3.6(P).

StatLink https://doi.org/10.1787/888934020255

This explanation does not hold in the case of Kazakhstan, however. Tertiary education rates for 55-65 year-olds in Kazakhstan are about half the rates observed among 25-34 year-olds (27% compared to 50%). The share of adults who have not attained an upper secondary qualification is similar in the two age groups (14% for older adults and 11% for 25-34 year-olds), meaning that, over time, an increasing share of adults have progressed from a secondary to a tertiary qualification. This upgrade in educational attainment does not appear to have translated in a corresponding increase in the skills of the adult population, possibly because of a decline in the quality of education. This hypothesis is plausible in light of the fact that, in contrast with older adults, 25-34 year olds performed significantly below the OECD average for the same age group.

In most countries and economies, the relationship between age and proficiency is an inverted U-shaped curve, with a peak between the mid-twenties and the early-thirties. In contrast, in Ecuador, Mexico and Peru, proficiency declines more or less linearly with age. This is probably due to the fact that upper secondary attainment rates in these countries have increased only very recently. On average across OECD countries, only 15% of 25-34 year-olds have not completed their upper secondary education, compared to 50% in Mexico, 36% in Ecuador and 26% in Peru. When looking at adults under 25, the share of respondents who have completed upper secondary education is actually close to the OECD average of 59% in Ecuador (57%) and higher in Peru (76%), and is not very distant in Mexico (43%). This is a good example of how the relationship between age and proficiency in cross-sectional data is influenced by cohort effects, such as different cohorts experiencing the effects of different education policies.

Proficiency in literacy and numeracy among older and younger adults

Figure 3.7 presents the average literacy score of adults in different age bands and the average difference between 55-65 year-olds and 25-34 year-olds. In most countries, these two groups have the lowest and highest average scores respectively in literacy. In a few countries adults aged under 25 have the highest average proficiency, but the differences with respect to 25-34 year-olds are very small (with the partial exception of Peru, where the youngest group of adults scored 10 points more on averages).

Literacy proficiency among older adults is lowest in Peru (175 score points) and Ecuador (181 score points). In both these countries, about half the adult population aged 55-65 scored below Level 1, and about one-third at Level 1. Proficiency among older adults in Mexico is only slightly higher: they averaged 197 score points although one-third still scored below Level 1, and one-third at Level 1. Average scores are much higher in Hungary (246 score points), Kazakhstan (249 score points, in line with the OECD average) and the United States (264 score points).

Ecuador and Peru recorded the lowest average proficiencies also for adults aged 25-34: 202 score points in Ecuador and 203 score points in Peru. Two-thirds of these adults in those countries scored at or below Level 1 in literacy. Average proficiency is significantly higher in Mexico (230 score points) and Kazakhstan (249 score points), and on a par with the OECD average in Hungary (276 score points) and the United States (279 score points).

There is much less variation across countries in the size of the differences between the older and younger age groups. In most countries, including Hungary, Mexico and Peru, the gap in literacy proficiency between the two groups is around 30 score points. The gap is smaller in Ecuador, at 21 score points, in the United States, at only 15 score points and in Kazakhstan (where the two groups recorded the same average proficiency).

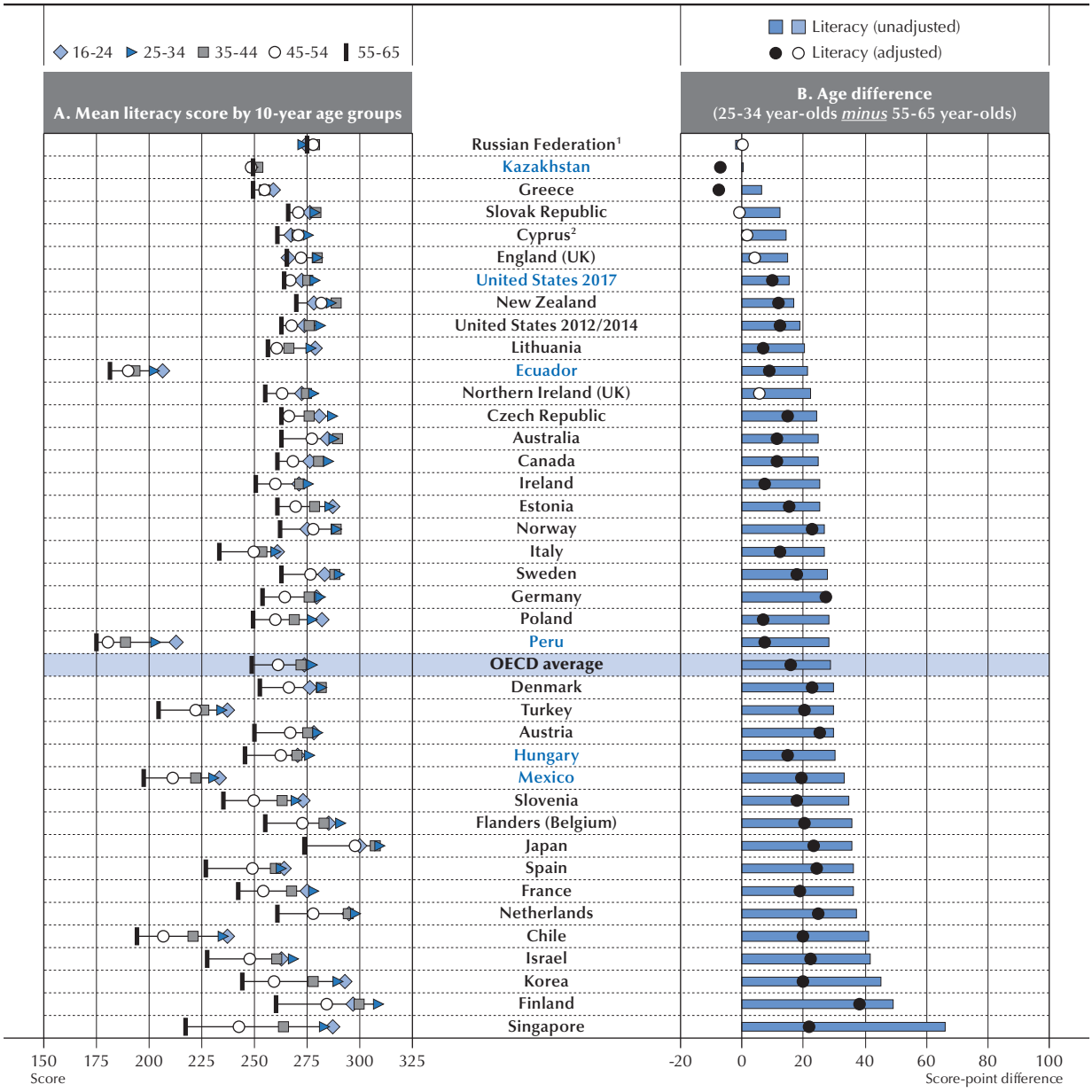
In most countries and economies, about half of the gap can be accounted for by differences in observable characteristics, notably in educational attainment, as younger cohorts are normally more educated than older cohorts. This effect is even stronger in Ecuador and Peru, where the adjusted differences are as small as 8 and 7 points, respectively. Both countries have experienced a significant expansion of basic education recently, more pronounced than in OECD countries. While 58% of older adults in Peru, and 68% in Ecuador, have not completed upper secondary education, these shares drop to 26% and 36%, respectively, among 25-34 year-olds. On average across OECD countries the differences between the two groups are smaller (20 percentage points), because educational expansion occurred earlier. In Germany, for instance, the shares of adults without upper secondary education and with a tertiary education are almost the same in the two age groups, and as a result adjusted differences are nearly identical to the unadjusted ones. Similarly, in the United States, where the difference in the share of tertiary-educated adults between the two age groups is only 7 percentage points (compared to a 16 percentage-points difference across OECD countries), adjusting for education has a minor effect on the size of the gap (which decreases from 15 to 9 points). As discussed above, it is hard to identify how much of the remaining (adjusted) gap captures an age effect and how much it captures cohort or period effects, which might be due to a number of reasons, such as changes in the quality of education over time. This seems to be a plausible explanation

in the case ok Kazakhstan, where older adults, despite being less educated than the younger cohorts, have the same level of literacy proficiency. As a consequence, after accounting for the different level of educational attainment, the estimated gap turns out to be negative, meaning that older adults would be more proficient than 25-34 year-olds, had they attained the same level of education.

Figure 3.7 ▪ **Age differences in literacy proficiency**

A. Mean literacy proficiency, by 10-year age groups

B. Difference in mean literacy score between the youngest (25-34 year-old) and oldest (55-65 year-old) adults



Notes: Statistically significant differences in Panel B are marked in a darker tone. Unadjusted differences are the differences between the two means for each contrast category. Adjusted differences are based on a regression model and take account of differences associated with other factors: gender, education, immigrant and language background and parents' educational attainment. Only the score-point differences between two contrast categories are shown in Panel B, which is useful for showing the relative significance of age with regard to observed score-point differences. The adjusted difference for the Russian Federation is missing due to the lack of language variables.

1. See note at the end of this chapter.
2. See note 1 under Figure 3.1.

Countries and economies are ranked in ascending order of the difference in literacy scores (25-34 year-olds minus 55-65 year-olds).

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.1(L) and A3.5(L).

StatLink https://doi.org/10.1787/888934020274

Proficiency in problem solving in technology-rich environments among older and younger adults

As the assessment of problem solving required test takers to have some basic familiarity with digital devices and applications, it might be expected that age differences would be more pronounced in this domain. Indeed, Figure 3.8 shows particularly low levels of proficiency in problem solving in technology-rich environments among older adults. In Ecuador, Mexico and Peru, the vast majority of older adults (55-65 year-olds) did not undertake the problem-solving assessment because they lacked the necessary ICT experience or failed a very basic test of ICT skills. Virtually no older adults demonstrated problem-solving proficiency at Level 2 or 3 in these three countries as a result. Proficiency in problem solving in technology-rich environments was on a par with the OECD average for older adults in Hungary, and well above the average in the United States.

When looking at younger adults, it is more interesting to look at their actual level of proficiency, rather than at the difference between them and older adults. Digital technologies might not yet be as widespread in middle-income countries as they are in more developed ones, but there is little doubt that a fast adoption of digital technologies will be essential if countries are to reap the benefits of globalisation, technological change and economic integration (OECD, 2019[5]).

From this perspective, it is concerning to see very low levels of proficiency in using ICT among younger adults in a number of countries. Mexico and Peru have the highest shares of 25-34 year-olds failing the core ICT test or having no ICT experience (28% in Mexico and 33% in Peru), similar to what is observed in Turkey (27%). Ecuador does slightly better, at 22%, but is still well behind Chile (13%). The share of this age group scoring at Level 2 or 3 is only 7% in Ecuador, 9% in Peru and 13% in Mexico.

Lack of basic ICT skills or experience was less common in Kazakhstan, where only 10% of 25-34 year-olds failed the ICT core or had no ICT experience. However, proficiency in problem solving in technology-rich environments remained well below the OECD average, with only 18% of adults in this age group scoring at Level 2 or 3. In both Hungary and the United States the share of these younger adults at Level 2 or 3 is close to 40% (in line with the OECD average), and the share who failed the ICT core or lacked ICT experience is below average, at 5% in Hungary and 4% in the United States.

When looking at the youngest adults (16-24 year-olds), however, there are some signs of improvement over time (i.e. comparing the older to younger cohorts) in the lowest performing countries. While the share of 16-24 year-olds scoring at Level 2 or 3 remains very low (only in Mexico does it reach 18%), they are less likely than 25-34 year-olds to opt out of the computer based assessment, fail the ICT core or to lack ICT experience. No clear sign of progress is apparent in Kazakhstan, where the performance of 16-24 year-olds was very close to that of 25-34 year-olds.

DIFFERENCES IN SKILLS PROFICIENCY RELATED TO GENDER

Proficiency in literacy and numeracy among men and women

Gender differences in literacy and numeracy skills are typically small, and countries that participated in Round 3 of PIAAC are no exception (Figure 3.9). Peru is the only Round 3 country where the gender gap in numeracy is above the OECD average; Peru's gap of 16 score points might appear small when compared with differences related to educational attainment or age, but is not negligible in size, as this represent almost one-third of the international standard deviation. Peru is also the only Round 3 country (and one of the few countries among all those that participated in PIAAC) where women have a statistically significant (although small) advantage in literacy.

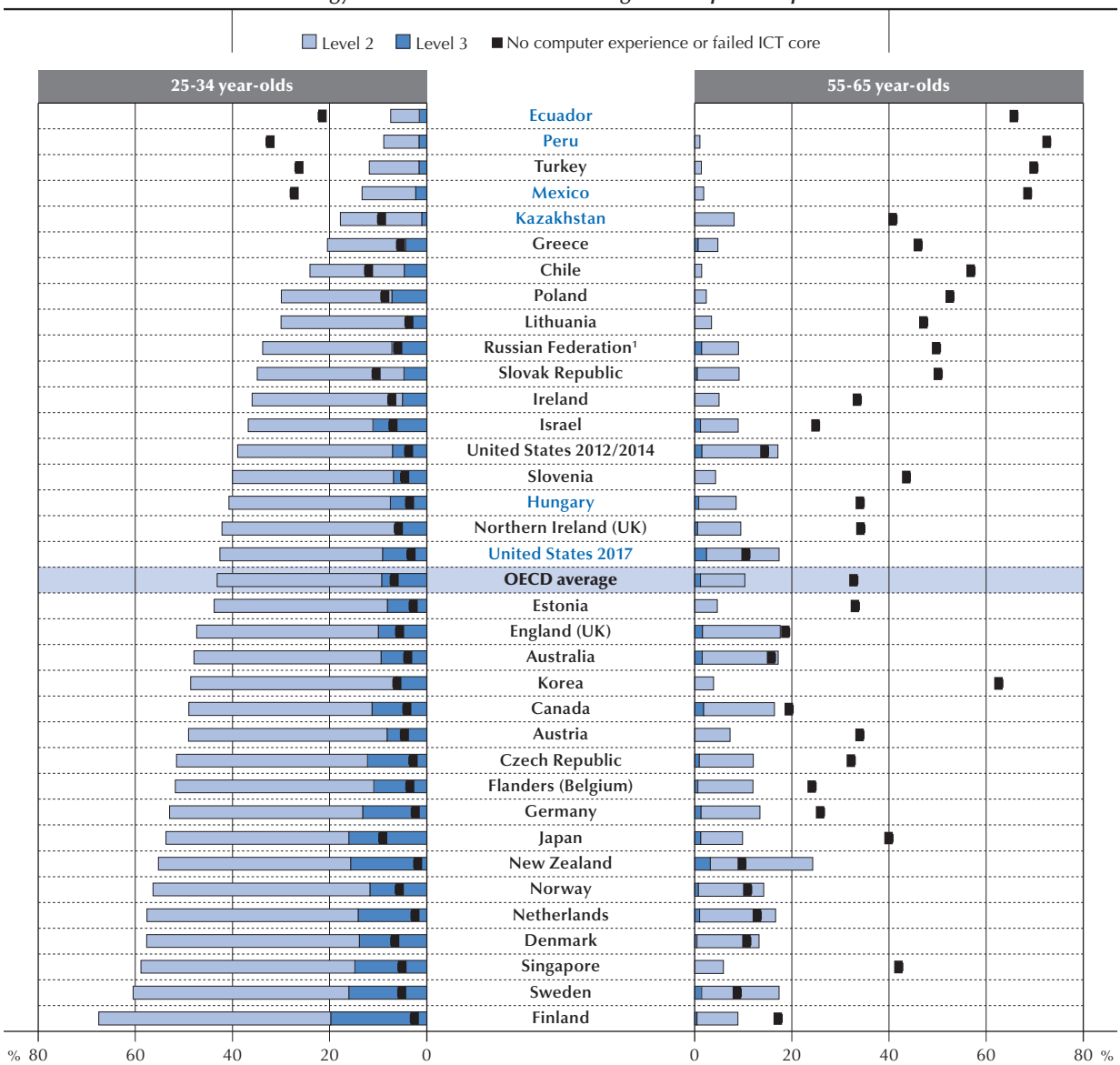
Hungary and Kazakhstan are among the few countries where there is no gender difference in numeracy proficiency. Hungarian women scored 271 points on average, 15 points above the OECD average (while Hungarian men scored 274 points, only 6 points above the average), although they still lag slightly behind top-performing countries like Japan (282 score points), Finland (277 score points) and the Slovak Republic (275 score points). In Kazakhstan both men and women score below the OECD average, but the gap is much narrower for women, at only 9 score points

Gender differences are typically more pronounced among older adults (Figure 3.10). This is mainly due to two reasons. The first is that the educational attainment of women has progressively caught up with that of men. The second is that women and men still tend to make different occupational choices, or have different labour-market outcomes for a given level of education, which might affect the extent to which they have the opportunity to practise and maintain their level of proficiency. This is particularly evident in Peru, where gender gaps in numeracy are as high as 19 score points (among the highest across all PIAAC participating countries and economies) for adults aged 25 and over, but are as low as 5 score points (below the OECD average) among adults aged 24 and under. This is probably due to the fact that only among

these younger adults do women have roughly similar levels of educational attainment to men. In all age groups over 25, women are over-represented among adults without an upper secondary education and under-represented among upper secondary educated adults. A similar pattern (although on a smaller scale) is evident for gender gaps in literacy as well.

Figure 3.8 ■ **Problem-solving proficiency among younger and older adults**

Percentage of adults aged 25-34 and 55-65 scoring at Level 2 or 3 in problem solving in technology-rich environments or having no computer experience



Notes: Percentages on the problem solving in technology-rich environments scale are computed so that the sum of percentages for the following mutually exhaustive categories equals 100%: opted out of the computer-based assessment; no computer experience; failed ICT core test; below Level 1, Level 1, Level 2 and Level 3. For more detailed results for each category, see corresponding table mentioned in the source below. Cyprus[2], France, Italy and Spain did not participate in the problem solving in technology-rich environments assessment.

1. See note at the end of this chapter.
2. See note 1 under Figure 3.1.

Countries and economies are ranked in descending order of the combined percentages of adults aged 25-34 scoring at Level 2 or 3.

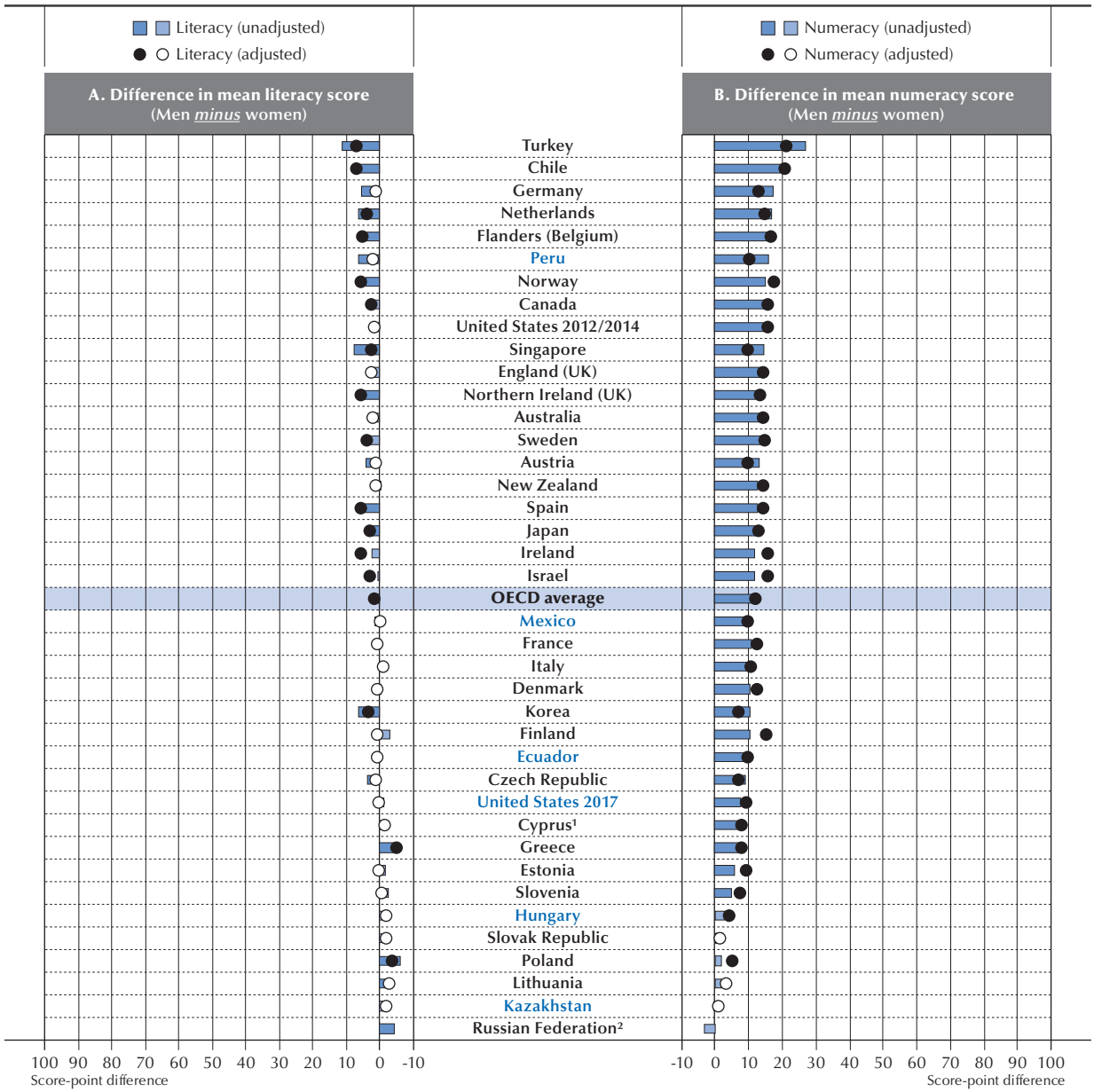
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A3.7(P).

StatLink https://doi.org/10.1787/888934020293

In Ecuador, gender gaps in numeracy are also wider than the OECD average for adults aged 45 and over, but are much smaller for adults below that age. A similar pattern is observed in Mexico, although the gender gap among older adults is in line with the OECD average. In Hungary, on the other hand, gender gaps are essentially identical (and extremely small) across the different age groups, in both literacy and numeracy. The numeracy proficiency among women aged 45 and over in Hungary is almost 20 points above the OECD average, and one of the highest overall.

Figure 3.9 ■ **Gender differences in literacy and numeracy proficiency**

Difference in mean score between men and women



Notes: Statistically significant differences are marked in a darker tone. Unadjusted differences are the differences between the two means for each contrast category. Adjusted differences are based on a regression model and take account of differences associated with other factors: gender, education, immigrant background, language and parents' educational attainment. The adjusted difference for the Russian Federation is missing due to the lack of the language variables.

1. See note 1 under Figure 3.1.
2. See note at the end of this chapter.

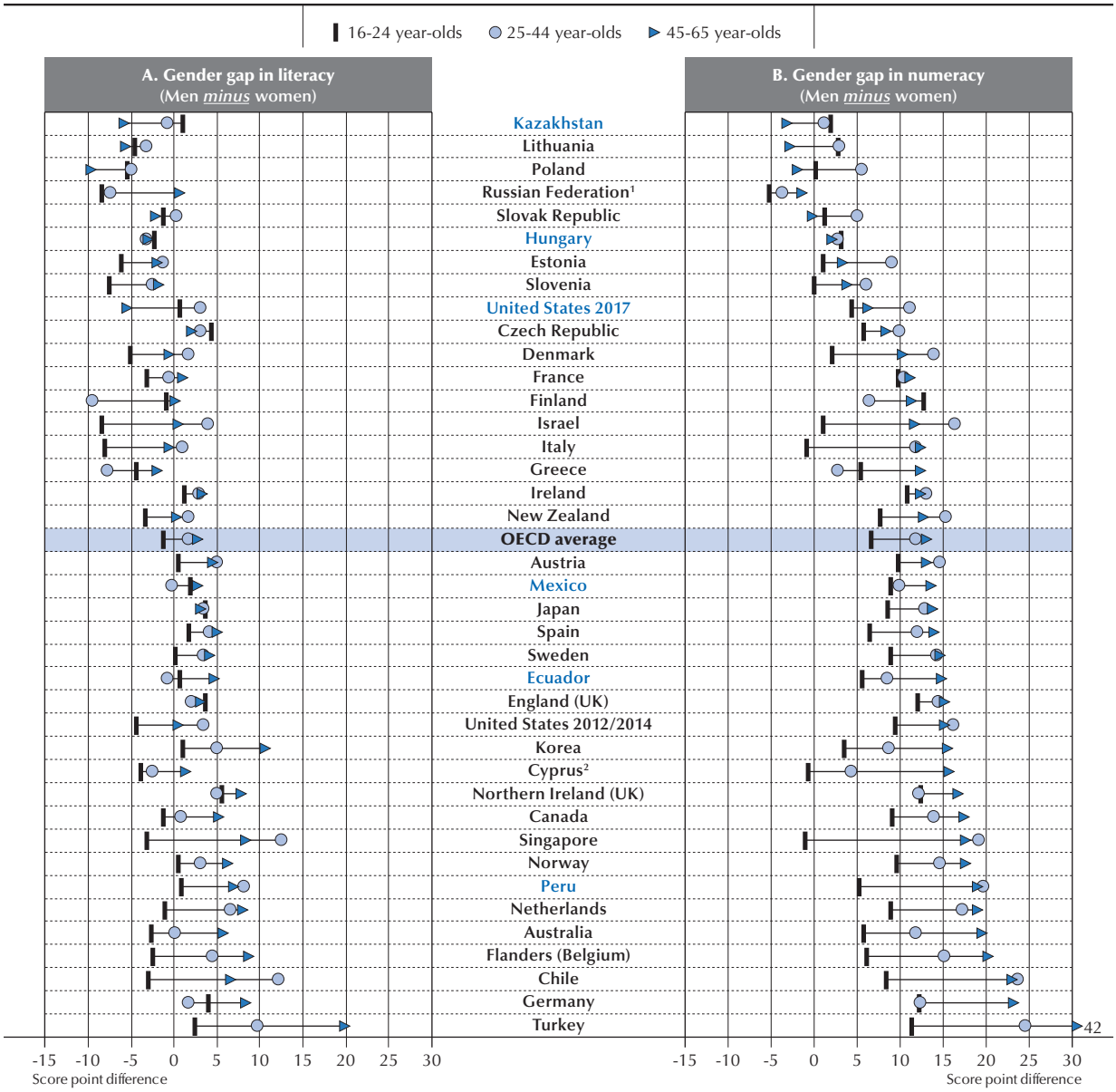
Countries and economies are ranked in ascending order of the difference in numeracy scores (Men minus women).

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.1(L), A3.1(N), A3.8(L) and A3.8(N).

StatLink https://doi.org/10.1787/888934020312

Figure 3.10 ▪ **Gender gap in literacy and numeracy, by age**

A. Difference in mean literacy score between men and women, by age group
B. Difference in mean numeracy score between men and women, by age group



1. See note at the end of this chapter.
2. See note 1 under Figure 3.1.
Countries and economies are ranked in descending order of the gender gap in numeracy among 45-65 year-olds.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.9(L) and A3.9(N).
StatLink https://doi.org/10.1787/888934020331

Proficiency in problem solving in technology-rich environments among men and women

Gender differences are also not particularly pronounced in the domain of problem solving. Men have a slight advantage. On average across OECD countries, 32% of men score at Level 2 or 3, compared to 28% of women, although a similar share of men and women have no computer experience or have failed the ICT core test (Figure 3.11).

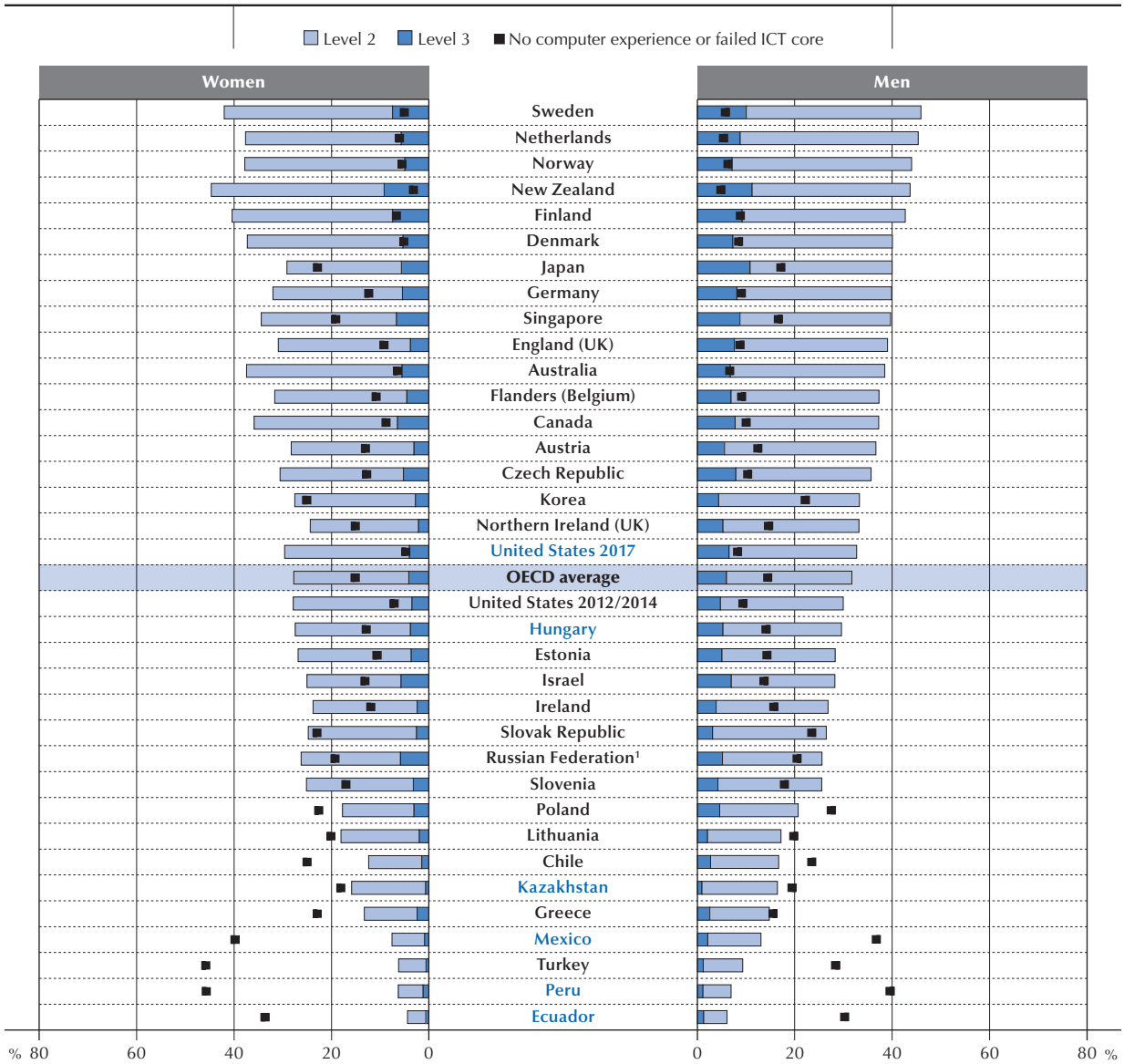
In Ecuador and Peru gender gaps are less pronounced at the top of the distribution: the percentage of men scoring at the two highest levels is 6% in Ecuador and 7% in Peru, while the corresponding shares for women are 4% in Ecuador and 6% in Peru. At the bottom end of the distribution, a larger share of women have no computer experience or fail the ICT core test: 35% in Ecuador and 47% in Peru, compared to 31% and 41% for men.

In Hungary and the United States men are over-represented at both the top and the bottom of the proficiency distribution. The share of men at Level 2 and 3 is 2 percentage points higher than the share of women in Hungary and 3 percentage points in the United States, while at the lower end (respondents with no computer experience or failing the core assessment), the share of men is 1 percentage point higher in Hungary and 2 percentage points higher in the United States.

In Kazakhstan no gender differences are observed in this domain, as the share of adults scoring at the different levels is nearly identical for both men and women.

Figure 3.11 ▪ **Problem-solving proficiency among men and women**

Percentage of women and men scoring at Level 2 or 3 in problem solving in technology-rich environments or having no computer experience



Notes: Percentages on the problem solving in technology-rich environments scale are computed so that the sum of percentages for the following mutually exhaustive categories equals 100%: opted out of the computer-based assessment; no computer experience; failed ICT core test; below Level 1, Level 1, Level 2 and Level 3. For more detailed results for each category, see the corresponding table mentioned in the source below. Cyprus[2], France, Italy and Spain did not participate in the problem solving in technology-rich environments assessment.

1. See note at the end of this chapter.
2. See note 1 under Figure 3.1.

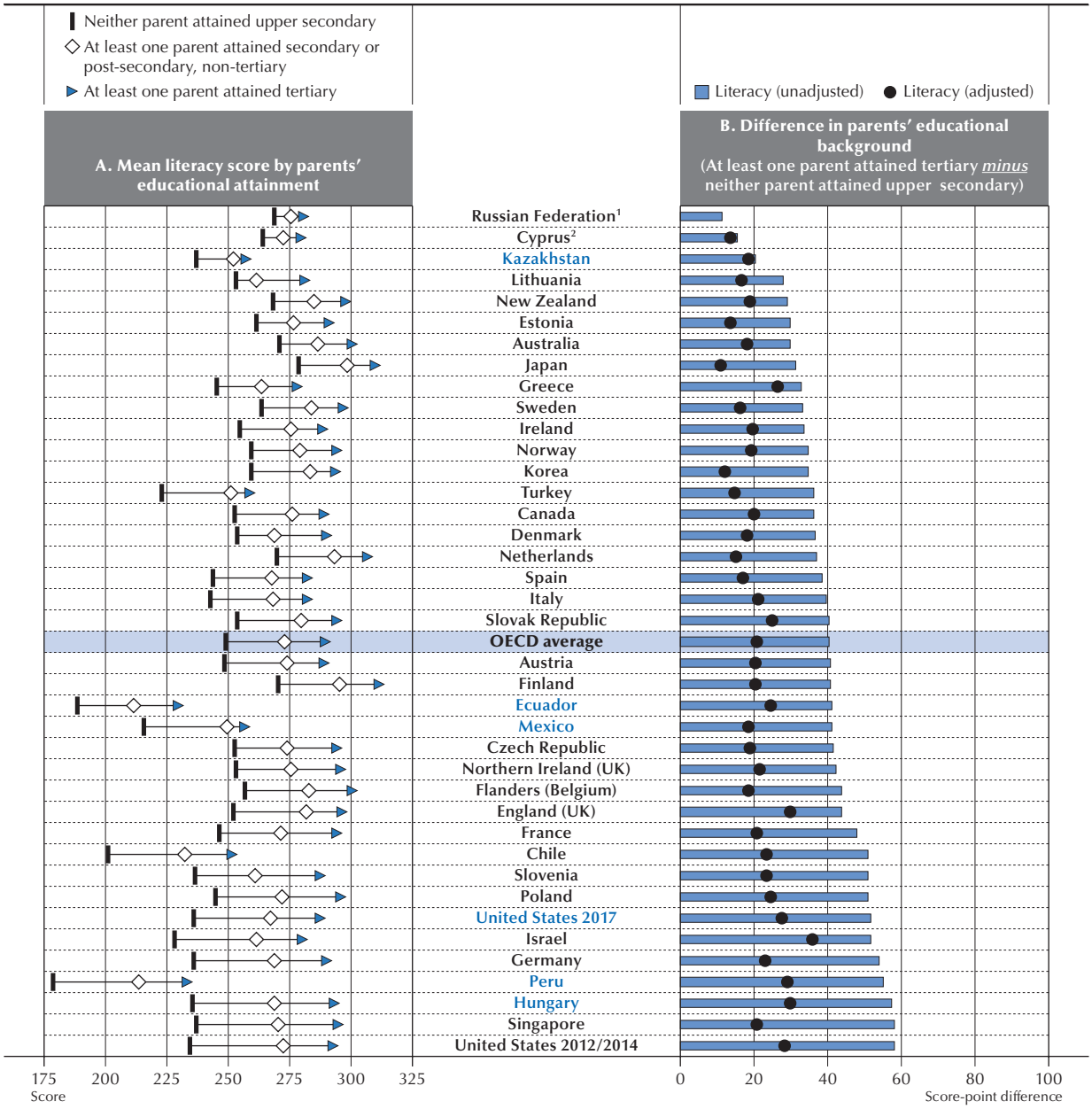
Countries and economies are ranked in descending order of the combined percentages of men scoring at Level 2 or 3.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A3.10(P).

StatLink https://doi.org/10.1787/888934020350

Figure 3.12 ■ **Differences in literacy proficiency, by parents' educational attainment**

A. Mean literacy proficiency, by parents' level of education
B. Difference in mean literacy score between adults with high- and low-educated parents



Notes: All differences in Panel B are statistically significant. Unadjusted differences are the differences between the two means for each contrast category. Adjusted differences are based on a regression model and take account of differences associated with other factors: age, gender, education, immigrant and language background. Only the score-point differences between two contrast categories are shown in Panel B, which is useful for showing the relative significance of parents' educational attainment with regard to observed score-point differences. Upper secondary includes ISCED 3A, 3B, 3C long and 4. Tertiary includes ISCED 5A, 5B and 6. The adjusted difference for the Russian Federation is missing due to the lack of the language variables.

1. See note at the end of this chapter.
2. See note 1 under Figure 3.1.

Countries and economies are ranked in ascending order of the unadjusted difference in literacy scores (at least one parent attained tertiary minus neither parent attained upper secondary).

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A3.1(L) and A3.11(L).

StatLink https://doi.org/10.1787/888934020369

DIFFERENCES IN SKILLS PROFICIENCY RELATED TO SOCIO-ECONOMIC BACKGROUND

It is well known that the family background in which people grow up is a crucial factor affecting their outcomes such as educational attainment or earnings. Given that people cannot choose their family background, reducing its impact on outcomes is often considered an important policy objective, in order to increase equality of opportunity.

Proficiency in literacy and numeracy among adults with high- and low-educated parents

The best proxy for socio-economic background available in the Survey of Adult Skills is the level of educational attainment attained by the parents of the participants in the Survey. Using this indicator, the results confirm the importance of socio-economic background on adults' outcomes: across the three rounds of the study, adults with at least one tertiary-educated parent score on average 41 points more than adults from families in which neither parent attained upper secondary education (Figure 3.12).

The countries that participated in Round 3 are no exception. In Ecuador and Mexico the differences are very close to the OECD average, at 41 score points; they are higher in the United States (52 score points), Peru (55 score points), and Hungary (57 score points); and they are smaller (but still significant) in Kazakhstan, at 20 score points.

Much of these raw differences are accounted for by differences in other personal characteristics, as the effect of socio-economic background mainly works through the intergenerational transmission of educational attainment: adults with highly educated parents are more likely to attain higher levels of education themselves. In most countries, the adjusted differences are about half the size of the unadjusted ones. Kazakhstan is an exception, as adjusting for observable characteristics has almost no impact on the size of the socio-economic gap. Adjusted differences are slightly below the OECD average in Mexico (18 score points), and remain higher than the average in Ecuador (24 score points), as well as in the United States (27 score points), Hungary and Peru (29 score points).

SUMMARY

This chapter has highlighted the proficiency levels of different subgroups of the population, defined according to a number of socio-demographic characteristics. The analysis has confirmed a number of expected results, such as the association between proficiency and educational attainment, the age-proficiency profile, and the extent to which men and women tend to perform differently in different domains.

While these associations hold across most countries and economies, a number of peculiarities have emerged from the analysis, and some can be traced back to the individual history of development and the policies adopted in different countries.

For example, the analysis has shown that, while Latin American countries in PIAAC tend to have lower performance across the board, they seem to be benefiting from the recent expansion in access to education, as more highly educated young cohorts show greater proficiency than older adults. This is not the case in Kazakhstan, where the expansion of tertiary education has not brought about the expected benefits in terms of higher proficiency. At the same time, young early school leavers in Ecuador and Peru demonstrated an extremely low level of proficiency, which calls for targeted policies to address the needs of this particularly vulnerable group of people.

Adults in Hungary, on the other hand, tend to score roughly at the same level as the OECD average and outperform many countries when the analysis is restricted to tertiary-educated adults. Moreover, Hungary stands out as a country where there are no gender gaps in numeracy, thanks to exceptionally strong performance of Hungarian women in that domain.

Notes

1. Adjusted differences are estimated through an ordinary least squares regression (one regression per country). The dependent variable is the literacy (or numeracy) score of each individual respondent, and the independent variables are the gender, age class, educational attainment, socio-economic background (measured by the highest level of education attained by either parents), and immigrant and language background. The dots in Figure 3.1 report the estimated regression coefficient for the various independent variables.

A note regarding the Russian Federation

The sample for the Russian Federation does not include the population of the Moscow municipal area. More detailed information can be found in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[6]).

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4

Use of skills in everyday life and at work

This chapter examines the use of numeracy skills at work and in everyday life, and the relationship between the intensity of individuals skills use and their employment status, wages, job satisfaction and economy-wide productivity. It also explores the factors associated with greater or lesser use of these skills in the workplace, including proficiency, the characteristics of workers – such as gender, age and educational attainment – and features of their jobs. It ends by considering how the sorts of tasks used at work, including social interactions, might affect which jobs are at risk of automation.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

In addition to assessing proficiency in literacy, numeracy and problem solving in technology-rich environments, the Survey of Adult Skills (PIAAC) collects information on the frequency with which adults engage in practices involving literacy, numeracy and problem solving such as reading different types of text, undertaking calculations and solving problems both in everyday life and at work. The survey collects information on engagement in these practices for a number of reasons. First, engaging with written materials and the mathematical demands of adult life is an important dimension of what it is to be literate and numerate in terms of the definitions of these constructs in the study (see definitions in Chapter 2). Second, practice is understood as a means by which individuals develop and maintain their skills during the lifetimes. Third, individuals' productivity and wages in the workplace are determined by both their skills and the intensity with which they engage in practices that use these skills.

This chapter focuses particularly on numeracy skills, and compares their use at work and in everyday life. It starts by estimating an index of engagement in numeracy practices, based on Jonas (2018[1]). Using an item response theory (IRT) model, it considers the frequency with which individuals perform eight different numeracy practices in their jobs or in everyday life. This index can better account for the different levels of complexity of numeracy practices as well as the fact that a small number of sophisticated users will tend to use advanced numeracy practices frequently, while there are many more unsophisticated users who use such practices rarely.

Information about other tasks performed on the job is used to measure the extent of workers' engagement in social interactions and problem-solving tasks, and the way work is organised and managed by the employers. It is also exploited to assess the risk that each job could be automated in Round 3 countries, extending previous analysis that the OECD conducted on Round 1 and 2 countries and economies.

The main findings discussed in this chapter are:

- Among high-income countries, proficiency in numeracy and engagement in numeracy practices are positively but weakly correlated at the country level, i.e. higher average numeracy scores tend to correspond to higher average values for the index of numeracy use. The correlation strengthens when Ecuador, Mexico and Peru are also considered.
- Countries ranking low in numeracy skills use in everyday life (Italy, Kazakhstan, Peru, Turkey) also rank low for their use at work, while those ranking high for everyday use (the Czech Republic, Finland, New Zealand and the United States) also rank high for use at work. This suggests that the use of skills in everyday life and at work are highly, albeit imperfectly, correlated at the country level.
- To make it easier to interpret the index of engagement in numeracy practices, individuals were grouped into three categories: limited, median and intensive users. Finland stands out as the country with the lowest proportion of limited users in numeracy, both in everyday life (13%) and at work (23%), closely followed by New Zealand (21% in everyday life and 27% at work) and the United States (25% and 33%). Conversely, the countries with the largest shares of limited users are Kazakhstan (70% in everyday life and 59% at work) and Turkey (66% and 57%).
- Ecuador, Kazakhstan, Mexico and Peru also rank at the lower end of the distribution of engagement in numeracy practices, as does Chile. In contrast, Hungary displays lower intensity in engagement in numeracy practices at work than the average OECD country but above-average intensity for numeracy use in everyday life. All Round 3 countries except the United States report lower proportions of median and intensive users of numeracy practices in everyday life and work – and higher proportions of limited users – than the average of OECD countries and economies, with the exception of Hungary for use at work.
- In almost all participating countries and economies, men engage in numeracy practices more frequently than women, both at work and in everyday life. Controlling for other personal and job-related characteristics reduces this gender gap, especially for the intensity of use in everyday life.
- In all countries and economies taking part in PIAAC except Greece, Italy and the United States, 55-65 year-olds engage less intensively in numeracy practices at work than 25-54 year-olds. Those aged 16-24 also engage less intensively than 25-54 year-olds, with the exception of Kazakhstan, Mexico, Peru and the Russian Federation. For the average OECD country, the differences between 25-54 year-olds and the youngest adults tend to be larger than those between 25-54 and 55-65 year-olds, but gaps vary substantially across countries. This is also true for the intensity of skills use in everyday life, once other individual and job-related characteristics are accounted for.
- As found in earlier PIAAC rounds, engagement in numeracy practices both at work and in everyday life is positively associated with educational attainment, as upper-secondary graduates engage in numeracy practices more frequently than less-educated individuals, but less frequently than tertiary graduates, on average.

- The gaps in the intensity of practice across attainment levels are wider in all Round 3 countries except the United States, but especially in Ecuador, Mexico and Peru. For these three countries, the adjusted gaps in numeracy use between adults with upper secondary education and those without are two to three times larger than the average for OECD countries. In Kazakhstan, conversely, individuals with below upper secondary education do not use numeracy less intensively than individuals with upper secondary education, either at work or in everyday life.
- There is also a wider (positive) gap between tertiary-educated adults and those with upper secondary education in Round 3 countries (except the United States) than the OECD average. This is especially true for Ecuador, Kazakhstan and Peru.
- With other features linked to engagement in numeracy held constant, being young, male, tertiary educated and more proficient in numeracy increases numeracy engagement among respondents whether they are working, unemployed or inactive, while being older and lacking an upper secondary qualification does the opposite. This is broadly the case for numeracy engagement at work as well as in everyday life, although these analyses cover two different populations. Students without upper secondary qualifications engage significantly more in numeracy practices than students with upper secondary education.
- Occupation and the human resource practices adopted in workplaces explain a large share of the variation in the index of use of numeracy. In particular, high-performance work practices (e.g. team work, mentoring or job rotation) explain between 15% and 24% of the variation in skills use among individuals.
- All Round 3 countries except the United States rank low, and lower than the OECD average, for engagement in social interaction and in problem-solving tasks at work. The United States, conversely, ranks at the top of both distributions of engagement, and displays the very highest intensity engagement in problem-solving tasks. These results may reflect, among other factors, how widespread decentralised management practices are across countries, and differences in the nature of production and the industrial structure of the economy.
- The task-related information collected in PIAAC can be used to identify the risk of automation attached to each job. Nedelkoska and Quintini (2018[2]) found that the frequency of solving complex problems, and teaching others or influencing or advising them are negatively correlated with the automatability of a person's job. Based on these authors' methodology, this report computes the risk of job automation for the Round 3 countries and presents it for the first time. With the exception of the United States, the proportion of workers at high or significant potential risk of automation in all Round 3 countries and economies is higher than the OECD average, reaching 61% in Mexico and 68% in Peru. However, many factors, including institutional settings and price dynamics, could affect the diffusion and adoption of labour-saving technologies, and make a difference between potential and actual automation of some tasks on the job.

MEASURING SKILLS USE IN THE WORKPLACE AND IN EVERYDAY LIFE

The Survey of Adult Skills (PIAAC) collects information about how often adults perform specific tasks in their everyday life and their jobs. Based on this information, it is possible to develop measures of the use of information-processing skills: reading, writing, numeracy, information and communications technology (ICT) skills, and problem solving.

Respondents are asked about the frequency with which they perform certain tasks associated with the use of information-processing skills. The resulting large amount of information can be combined into indices, each of which groups together several PIAAC questions. There are five potential indicators related to the use of reading, writing, numeracy, ICT skills and problem solving at work, and a further five related to engagement in these activities in everyday life. While in OECD (2013[3]; 2016[4]) indices were computed as a weighted average of the responses to different questions (or items), this chapter exploits item response theory instead. This estimation method can better account for the ranking of technical difficulty and rarity among the different items related to the same skill. Box 4.1 provides further details on the methodology used and the list of items associated with each indicator.

In this chapter, the index of numeracy use (also referred to as "engagement in numeracy practices") summarises information not just about six activities involving calculations and use of mathematical formulas (use of a calculator; calculation of prices, costs or budgets, etc.), but also two further activities which usually fall under reading activities but which require the interpretation of mathematical information (reading bills, invoices, bank or financial statements; and reading diagrams, maps or schematics).

Table 4.1 provides a summary of the information about the numeracy activities that adults undertake at work and in everyday life, showing the proportion of adults who never engage in the activities in question and the mean value for the item (a higher score reflects more frequent engagement).

Unsurprisingly, advanced maths is the least frequently used of all the numeracy practices considered, followed by preparing charts and tables and using simple algebra or formulas. These are also the practices which the largest number of respondents said they never used, although with a relatively stark gap after the first two. At the opposite end of the frequency spectrum, calculating costs or budgets and using calculators are frequent both at work and in everyday life. For other practices, however, individuals report different patterns of use in everyday life and at work. On average across all respondents, reading financial statements happen very frequently in everyday life and more frequently than most other practices, while they are as frequent as other practices at work.

Table 4.1 Descriptive statistics on numeracy practices

OECD weighted averages

Numeracy practices	% missing	% never	Mean	S.D.
Panel A: In everyday life				
Read financial statements	1.5	15.9	3.02	1.12
Read diagrams, maps or schematics	1.5	50.8	1.91	1.10
Calculating costs or budgets	1.5	23.7	2.86	1.35
Use or calculate fractions or percentages	1.5	44.6	2.22	1.31
Use a calculator	1.5	23.4	2.79	1.31
Prepare charts, graphs or tables	1.4	74.7	1.41	0.85
Use simple algebra or formulas	1.4	56.1	2.01	1.26
Use advanced maths or statistics	1.4	86.5	1.24	0.74
Panel B: At work				
Read financial statements	0.3	48.3	2.46	1.60
Read diagrams, maps or schematics	0.3	47.6	2.36	1.50
Calculating costs or budgets	0.3	47.5	2.52	1.65
Use or calculate fractions or percentages	0.3	46.4	2.59	1.65
Use a calculator	0.3	30.4	3.22	1.70
Prepare charts, graphs or tables	0.3	60.7	1.89	1.27
Use simple algebra or formulas	0.3	54.3	2.31	1.54
Use advanced maths or statistics	0.3	86.1	1.27	0.77

Notes: Response format: 1 = "Never", 2 = "Less than once a month", 3 = "Less than once a week but at least once a month", 4 = "At least once a week but not every day", 5 = "Every day". S.D. stands for standard deviation.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.1.
StatLink https://doi.org/10.1787/888934020388

Box 4.1 Constructing indices of skills use and of engagement in numeracy practices

In the Survey of Adult Skills, the intensity in use of certain skills is approximated by how frequently tasks relevant to each skill are carried out. Indicators of skills use can be calculated considering the answers to multiple questions referring to the same skill.

The list of tasks falling under the scope of each index is reported in Table 4.2. For instance, an index of writing skills use is derived from a set of questions investigating the frequency with which individuals write different types of documents (letters, memos, e-mails, articles, reports, forms).

For numeracy use, the eight selected items reflect the multiplicity of applications for numeracy skills. Two questions aim at capturing the ability to interpret numerical information (read bills, bank or financial statements; read diagrams, maps or schematics), three others the mastery of pure mathematical knowledge (use of fractions, decimals or percentages; use of algebra or simple formulas; use of more advanced maths), and three others some technical skills which require familiarity with maths. As a result, this indicator of engagement in numeracy practices differs from the one used in OECD (2013[3]; 2016[4]), which excluded information on reading bills, invoices, bank or

...

financial statements, and reading diagrams, maps or schematics. For this report, these were omitted from the index of use of reading skills as they were instead included in the numeracy skills index.

The frequency of each task is reported using five discrete values, ranging from 1 (the task is never carried out) to 5 (the task is carried out every day). One way to aggregate information over multiple items is to take (weighted) averages across items. However, the result can be hard to interpret, as the different numeracy practices are treated indiscriminately, regardless of their rarity and relative difficulty. For instance, the "ideal" frequency of the use of reading skills may not be the same as the frequency for solving complex problems. Furthermore, the value of the indicator could reflect both the number of practices and their frequency of use. For example, the same value of an indicator could result from using multiple different numeracy skills infrequently, or from engaging very regularly in a small number of numeracy practices.

Here, the indicators of engagement in a given activity are instead estimated using item response theory (IRT). An IRT model estimates the probability with which the respondent gives a certain answer to the set of underlying questions ("items"). The collection of these probabilities approximates an underlying, unobservable trait of the individual, which in this case is the "proficient use of skills". Researchers are interested in understanding how the unobservable trait relates to each individual item and to the group of items as a whole, and IRT models enable the study of these relationships. While Chapter 17 of OECD (2019[5]) contains more information on IRT models in PIAAC, the use of IRT is now considered best practice in many areas of test analysis (Braun and von Davier, 2017[6]).

After rescaling, the resulting index of skills use (or the "engagement index") uses continuous values between 0 and 1. A given value of the index implies that the individual ranks in that percentile of the distribution of the skills use.

Following Jonas (2018[1]), individuals can be further grouped by their level of engagement in the use of skills (limited, median or intensive), by taking into account whether the frequency with which they engage in practices is higher or lower than in the population as a whole. For instance, in the case of numeracy use in everyday life, intensive users report frequently using the skills which are most rarely mentioned by other individuals, limited users report high frequencies of the three most frequent items, and median users high frequencies of the six most frequent items. This grouping corresponds to different parts of the distribution of skills use in everyday life, as estimated by the IRT model. Jonas (2018[1]) studied this distribution and found that individuals falling into the first 40 percentiles could be considered limited users, individuals in the top 25 percentiles intensive users, and the remaining individuals median users. The same thresholds apply for numeracy skills use at work.

While Jonas (2018[1]) focuses particularly on numeracy use in everyday life, this chapter extends his methodological approach to skills use at work. Nevertheless, unreported analysis by the OECD for this report shows that differences in the use of numeracy practices of different complexity across individuals are less marked at work than in everyday life. In the case of skills use at work, IRT-based indicators and indicators based on weighted averages across items – as in OECD (2013[3]; 2016[4]) – yield very similar results.

Table 4.2 Indicators of skills use at work and in everyday life

Indicator	Group of tasks
Reading	Reading documents (directions, instructions, letters, memos, e-mails, articles, books, manuals).
Writing	Writing documents (letters, memos, e-mails, articles, reports, forms).
Numeracy	Calculating prices, costs or budgets; use of fractions, decimals or percentages; use of calculators; preparing graphs or tables; algebra or formulas; use of advanced maths or statistics (calculus, trigonometry, regressions); reading bills, invoices, bank or financial statements; reading diagrams, maps or schematics.
ICT skills	Using e-mail, Internet, spreadsheets, word processors, programming languages; conducting transactions on line; participating in online discussions (conferences, chats).
Problem solving	Solving simple problems, solving complex problems.

Note: All indicators are available for skills use at work and in everyday life with the exception of problem solving which is only covered at work.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018).

LEVELS OF SKILLS USE IN THE WORKPLACE AND IN EVERYDAY LIFE

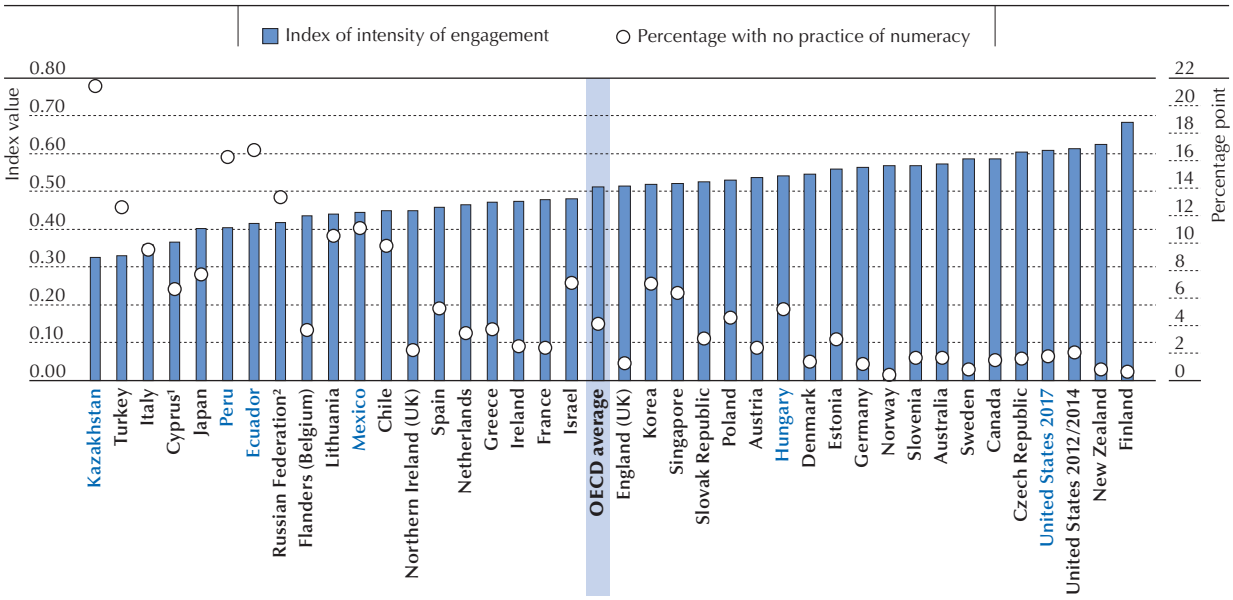
Figure 4.1 plots the index of intensity of engagement in numeracy practices in everyday life, as an average across individuals in the country, as well as the percentage of respondents answering "Never" to all eight questions of the index. Figure 4.2 plots the same statistics, but for the use of numeracy skills at work, for those respondents who are employed. While the OECD average for the index is similar for engagement in numeracy at work and in everyday life, national values for the engagement index are more diverse in everyday life (ranging from 0.3 to 0.7) than at work (ranging from 0.4 to 0.6). Any comparisons, however, must take into account that the underlying populations differ: skills use at work is calculated for employed workers only, while skills use in everyday life for all surveyed individuals.

Countries ranking low for skills use in everyday life (Italy, Kazakhstan, Peru, Turkey) also rank low for their use at work, and, similarly, the countries at the top of the distribution for everyday skills use (the Czech Republic, Finland, New Zealand and the United States) also rank high for their use at work. This suggests that the use of skills in everyday life and at work are highly, albeit imperfectly, correlated at the country level. Ecuador, Kazakhstan, Mexico and Peru also rank in the lower part of the distribution of engagement in numeracy practices for both indicators, similar to Chile. Hungary, in contrast, displays below-average intensity in engagement in numeracy practices at work, and above-average intensity for numeracy use in everyday life.

Countries and economies with similar engagement index values can report markedly different shares of the population declaring they never use any of the numeracy practices considered. For instance, both Singapore and the Slovak Republic have an index of engagement of around 0.52, but 6% of Singaporeans never engage in any numeracy practice in everyday life, compared to 3% of Slovaks. This reflects how country averages can hide considerable variation in the use of skills among individuals within a country. Overall, the proportion of respondents who never engage in any numeracy practice is lower for numeracy use in everyday life than at work (4% in everyday life, compared with and 15% at work on average across OECD countries).

Figure 4.1 ▪ **Engagement in numeracy practices in everyday life**

Index of intensity of engagement in numeracy practices in everyday life, by country



Notes: The "percentage with no practice of numeracy" in everyday life is the percentage of respondents answering "never" to all eight questions of the index. The index of intensity of engagement is an average across individuals in the country, and ranges between 0 and 1.

1. *Note by Turkey:*
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

2. See note at the end of this chapter.

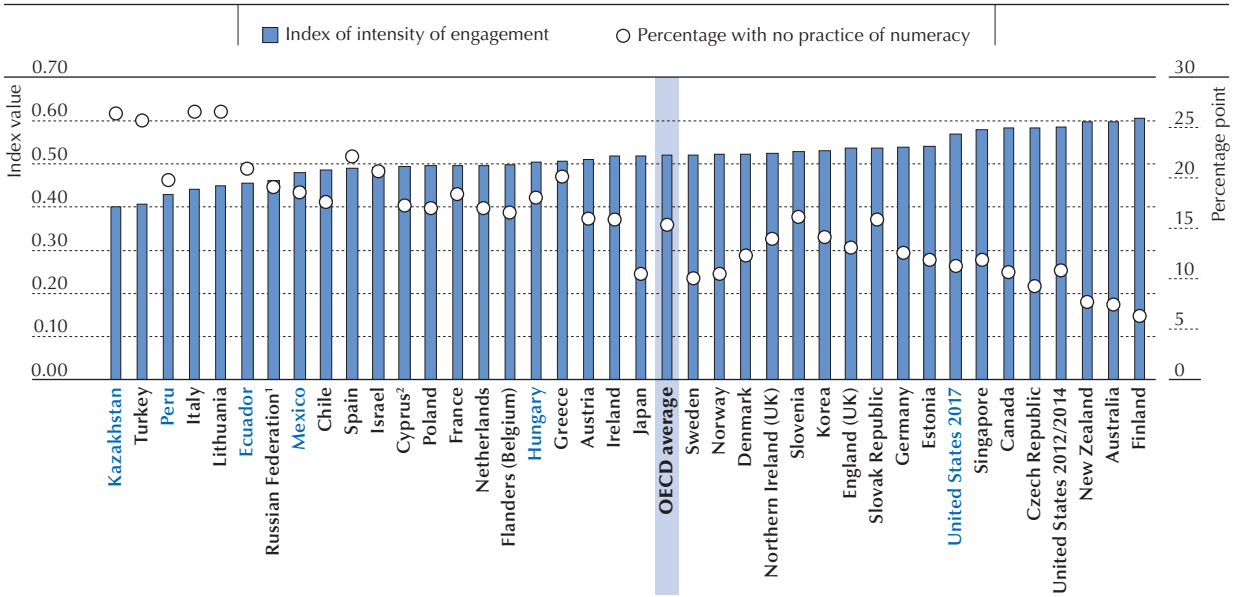
Countries and economies are ranked in ascending order of the index of engagement in numeracy practices in everyday life.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.2.

StatLink https://doi.org/10.1787/888934020426

Figure 4.2 ■ **Engagement in numeracy practices at work**

Index of intensity of engagement in numeracy practices at work, by country



Notes: The "percentage with no practice of numeracy" at work is the percentage of respondents answering "Never" to all eight questions of the index. The index of intensity of engagement is an average across individuals in the country, and ranges between 0 and 1.
1. See note at the end of this chapter.
2. See note 1 under Figure 4.1.
Countries and economies are ranked in ascending order of the index of engagement in numeracy practices at work.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.2.
StatLink https://doi.org/10.1787/888934020445

The relationship between proficiency and use

Figure 4.3 and Figure 4.4 highlight how proficiency and engagement in numeracy practices are related for the average individual in each country and economy.[1] The correlation is positive and significant at the 1% confidence level when all countries and economies in the sample are considered, but is smaller when Latin American countries are excluded from the sample.[2] Furthermore, the relationship is more positive for the engagement index at work than in everyday life. Low levels of mathematical competence can reduce an individual's propensity to engage in mathematical activities while the opposite applies for high levels of mathematical proficiency. At the same time, use can help to sharpen proficiency in numeracy or limit its obsolescence through the frequent exercise of mathematical skills.

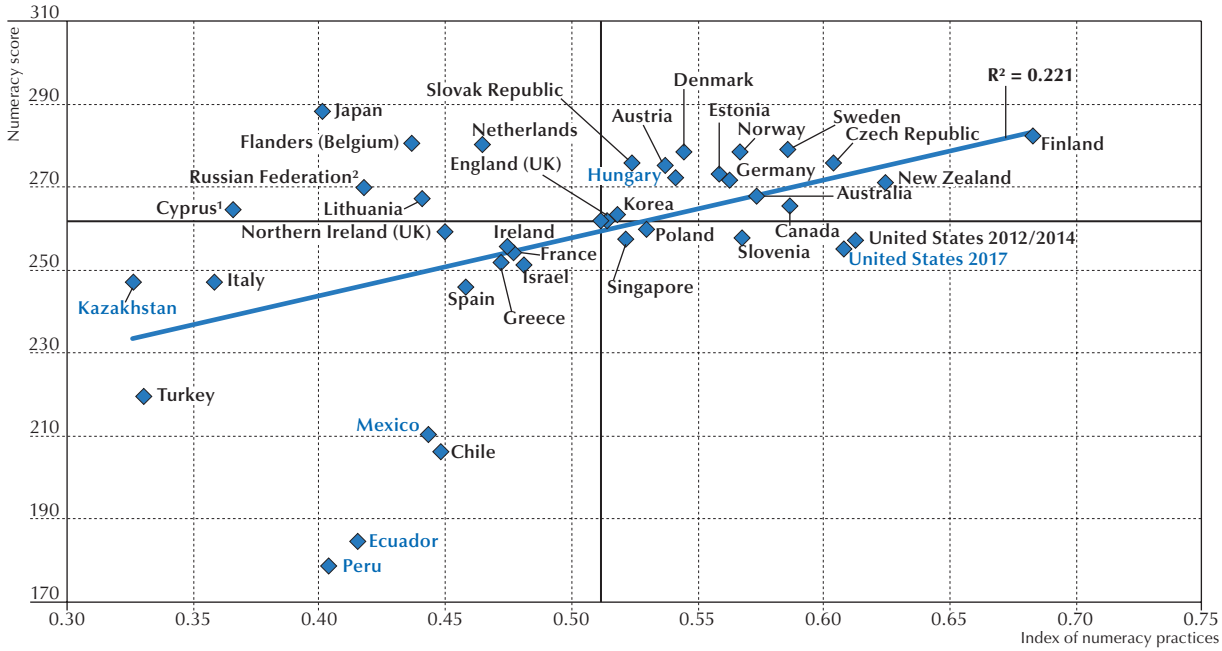
The relationship between proficiency and use, however, becomes less positive and only significant at the 10% level when the sample is restricted to high-income countries (according to the World Bank Atlas) and thus excludes Ecuador, Kazakhstan, Mexico, Peru, the Russian Federation and Turkey. On average among individuals in a country, skills use seems to be less tightly related to numeracy proficiency in high-income countries than in middle-income ones.

The relatively small share of the cross-country variation in numeracy proficiency, which can be explained by skills use (i.e. the R-squared values in Figure 4.3 and Figure 4.4) suggests that other factors can play a role in explaining proficiency, and can change the correlation of numeracy proficiency with use. One such factor could be a country's age structure: if the correlation between skills use and proficiency is lower among older individuals than younger ones, the correlation between these two facets will be lower in countries and economies with higher proportions of older individuals.

Another factor is the presence of individuals who perform strongly in numeracy (Level 4 or 5) but make little use of it in their jobs. Unreported analysis shows that these account for 1.8% of employed individuals on average among OECD countries in the Survey of Adult Skills, but also that the share can be as high as 3.9% (Flanders, Belgium). In contrast, the Latin American Round 3 countries display the lowest proportion of such individuals among all countries, just below Chile (0.3%).

Figure 4.3 ▪ **Engagement in numeracy practices in everyday life and numeracy score**

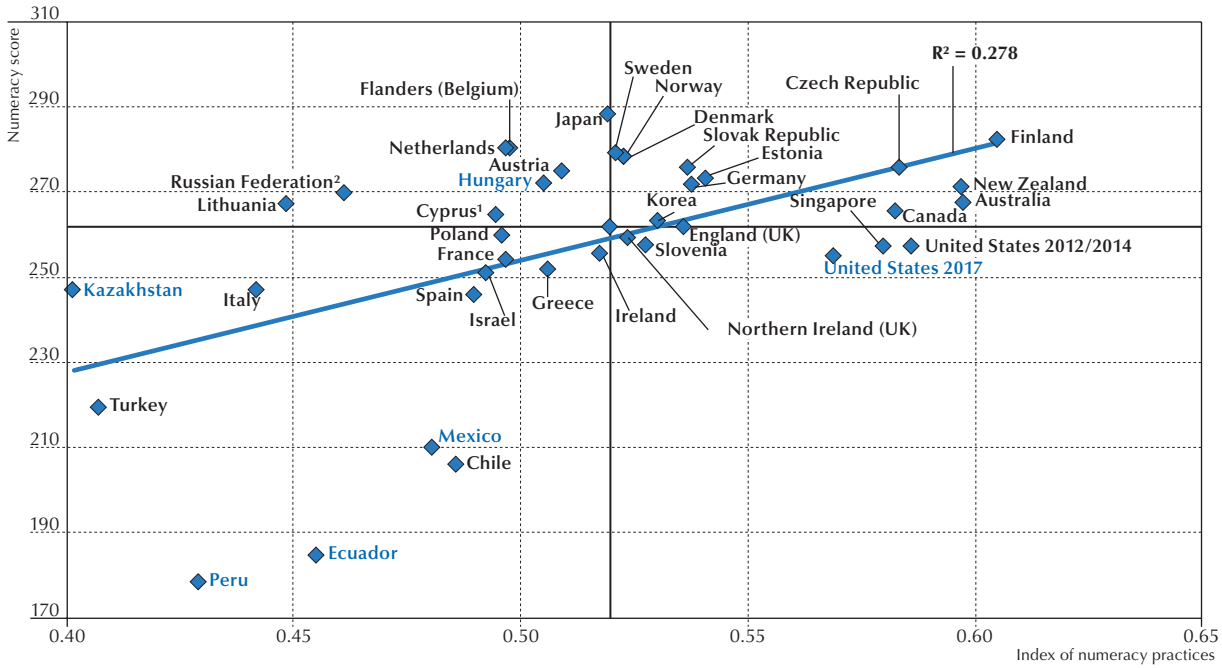
Country averages of index of engagement in numeracy practices in everyday life and of numeracy scores



Notes: The solid lines dividing the figure in quadrants correspond to the OECD average values. The R-squared signals the proportion of the variation in country averages of numeracy proficiency which can be explained by country averages in numeracy use.
1. See note 1 under Figure 4.1.
2. See note at the end of this chapter.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A4.2 and A2.4.
StatLink https://doi.org/10.1787/888934020464

Figure 4.4 ▪ **Engagement in numeracy practices at work and numeracy score**

Country averages of index of engagement in numeracy practices at work and of numeracy scores

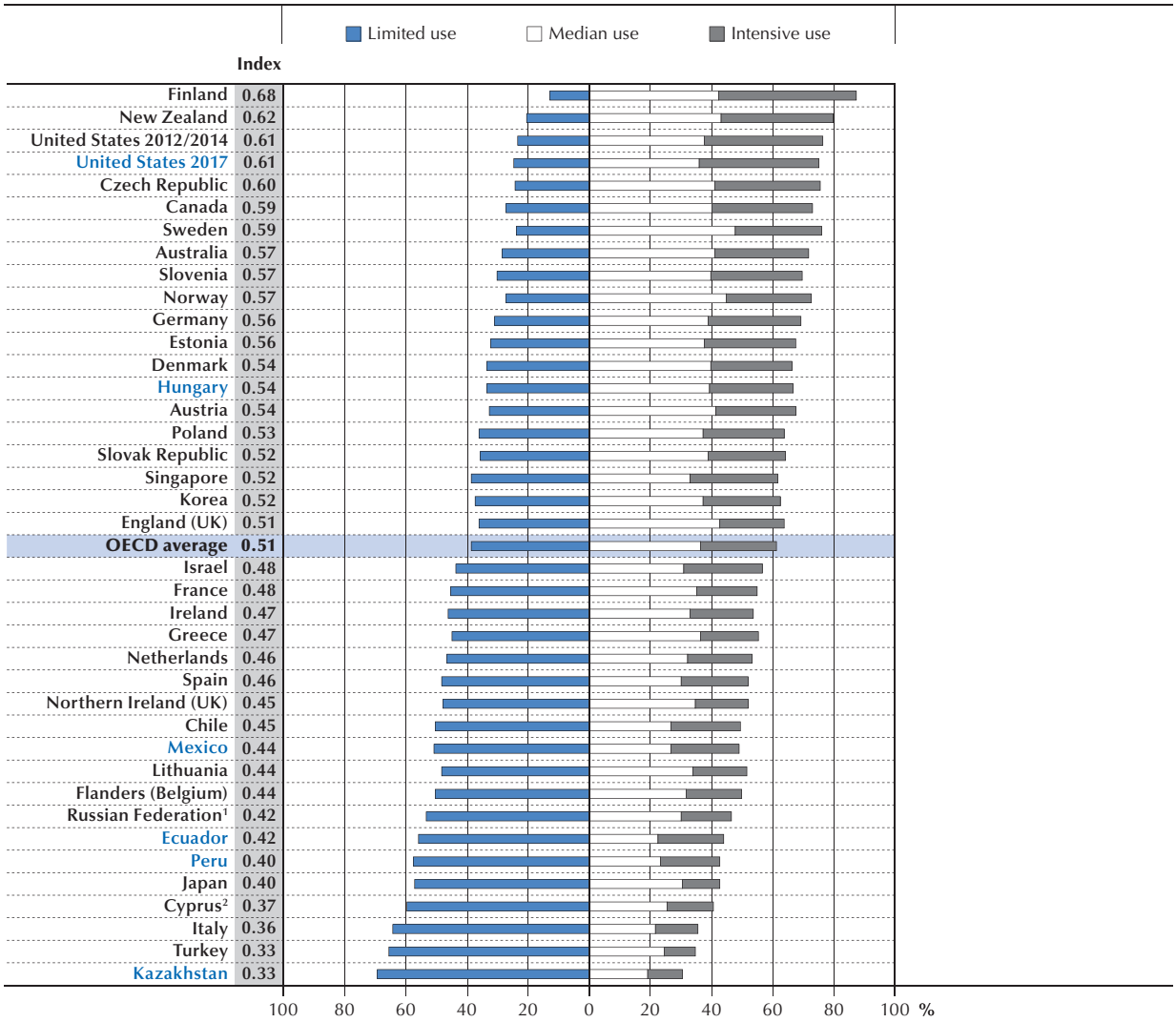


Notes: The solid lines dividing the figure in quadrants correspond to the OECD average values. The R-squared signals the proportion of the variation in country averages of numeracy proficiency which can be explained by country averages in numeracy use.
1. See note 1 under Figure 4.1.
2. See note at the end of this chapter.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A4.2 and A2.4.
StatLink https://doi.org/10.1787/888934020483

To facilitate the interpretation of the index of engagement in numeracy practices, in Figure 4.5 and Figure 4.6, individuals have been grouped into three categories as described in Box 4.1: limited, median and intensive users of numeracy practices. Finland stands out as the country with the lowest proportion of limited users, both in everyday life (13%) and at work (23%), closely followed by New Zealand (21% in everyday life and 27% at work) and the United States in (25% and 33%). Conversely, these shares are highest in Kazakhstan (70% in everyday life and 59% at work) and Turkey (66% and 57%).

Figure 4.5 ■ **Engagement in numeracy in everyday life**

Percentage of adults displaying a given level of intensity in numeracy practices in everyday life, by country

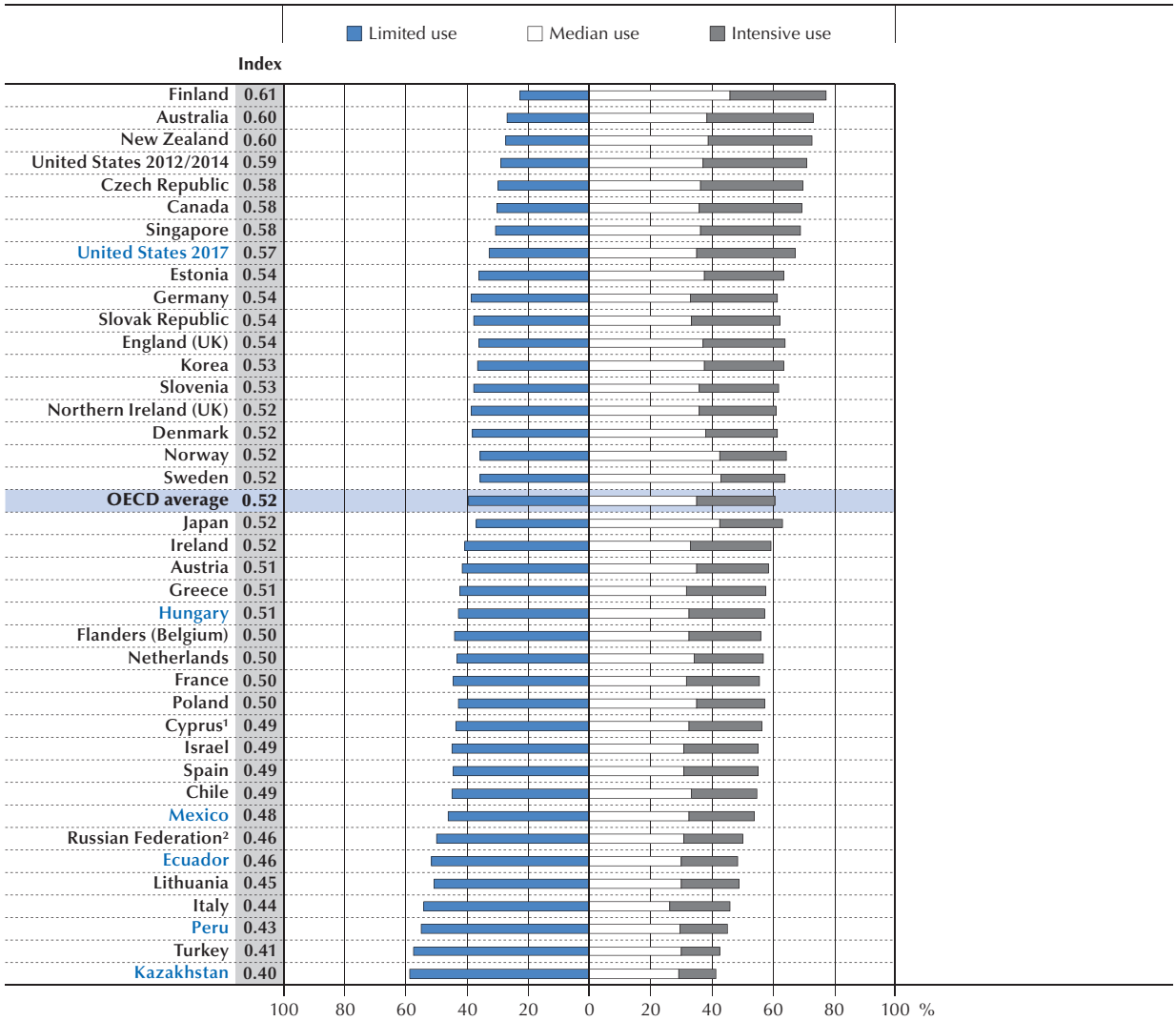


Note: The figure after the country name corresponds to the average value of its index of engagement in numeracy practices.
1. See note at the end of this chapter.
2. See note 1 under Figure 4.1.
Countries and economies are ranked in ascending order of the percentage of adults with limited use of numeracy practices in everyday life.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.3.
StatLink https://doi.org/10.1787/888934020502

These are the same countries at the top and bottom of the rankings when looking at the index of engagement in numeracy practices (Figure 4.1 and Figure 4.2). However, the categorisation of individuals into three groups expands the information set provided by the index, as it explains how the different proportions of intensive and limited users affect a given value of the index. Most countries with a large share of limited users also have a small share of intensive users but this is not the case for all of them. Consequently, countries with similar engagement in everyday life, e.g. Sweden and Canada, can have different proportions of intensive users (28% in Sweden compared with 33% in Canada) or limited users (24% compared with 27%).

Figure 4.6 ▪ **Engagement in numeracy at work**

Percentage of adults displaying a given level of intensity in numeracy practices at work, by country



Note: The figure after the country name corresponds to the average value of its index of engagement in numeracy practices.
1. See note 1 under Figure 4.1.
2. See note at the end of this chapter.
Countries and economies are ranked in ascending order of the percentage of adults with limited use of numeracy practices at work.
Source: Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.3.
StatLink https://doi.org/10.1787/888934020521

In common with the findings highlighted in Figure 4.1 and Figure 4.2, the average OECD figures for engagement in everyday life and at work are very similar. However, individual countries and economies show more variation between skills use in everyday life and at work. All Round 3 countries except the United States report lower proportions of median and intensive users, and higher proportions of limited users than the average of OECD countries, as far as engagement in numeracy practices at work is concerned. The same applies for engagement in numeracy practices in everyday life, except for Hungary, which displays higher proportions of intensive users than the average OECD country (27% compared to 25%), and lower proportions of limited users (33% compared to 39%).

NUMERACY PRACTICES AT WORK AND IN EVERYDAY LIFE: THE RELATIONSHIP TO DEMOGRAPHIC CHARACTERISTICS

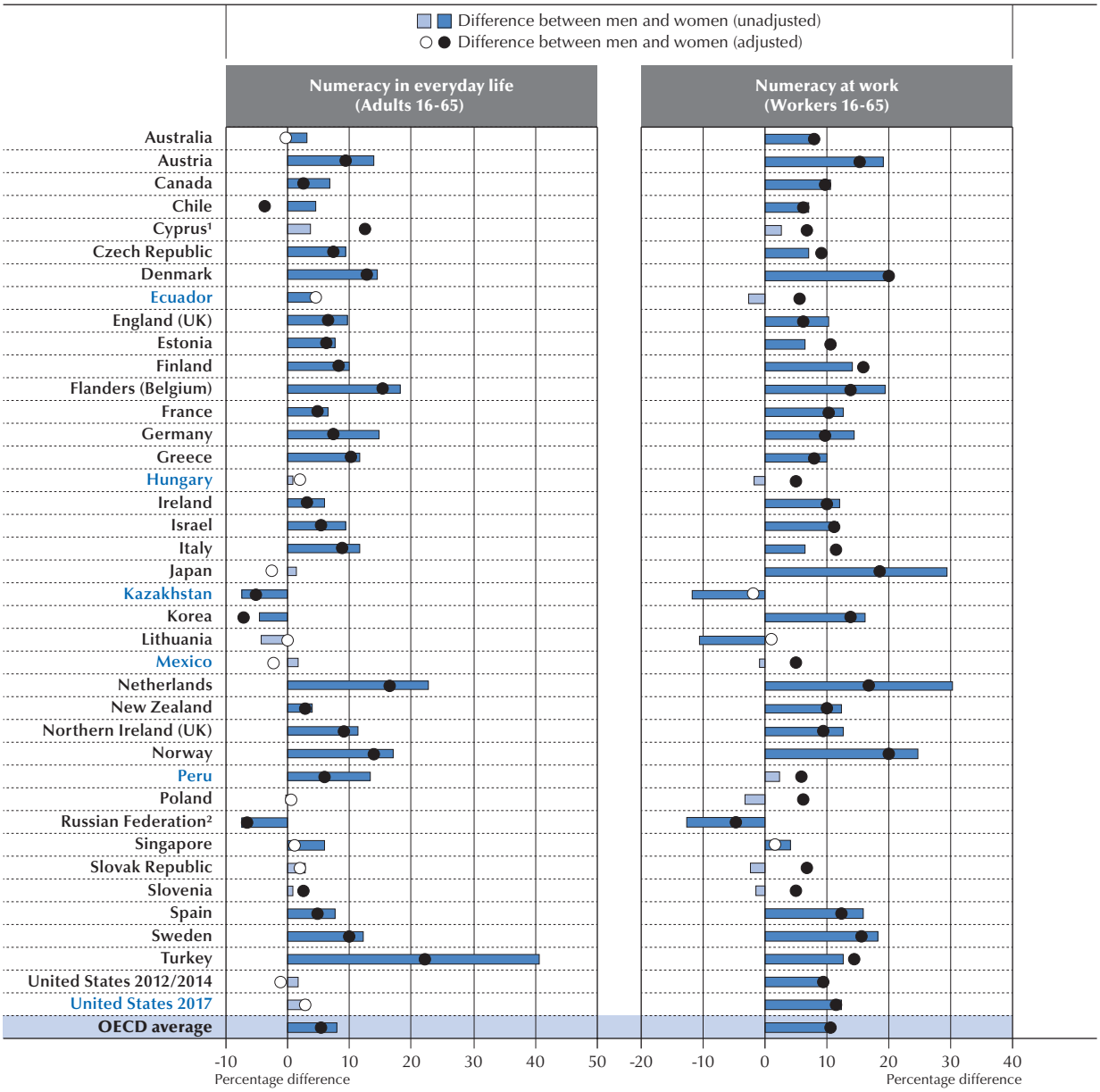
Engagement in numeracy skills is related to a number of other factors, both individuals' personal characteristics and features of their workplace and the context of their lives. This section explores these relationships.

Gender

OECD (2016[4]) highlighted that men and women differed significantly in how frequently they used numeracy skills in the workplace. The indicators of numeracy engagement presented here confirm that men engage in numeracy practices more frequently than women (Figure 4.7, unadjusted series). These gender differences in the use of numeracy are found both at work and in everyday life, although they are larger at work. Kazakhstan, Korea, Lithuania and the Russian Federation are the exceptions, with women using numeracy skills more frequently than men in everyday life.[3]

Figure 4.7 ■ **Engagement in numeracy practices at work and in everyday life, by gender**

Adjusted and unadjusted gender differences in engagement, as a percentage of the average engagement by women



Notes: Adjusted estimates are based on ordinary least square regressions. For engagement in numeracy in everyday life, regressions are estimated on the sample of all individuals in the Survey, and include further controls for numeracy proficiency scores, age group, educational attainment group, and labour market status (employed, unemployed, inactive, student). For engagement in numeracy at work, regressions are estimated on the sample of individuals at work, and include further controls for numeracy proficiency scores, age group, educational attainment, occupation, contract type, and hours worked. Statistically significant differences are marked in a darker tone.

1. See note 1 under Figure 4.1.
2. See note at the end of this chapter.

Countries and economies are listed in alphabetical order.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.4.

StatLink https://doi.org/10.1787/888934020540

This gender gap could stem from gender differences in individual characteristics, as well as from differences in the nature of the jobs that men and women hold. For example, if full-time jobs tended to require numeracy skills more often than part-time ones, women – who are more likely to be employed part-time – might display less engagement in numeracy practices on average as a result. For this reason, Figure 4.7 also plots adjusted differences, which control for numeracy proficiency scores, age group and educational attainment group. The adjustment also considers individuals' labour-market status (for numeracy use in everyday life), and hours worked, contract type and occupation of employment (1-digit ISCO 2008 occupational classes) for numeracy use at work.[4,5]

Adjusting for these characteristics, however, hardly changes the differences between genders. When it does, it usually increases men's advantage for numeracy engagement at work (the differences in Ecuador, Hungary, Poland, the Slovak Republic and Slovenia become positive and significant at the 5% level), and, in some countries, it increases the advantage among women for numeracy engagement in everyday life (in Chile).

As with the unadjusted series, the adjusted average gender gap in numeracy engagement across OECD countries and economies is larger at work than in everyday life. This may be due to factors not taken into account by the adjustment procedure, the self selection of workers into jobs with different numeracy skills use, or discriminatory practices by employers. On average across OECD countries, however, the adjustment leaves the size of the gender gap essentially unchanged for numeracy use at work whereas the gap narrows by approximately 30% for numeracy use in everyday life, suggesting that a large part of the gap can be explained by the features included in the adjustment procedure.

Overall, for use both at work and in everyday life, the OECD average hides some differences across countries in the effect of the adjustment, possibly related to differences in the complex interactions that exist among the controls in the adjustment procedure. After adjustment, the gender gaps in numeracy engagement at work in Denmark, Flanders (Belgium), the Netherlands, Norway and Sweden decline but remain the largest among participating countries and economies. Japan and Korea also display large gender gaps, but only for numeracy use at work. All the Round 3 countries display similarly small adjusted gaps in numeracy use at work with the exception of the United States, which lies close to the OECD average. The gaps are much smaller – and statistically insignificantly different from zero at the 5% confidence level – in the case of numeracy use in everyday life, with the exception of Kazakhstan and Peru.

Age

In all countries and economies considered, 55-65 year-old workers engage in numeracy practices at work less intensively than 25-54 year-olds, although the differences are not statistically different from zero in Greece, Italy and the United States (Figure 4.8). The youngest age group (16-24 year-olds) also engage less intensively than 25-54 year-olds, with the exception of Kazakhstan, Mexico, Peru and the Russian Federation. For the average OECD country, the differences between the youngest adults and 25-54 year-olds are more substantial than between 25-54 year-olds and the older age group, but the gaps differ substantially across countries. The unadjusted differences between age groups are, in any case, larger than the differences between women and men.

The direction of these differences is probably driven by the fact that skills appear to peak between the ages of 25 and 54. The decline in use over time may reflect the decline in proficiency, which peaks at around the age of 30, as in Paccagnella (2016[7]), for example. It could also reflect improvements in the average educational attainment of the population over time, as in Ecuador or Peru, since age and cohort effects cannot be distinguished in a cross-sectional dataset such as the Survey of Adult Skills. However, career patterns may also play a role. For instance, workers aged between 25 and 54 could be more likely to hold jobs that require strong engagement in numeracy, while younger people hold more junior positions, and the roles of older workers may involve more managerial tasks.

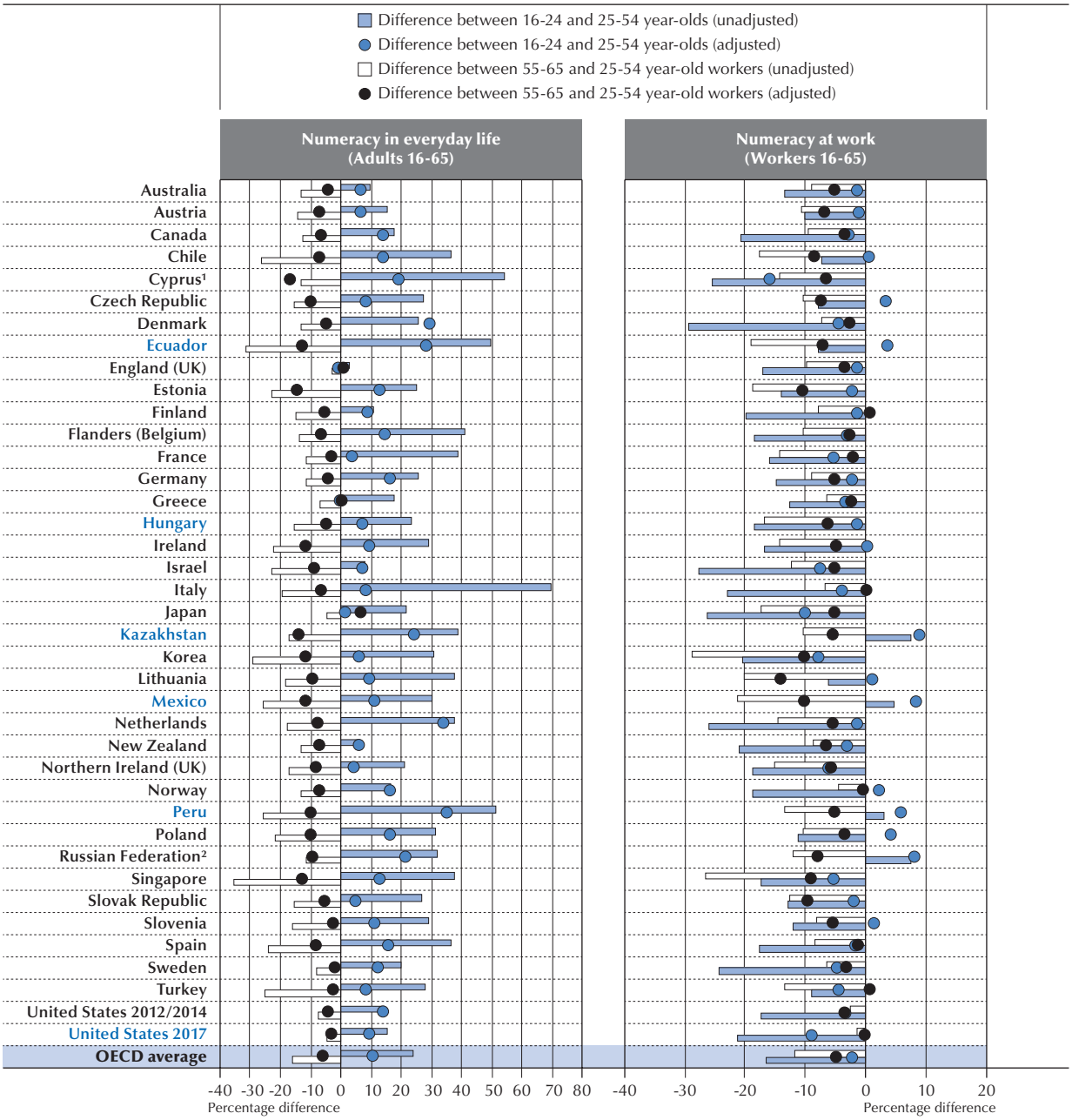
For the average OECD country, controlling for other individual and work-related characteristics reduces the gaps between age groups, but 25-54 year-olds still use numeracy practices more intensively than older and younger individuals at work. The gaps are larger relative to older than younger individuals, with the gap between the youngest workers and 25-54 year-olds reversed in some countries. This reflects the fact that older individuals make less intensive use of numeracy practices than young individuals, once other determinants of numeracy use are accounted for.

Turning to numeracy in everyday life, the gap still favours 25-54 year-olds over older individuals. Conversely, the youngest adults make greater use of numeracy skills in everyday life than those aged 25-54. Accounting for other correlates of numeracy engagement, including respondents' labour-market status, decreases but does not erase the advantage of young

individuals in everyday use in most countries and economies. In Ecuador and Peru this advantage is comparable to the advantage in Denmark and the Netherlands, and approximately three times the OECD average. Only in Japan is the adjusted gap for the youngest adults smaller than the gap between 25-54 year-olds and 55-64 year-olds.

Figure 4.8 ▪ **Engagement in numeracy practices at work and in everyday life, by age group**

Adjusted and unadjusted age differences in engagement, as a percentage of the average engagement by 25-54 year-olds



Notes: Adjusted estimates are based on ordinary least square regressions. For engagement in numeracy in everyday life, regressions are estimated on the sample of all individuals in the Survey, and include further controls for numeracy proficiency scores, gender, educational attainment group, and labour market status (employed, unemployed, inactive, student). For engagement in numeracy in everyday life, regressions are estimated on the sample of individuals at work, and include further controls for numeracy proficiency scores, gender, educational attainment group, occupational dummies, contract type, and hours worked.

1. See note 1 under Figure 4.1.
2. See note at the end of this chapter.

Countries and economies are listed in alphabetical order.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.5.

StatLink https://doi.org/10.1787/888934020559

This result is largely driven by the fact that the measure of skills use in everyday life also encompasses those young individuals who are not in work, and are more likely to be in education, and whose greater use of numeracy may reflect their course requirements. Jonas (2018[1]) similarly reports that the percentage of 16-25 year-olds making intensive use of numeracy practices in everyday life is almost double that of 26-55 year-olds, and three times that of older individuals.

Overall, the adjustment procedure reduces the magnitude of the raw gap much more than in the case of the gender gap. Gender gaps remain high after adjustment, reaching 70-100% of the unadjusted ones, while gaps between age cohorts reduce considerably upon adjustment, reaching 14-44% of the unadjusted ones, with the gap for the oldest group reducing less than the gap for the youngest.

Educational attainment

Figure 4.9 explores differences in engagement in numeracy practices between individuals with and without upper secondary education, and between individuals with tertiary and upper secondary education.

The results mirror those in OECD (2016[4]). In essentially all countries and economies considered, compared to individuals with an upper secondary qualification, respondents with tertiary qualifications engage in numeracy practices more intensively, while respondents without an upper secondary qualification engage less intensively. These patterns hold for numeracy engagement both in everyday life and at work.

The average unadjusted differences across OECD countries are large: 18-22% for intensity of use in everyday life and 25-26% for use at work, even larger than those observed between age groups. However, the gaps narrow considerably when other correlates of engagement in numeracy practices are accounted for: on average across OECD countries the adjusted gaps in numeracy use in everyday life fall to 6% between those with and without an upper secondary education, and 15% between tertiary-educated adults and those with an upper secondary education. The adjusted gaps are also smaller for numeracy use at work, but still as high as 8-9% of the use among upper secondary-educated workers.

In Ecuador, Mexico and Peru the adjusted gap for numeracy use in everyday life between those with and without an upper secondary education is three times the OECD average. In Mexico and Peru the adjusted gap for numeracy use at work is also double the average. In Kazakhstan, conversely, individuals with without upper secondary education do not use numeracy less intensively than individuals with an upper-secondary qualification, either at work or in everyday life.

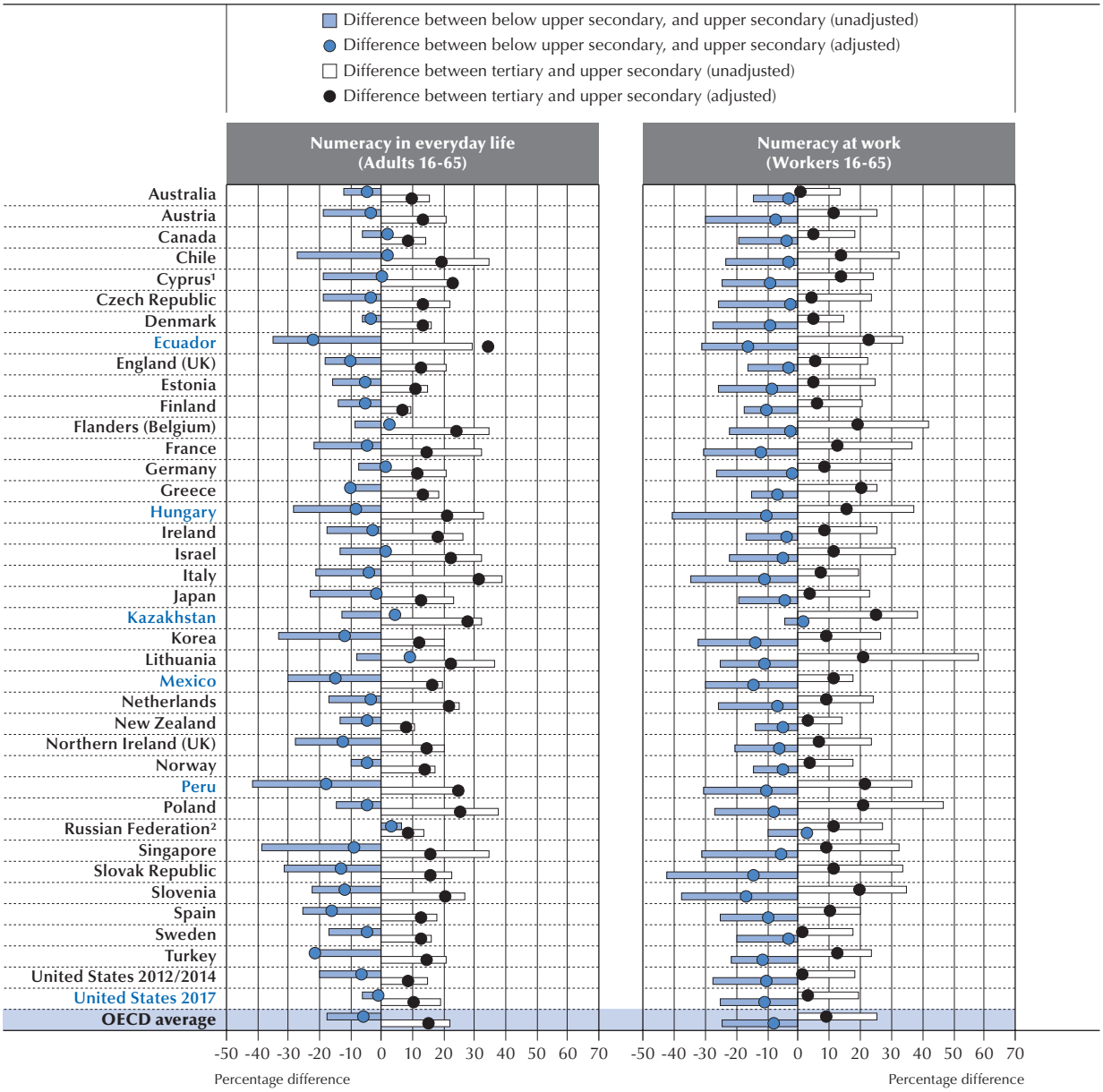
The gap in use between tertiary-educated individuals and those with upper secondary education is positive on average across the participating OECD countries. It is also much wider in Round 3 countries than on average (except for the United States), and especially in Ecuador, Kazakhstan and Peru, where the differences in usage at work and everyday life range between 21% and 33%. Hungary lies close to the OECD average for all the mentioned gaps in numeracy engagement, although with slightly larger gaps.

While the use of skills is affected by a variety of phenomena, more educated individuals would be expected to have higher skills, and likely make greater use of them. However, although controlling for other determinants reduces the differences in numeracy engagement between individuals with different educational backgrounds, a sizeable difference remains. This, in turn, calls for greater reflection on how the use of skills could be encouraged among individuals with lower educational attainment, so that the combination of fewer years of education and lower numeracy use than their skill level would otherwise suggest does not produce a negative spiral which leaves the least educated with lower and lower skills over time.

Figure 4.8 already highlighted the significant difference in numeracy engagement in everyday life between 16-24 year-olds and 25-54 year-olds, which could be explained by many respondents in the younger cohort being students. Further insights into the determinants of engagement in numeracy practices in everyday life can be derived by comparing workers, students and inactive or unemployed respondents. Figure 4.10 estimates the relationship between intensity of numeracy engagement and a number of likely correlates for these three subgroups of respondents. While the magnitudes differ and can hardly be compared visually across groups (as they originate from different samples), the direction of the associations are the same for the three groups, with the exception of below upper secondary educational attainment.

Figure 4.9 ▪ **Engagement in numeracy practices at work and in everyday life, by educational attainment**

Adjusted and unadjusted differences in engagement by educational attainment, in percentage of the average engagement by individuals with upper secondary education



Notes: Adjusted estimates are based on ordinary least square regressions. For engagement in numeracy in everyday life, regressions are estimated on the sample of all individuals in the Survey, and include further controls for numeracy proficiency scores, gender, educational attainment group, and labour market status (employed, unemployed, inactive, student). For engagement in numeracy in everyday life, regressions are estimated on the sample of individuals at work, and include further controls for numeracy proficiency scores, gender, educational attainment group, occupational dummies, contract type, and hours worked.

1. See note 1 under Figure 4.1.
2. See note at the end of this chapter.

Countries and economies are listed in alphabetical order.

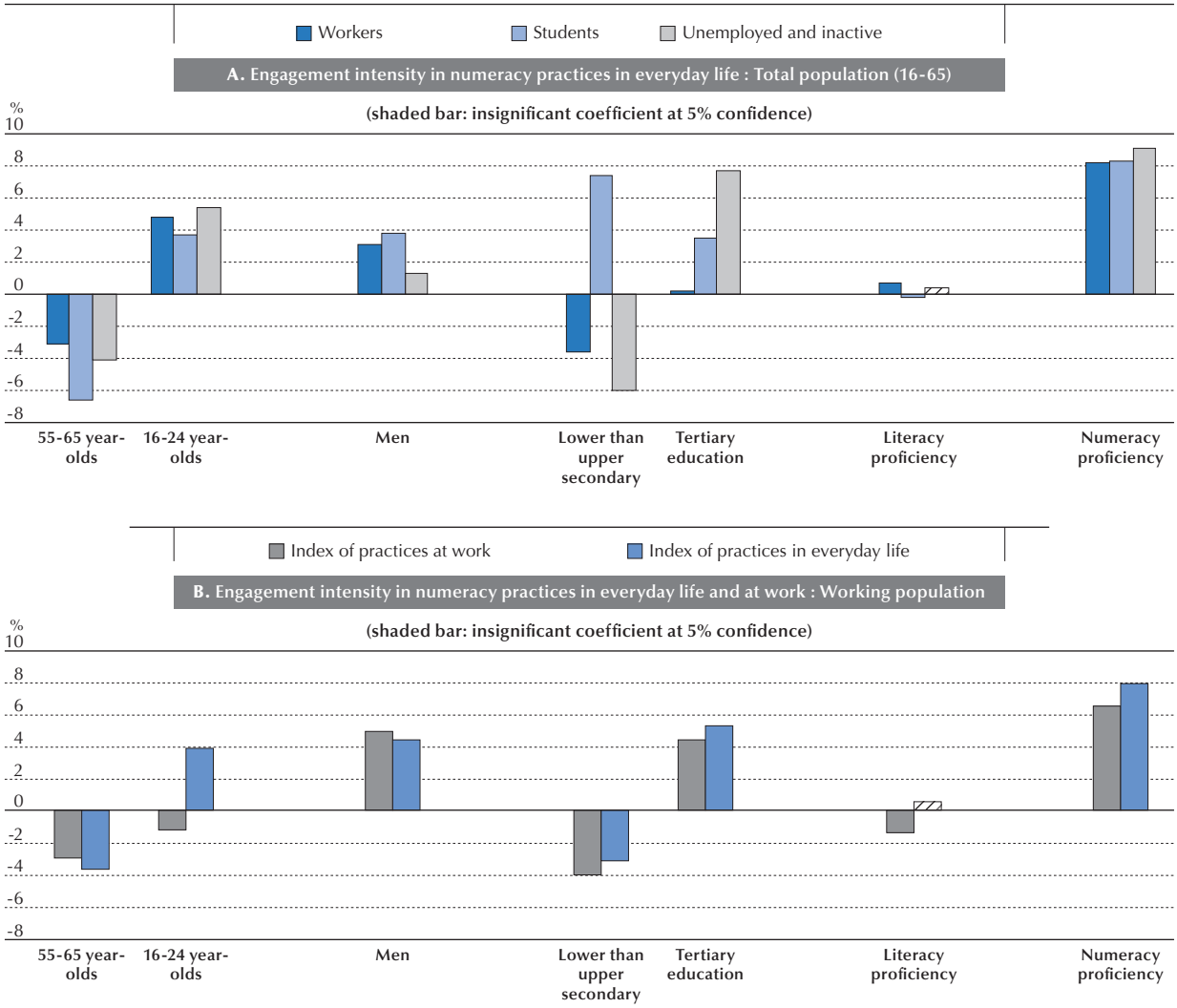
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.6.

StatLink https://doi.org/10.1787/888934020578

A standard deviation increase in numeracy proficiency is associated with a higher position of the individual in the distribution of the index of approximately 8 percentiles, for all three categories of interest (Figure 4.10 Panel A).[6] Conversely, the intensity of numeracy use and proficiency in literacy are essentially unrelated. This stark difference suggests that intensive numeracy use does not rely on high levels of writing and reading skills, once the level of proficiency in numeracy is already accounted for.

Figure 4.10 ▪ **Determinants of the intensity of engagement in numeracy practices**

Ordinary least square coefficients, OECD sample only



Notes: The figure reports 100 times the coefficients of a regression of the engagement in numeracy practices on the specified controls. The regression for Panel B further controls for occupation, contract type, and hours worked. The bars for literacy and numeracy proficiency multiply the estimated coefficient by the standard deviation of the respective proficiency in the sample. The reference category for men is women, for older and younger is prime-age individuals (25-54 years old), for lower than upper secondary and tertiary education it is upper secondary education. The sample sizes are different for Panel A and Panel B. Statistically insignificant coefficients at 5% confidence level are shaded.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A4.7 and A4.8.

StatLink https://doi.org/10.1787/888934020597

With other covariates of engagement in numeracy held constant, being young, being male, holding a tertiary qualification and being more proficient in numeracy increases numeracy engagement for workers, unemployed and inactive respondents. Being older and not having an upper secondary education does the opposite. This is broadly the case for numeracy engagement at work as well as in everyday life, although the analyses consider two different populations.[7] Students without an upper secondary education engage significantly more intensely in numeracy practices than students with one, and even more than tertiary-educated students.

Explaining other information-processing skills at work

The analysis of the correlates of numeracy engagement presented in Figure 4.7 to Figure 4.10 has paid particular attention to the role of education, gender and age, as these are reported and of equal importance for the use of numeracy at work and in everyday life. Of course, this does not exclude the possibility that other characteristics, both personal and related to the individual's working life and context, could influence the intensity of numeracy use. These may include individual preferences about using numeracy in everyday life, or working in the type of jobs that require more or less frequent use of numeracy. Although information about these preferences is not reported in the Survey of Adult Skills, the industry sector

and size of individuals' employers, their internal work organisation, and the type of employment contract, are also likely to shape an individual's engagement in numeracy practices, especially at work (OECD, 2016[4]).

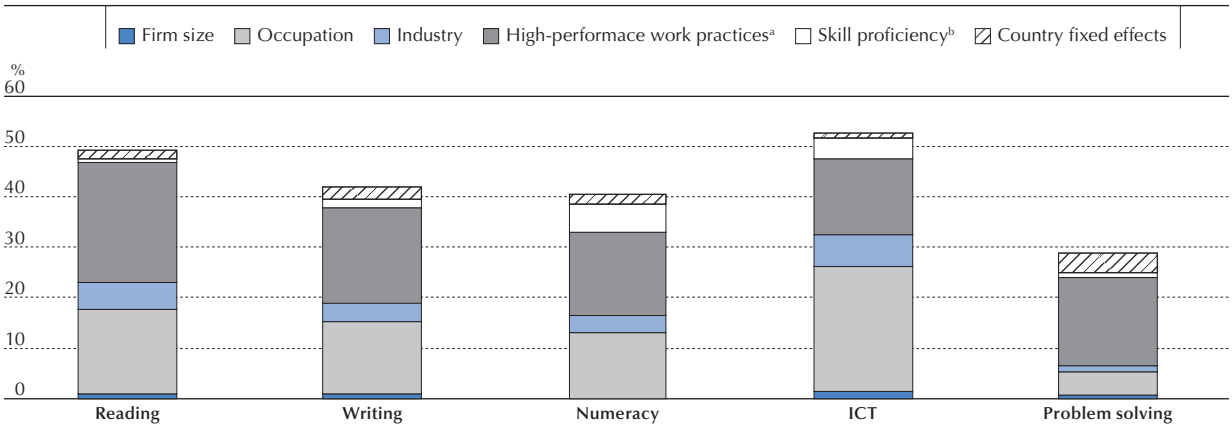
In particular, implementing what are known as "high-performance work practices" could raise skills use and productivity. These managerial and human relations practices involve aspects of work organisation – such as team work, autonomy, task discretion, mentoring, job rotation and applying new learning – as well as management practices such as employee participation, incentive pay, training practices and flexibility in working hours (Bloom and Van Reenen, 2010[8]). These practices can be at least partially approximated by information collected in the Survey of Adult Skills. The survey asks workers about their degree of co-operation with each other, participation in training, flexibility to choose the sequence of their tasks and the type and speed of their work, flexibility to organise their time and activities at work, and whether bonus payments are offered.

Another factor that determines how workers use their skills is the size of the establishment where they work. Workers employed in large organisations are more likely to be better educated and to interact with more sophisticated technologies, which would translate into greater engagement in numeracy practices.

Figure 4.11 shows how the variation in skills use at work in the OECD countries covered by the survey can be attributed to different factors, including individual proficiency, job/employer characteristics and human-resource practices. The observable components included in the model explain 29.0-53.0% of the variation in skills use, of which 1-3.8% is attributed to underlying country characteristics.

Figure 4.11 ▪ **Explaining information-processing skills used at work**

Percentage of the variance in skills use explained by each factor



Notes: Each column is based on a pooled regression of all OECD countries included in the Survey of Adult Skills, where the dependent variable is the skill use expressed in the x-axis, and the list of covariates is included in the legend. Individual country results can be found in the tables cited in the source. The index of problem-solving skills use is calculated as an average of respondents' answers to two items only, referring to the frequency of simple versus complex problem solving.

(a) High performance work practices include the following variables: choosing and changing the sequence of your tasks, the speed of work and how to do your work, organising your own time and planning your own activities; cooperating with others; instructing, teaching or training people; sharing information with co-workers; bonuses; participating in training; flexible working hours.

(b) For reading and writing, skills proficiency refers to proficiency in literacy; for numeracy, skills proficiency refers to proficiency in numeracy; for ICT and problem solving, skills proficiency refers to proficiency in problem solving in technology-rich environments (hence, the analysis excludes countries for which this proficiency domain was not tested).

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.9.

StatLink https://doi.org/10.1787/888934020616

The bulk of the residual variation is explained by the use of high-performance work practices by the employer (15.0-24.0% depending on the skill use considered), and by the worker's occupation (4.5-24.6%). In contrast, proficiency in literacy, numeracy or problem-solving skills, only explains a small part of the variation in skills use at work, but slightly more for ICT (4.2%) and numeracy engagement (5.6%) than other skills use.

The high correlation between human-resource practices and skills use at work is in line with the findings of OECD (2016[9]) and with a large body of literature showing that participatory practices at work – such as allowing workers more flexibility in determining the way and rhythm at which they carry out their tasks – encourage better use of skills in the workplace. Further incentives to use skills could be provided by management practices such as bonuses, training and flexibility over working hours.

These results taken together confirm that proficiency alone cannot be used as a good proxy for the use of skills at work. Conversely, job-specific characteristics such as occupation and managerial practices explain a significant share of the variation in use across skill types.

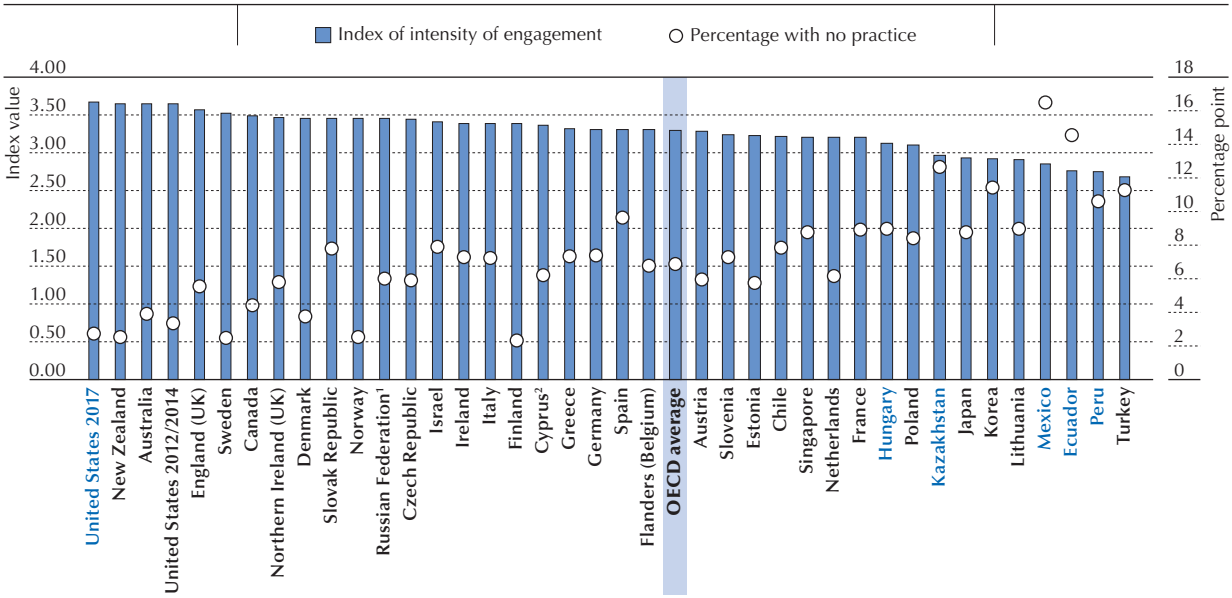
ENGAGEMENT IN PROBLEM SOLVING AND SOCIAL INTERACTION TASKS AT WORK, AND AUTOMATION

Workers perform a number of other tasks at work, which have not been considered in the indices of skills engagement so far. For instance, an index of skills use at work can be computed for problem-solving tasks as in Figure 4.11. The Survey of Adult Skills asks individuals about how often they solve simple and complex problems at work. The index plotted in Figure 4.12 is constructed as an average of the reported frequencies for these items, ranging from 0 ("never") to 4 ("every day"). While solving simple problems is a frequent activity for most workers, solving complex ones is much rarer, but a frequent activity for a few very skilled individuals. Similarly to numeracy engagement, therefore, averaging the frequencies reported for the two underlying items partially confounds the frequency of the task with its complexity.

Figure 4.12 shows that the average worker in the United States, New Zealand and Australia engages in problem solving at work more frequently than in any other country, but the variation across countries and economies is relatively small. Conversely, Ecuador, Mexico, Peru and Turkey report the lowest frequency of problem solving for the average worker. While Hungary and Kazakhstan display higher average frequency values than Ecuador, Mexico or Peru, in all Round 3 countries except the United States the use of problem solving at work is less frequent than the OECD average across countries.

Figure 4.12 ▪ **Engagement in problem-solving tasks at work**

Index of intensity in engagement in problem-solving tasks, by country



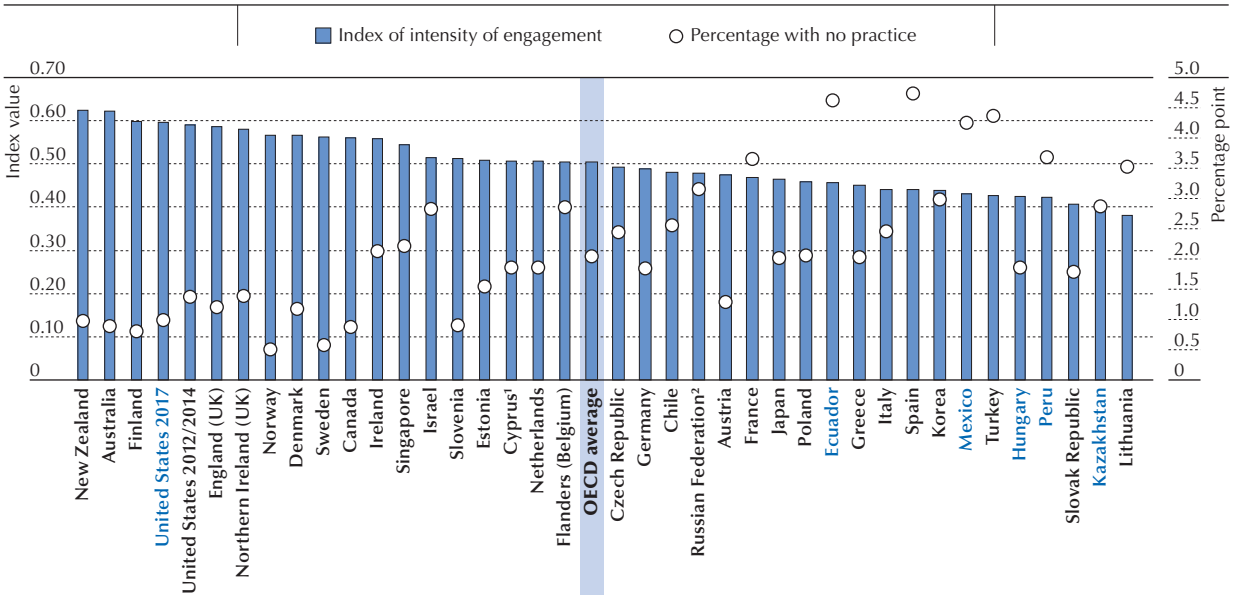
Notes: The index of problem solving skills at work is computed averaging the frequency with which workers solve simple and complex problems, and ranges from 0 to 4. "Percentage with no practice" is the proportion of the working population answering "never" for both of the two activities covered by the index.
1. See note at the end of this chapter.
2. See note 1 under Figure 4.1.
Countries and economies are ranked in descending order of the index of engagement in problem solving tasks.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.10.
StatLink https://doi.org/10.1787/888934020635

The frequency with which workers advise, influence or teach people can also provide evidence about the intensity with which workers interact with colleagues on the job. An index of engagement in social interactions at work has been constructed in very much the same way as the index of engagement in numeracy practices (see Box 4.1), i.e. applying IRT on the set of relevant items. The indicator considers how frequently workers interact with each other (share work-related information, co-operate with colleagues), and also how frequently their job requires interaction with others (teach, give presentations, advise, influence, sell to or negotiate with people).

In Figure 4.13, New Zealand stands out as the country where individuals engage in social interactions at work most frequently, along with Australia, Finland and the United States. At the opposite end of the spectrum, individuals use social interaction skills at work less frequently in Kazakhstan, Lithuania, Peru and the Slovak Republic. All Round 3 countries except the United States rank low in the distribution, suggesting limited engagement in social interaction at work.

Figure 4.13 ▪ **Engagement in social interaction tasks at work**

Index of intensity in engagement in social interactions, by country



Notes: The index of engagement in social interactions accounts for the frequency with which workers: share work related information, co-operate with colleagues, teach, give presentations, advise, influence, sell to or negotiate with people. The index ranges from 0 to 1. "Percentage with no practice" is the proportion of the working population answering "never" for all of the activities covered by the index.
1. See note 1 under Figure 4.1.
2. See note at the end of this chapter.
Countries and economies are ranked in descending order of the index of engagement in social interaction tasks.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.10.
StatLink https://doi.org/10.1787/888934020654

Although the proportion of individuals never engaging in social interactions is not perfectly correlated with the index, countries with the highest values of the index do tend to have a smaller share of adults who report never engaging in any of the social interaction tasks listed above, while those with the lowest values tend to have larger shares of such people. The proportion of individuals never engaging in social interactions exceeds the OECD average for all Round 3 countries except Hungary and the United States, but is especially high in Ecuador, Mexico, Spain, and Turkey.

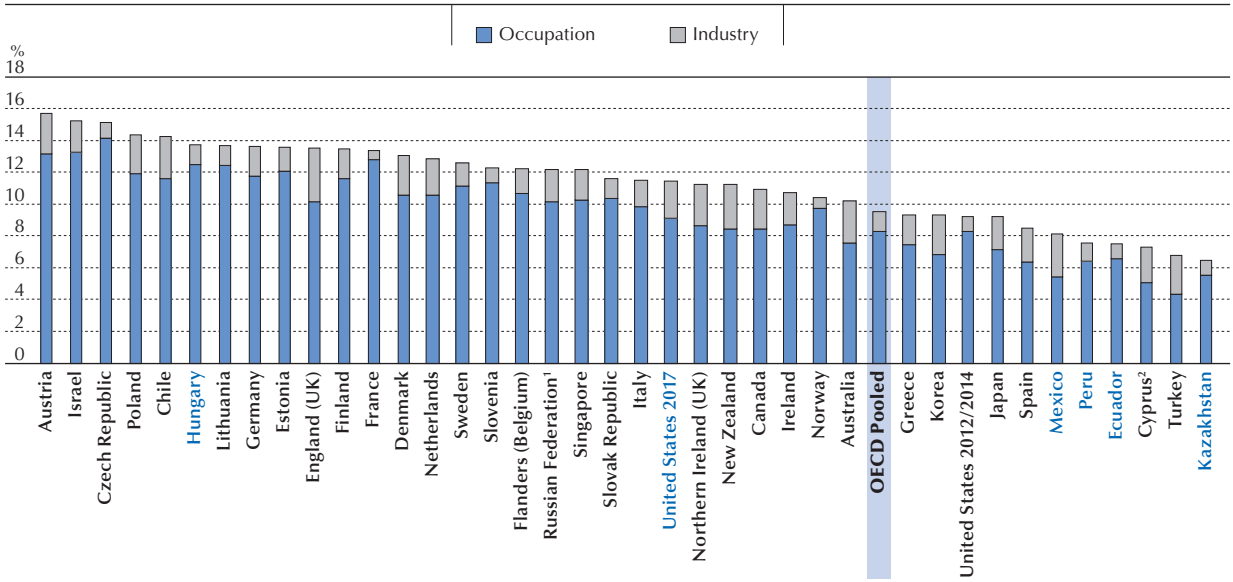
These cross-country differences in the indexes of engagement in social interactions and problem solving at work may reflect differences in the use of decentralised management practices, which allow workers to negotiate, advise, instruct etc. more frequently. Another explanation could lie in differences in the nature of production and the industrial structure of countries, which may require different intensities of social interaction, for example production lines in manufacturing industries.

For this reason, the following two graphs (Figure 4.14 and Figure 4.15) report the share of the variance of the social interaction and problem-solving indexes that can be explained by the respondent's industry and occupation. Together, occupation and employment sector explain 7-16% of the variance in the index of engagement in problem-solving tasks on average across the respondents and countries, and 13-34% of the variation in workers' engagement in social interactions.

A worker's occupation accounts for most of these proportions: across all OECD countries, occupation explains approximately 8% of the variance in engagement in problem-solving tasks, and 15% of that in social interactions. In contrast, the industry of employment accounts for 1% of the variance in engagement in problem-solving tasks, and 2% of that for social interactions. For Ecuador, Kazakhstan, Mexico and Peru, however, occupation and employment industry together explain a smaller part of the total variance in engagement in problem solving than in most other participating countries. This suggests that components other than the production structure should be considered when attempting to explain problem-solving engagement at work in these countries.

Figure 4.14 ▪ **Variance decomposition of the index of problem-solving tasks at work**

Percentage of the variance explained by industries and occupations



Notes: The index of problem solving skills at work is computed averaging the frequency with which workers solve simple and complex problems, and ranges from 0 to 4. Each column is based on regression where the dependent variable is the index of skills use, and the list of covariates includes: occupational dummies (1 digit ISCO2008), industry dummies (1 digit ISIC rev.4), firm size, hours worked, contract type, literacy and numeracy proficiency, age groups, educational attainment groups and a gender dummy. "OECD pooled" regressions are estimated on the full sample of individuals working in OECD countries, using sampling weights.

1. See note at the end of this chapter.
2. See note 1 under Figure 4.1.

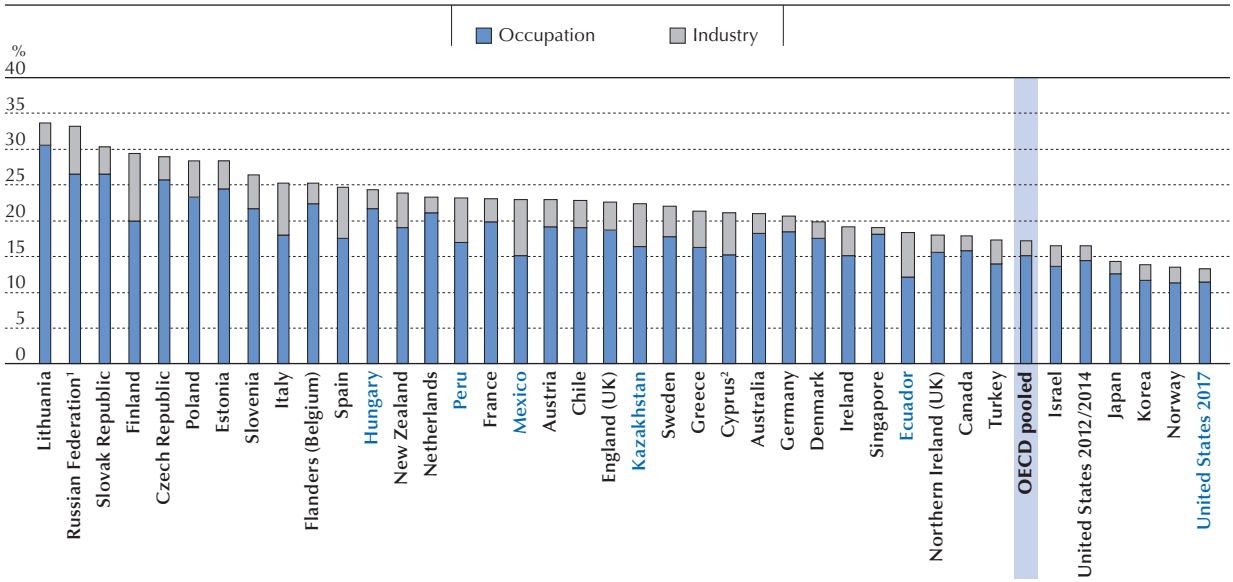
Countries and economies are ranked in descending order of the variance explained.

Source: Survey of Adult Skills (PIAAC) (2012 ,2015, 2018), Table A4.11.

StatLink https://doi.org/10.1787/888934020673

Figure 4.15 ▪ **Variance decomposition of engagement in social interaction tasks at work**

Percentage of the variance explained by industries and occupations



Notes: The index of engagement in social interactions accounts for the frequency with which workers: share work related information, cooperate with colleagues, teach, give presentations, advise, influence, sell to or negotiate with people. The index ranges from 0 to 1. Each column is based on regression where the dependent variable is the index of skills use, and the list of covariates includes: occupational dummies (1 digit ISCO2008), industry dummies (1 digit ISIC rev.4), firm size, hours worked, contract type, literacy and numeracy proficiency, age groups, educational attainment groups and a gender dummy. "OECD pooled" regressions are estimated on the full sample of individuals working in OECD countries, using sampling weights.

1. See note at the end of this chapter.
2. See note 1 under Figure 4.1.

Countries and economies are ranked in descending order of the variance explained.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.11.

StatLink https://doi.org/10.1787/888934020692

For these countries, occupation explains a lower proportion of total variance in problem solving engagement than in almost all other countries, while the industry of employment explains a larger share of the variance in engagement in social interactions than in the average country. Finland, Italy, the Russian Federation and Spain display similar proportions.

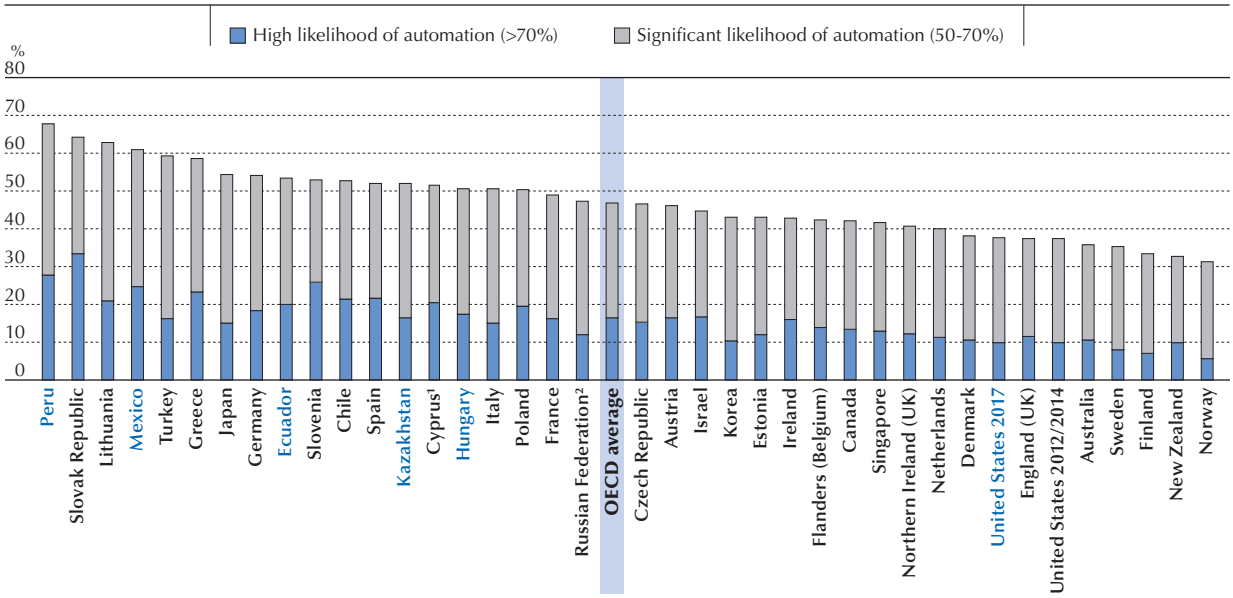
While occupation and industry explain a large share of the variation in problem solving and social interactions, there is a significant degree of heterogeneity within occupations and industries. Even within narrowly defined sectors and occupations, individuals perform social interactions to a different degree. Jobs requiring frequent social interactions are also less likely to be automated, insofar as current levels of technological development allow for the automation of mostly routine-intensive, codified tasks.

Nedelkoska and Quintini (2018[2]) exploit this variation to estimate the extent to which an individual's job is at risk of automation, based on data from the Survey of Adult Skills. The risk of a person's job being automated is a direct function of the tasks the individual performs on the job. Nedelkoska and Quintini (2018[2]) found that the frequency of solving complex problems and of teaching, influencing or advising others are negatively correlated to the automatability of a person's job. They also found that many occupations in OECD countries are characterised by high and rising levels of social interactions, problem-solving skills, creativity and ability to care for others.

Figure 4.16 exploits the estimates of the risk of automation by Nedelkoska and Quintini (2018[2]) to compute the share of employment currently at high risk (i.e. with a probability of automation greater than 70%) and at significant risk (i.e. with a probability of automation between 50% and 70%). On average across the OECD countries and economies taking part in the survey, 16.6% of all jobs have high likelihood of automation, and 30.2% have a significant one.

Figure 4.16 ▪ **Likelihood of automation or significant change to jobs**

Percentage of workers at significant or high risk of automation



Notes: Jobs are at high risk of automation if their likelihood to be automated is at least 70%. Jobs at risk of significant change are those with the likelihood of being automated estimated at between 50 and 70%. Estimates are based on Nedelkoska, L. and G. Quintini (2018), "Automation, Skill Use and Training", OECD Social, Employment and Migration Working Paper N. 202. The values for "OECD" are simple averages.
1. See note 1 under Figure 4.1.
2. See note at the end of this chapter.
Countries and economies are ranked in descending order of the sum of proportions of workers at high and significant risk of automation.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A4.12.

StatLink https://doi.org/10.1787/888934020711

Overall averages, however, hide substantial differences: the Slovak Republic has the largest share of jobs at high risk of automation (33.6%), while Norway has the smallest (5.7%). More generally, jobs in Anglo-Saxon and Nordic countries and the Netherlands are less automatable than jobs in Eastern European and South European countries, Germany, Chile and Japan. The proportion of workers at high or significant risk of automation in the Round 3 countries (except the United States) is higher than the OECD average, reaching 60.8% in Mexico and 67.6% in Peru, the latter having the highest share among the countries and economies participating.

A word of caution is nevertheless needed in interpreting these figures. The reported probability of automation is derived from the assessment of what is potentially automatable in the country, rather than by the effective diffusion of labour-saving technologies in a given country. What is more, other economic mechanisms such as factor prices as well as the institutional environment can shape the intensity and timing with which a certain technology is adopted by different employers in a country. All these aspects can shield a worker's job from being automated, even in sectors and occupations displaying large potential for automation.

SUMMARY

Countries ranking low for the use of skills everyday life (Italy, Kazakhstan, Peru and Turkey) also rank low for their use at work, while the opposite applies to the countries ranking at the top of the distribution (the Czech Republic, Finland, New Zealand and the United States). The results are similar when individuals are grouped into three categories by their engagement in numeracy practices, with the same countries at the top and the bottom of the rankings. All Round 3 countries except the United States report smaller proportions of median and intensive users of numeracy in everyday life and at work, and larger proportions of limited users than the average for OECD countries and economies, with the exception of Hungary (for use at work only) and the United States.

A new index of intensity of social interactions estimates that individuals in all Round 3 countries except the United States also engage in social interaction at work much less than the OECD average, and less than most other participating countries and economies. The same can be said about engagement in problem solving at work. This is also reflected in high proportions of jobs at high or significant risk of automation (over 60% for Mexico and Peru), which usually display limited engagement in social interactions.

Average engagement in numeracy practices and numeracy proficiency are positively correlated at the country level, although only weakly. Low levels of mathematical skills would be expected to impede the intense use of numeracy, while greater use can slow down any decline in numeracy proficiency over time. The correlation, however, is weaker if the Round 3 countries are excluded from the sample. Furthermore, proficiency was found to explain only about 5-6% of the variation in individuals' use of numeracy skills at work across all participating countries and economies, and much less than that for other information-processing skills.

With other covariates of engagement in numeracy held constant, the average student, worker, unemployed or inactive respondent all use numeracy more intensively if they have attained a tertiary rather than an upper secondary qualification. The reverse is true for being older and unemployed or inactive, and for lacking upper secondary education. These associations hold for students as well, with the exception of those who have not (yet) attained an upper secondary qualification, who engage in numeracy more intensively than upper secondary graduates, if other factors are held constant.

A large part of the variation in use of numeracy practices is explained by a worker's occupation, and by the human resource practices adopted in the workplace. High-performance work practices in particular – including work organisation and management practices – explain between 15% and 24% of the variation in skills use across individuals, the most significant of the considered factors. This is in line with countries' efforts to promote better skills use through innovation on the workplace, e.g. through training, of which high-performance work practices are catalysts.

Notes

1. Figure 4.3 reproduces Figure 2.3 in Jonas (2018[1]), but including the PIAAC Round 3 countries. As IRT exploits information on the overall sample to define individuals' and countries' positions in the distribution, the average values of the index of engagement intensity vary slightly here from those reported in Jonas (2018[1]).

2. At the *worker* level, the correlation of proficiency and skills use is positive and highly significant, independently of whether Latin American countries are included or excluded. The R-squared value also remains of similar magnitude, between 0.2 and 0.3 depending on the specification.

3. Other negative gaps are not statistically significant (see Table A4.4).

4. The high level of aggregation considered for occupational dummies may influence the magnitude of the reported coefficients, if large differences in skills use exist between more disaggregated occupations within the same 1-digit occupational group.

5. The empirical model proposed here is parsimonious in the number of correlates of numeracy engagement. Possible extensions could account for other factors such as features of the employer (size, sector of operation) or other individual characteristics such as experience or family background.

6. Contrary to other covariates in the model, proficiency is a continuous variable and not a categorical ("dummy") one. Ex-ante standardisation allows the magnitude of coefficients to be interpreted in terms of standard deviations of proficiency.

7. Being a young adult rather than in the 25-54 year-old age group reflects differently on numeracy engagement at work and in everyday life. These opposite signs were already evident in Figure 4.8.

A note regarding the Russian Federation

The sample for the Russian Federation does not include the population of the Moscow municipal area. More detailed information can be found in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[5]).

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5

The outcomes of investments in skills

This chapter looks at how proficiency in literacy, numeracy and problem solving in technology-rich environments makes a difference to the outcomes experienced by individuals – and how these differ among the six countries that participated in the third round of the Survey of Adult Skills. It finds that proficiency is positively linked to a number of important economic and social outcomes – not just employment and wages, but also aspects of well-being such as health, volunteering and political efficacy. It also considers the impact of wages on mismatches between workers' qualifications and skills and those needed for their jobs.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Previous chapters of this report have compared the level, distribution and use of information-processing skills among countries and socio-demographic groups. This chapter focuses on the relationship between proficiency and skills use and labour-market and social outcomes including employment, earnings, skills mismatches, self-reported health, participation in associative or volunteer activities, and individuals' sense of influence over the political process. It discusses the results with a particular focus on numeracy proficiency but very similar results would be obtained using literacy proficiency.

The main findings of this chapter are:

- Educational qualifications and proficiency in information-processing skills reflect different aspects of an individual's human capital and are separately identified and valued in the labour market. After the effects of educational attainment have been taken into account, an increase of one standard deviation in an individual's numeracy proficiency (56 score points) is associated with a 1.6 percentage-point increase in the probability of being employed as opposed to being unemployed. The same increase in numeracy proficiency is also associated with a 7% increase in hourly wages, on average across the OECD countries and economies participating in the Survey of Adult Skills (PIAAC).
- Proficiency and years of education appear to play a very small role in the employment outcomes of adults in all Round 3 countries, with the exception of Hungary. The relationship between proficiency and hourly wages is also relatively weak in these Round 3 countries (excluding Hungary) and below the OECD average, while years of education are more strongly correlated with hourly wages than the OECD average, particularly in Kazakhstan and the United States. In Hungary, on the other hand, proficiency in numeracy and years of education are comparatively strong predictors of employment and wages. This is likely to reflect differences in institutional arrangements (such as wage-setting mechanisms) as well as the relative weight given to educational qualifications and other factors in employers' hiring, promotion and wage-setting decisions.
- Mismatches between workers' qualifications and skills and what they report as required or expected in their jobs are pervasive in most countries and economies participating in PIAAC.
- On average across the OECD countries and economies that participated in the Survey of Adult Skills, about 22% of workers report that they are overqualified – that they have higher qualifications than required to get their jobs – and 12% report that they are underqualified. Moreover, 11% have higher levels of numeracy skills than those typically required in their job, and 4% are underskilled. Finally, 40% of workers are mismatched by field of study: they work in an occupation that is unrelated to their field of study. These forms of mismatch overlap; it is common for workers who are mismatched by field of study to also be overqualified, for example.
- In Hungary, Kazakhstan and the United States, the overall incidence of skill mismatch is at or below the rate observed in the OECD on average. In contrast, the Latin American countries in Round 3 – Ecuador, Mexico and Peru – stand out along with Chile from Round 2 for their very high incidence of overskilling. Although measured differently, this is in line with the relatively low use of literacy and numeracy skills in the workplace in these countries (see Chapter 4).
- Chile, Ecuador and Mexico, along with the United States, also have a relatively high incidence of mismatches by field of study: 10 percentage points higher than the OECD average in Chile, 17 percentage points higher than average in Ecuador, 12 percentage points higher than average in Mexico and 8 percentage points higher than average in the United States. Latin American countries may be more likely to lack training systems that provide relevant skills and are aligned with the needs of the economy (OECD, 2018[1]). However, the difference could also be explained on statistical grounds, in countries with a large population of graduates from general programmes. Finally, Ecuador stands out in that underqualification is more common than overqualification. This could reflect the rapid growth in the demand for higher qualifications, which has not been matched by an equivalent increase in graduate numbers. The incidence of qualification mismatch is lower than average in Peru and Mexico.
- Qualification and skills mismatches may both have distinct effects on wages, even after adjusting for both qualification level and proficiency scores, because jobs with similar qualification requirements may have different skill requirements. This may happen because employers can evaluate qualifications but they cannot measure skills directly. Overqualification has a stronger negative association with real hourly wages than overskilling or field-of-study mismatches. On average across participating OECD countries, overqualified workers earn about 17% less than well-matched workers with the same qualification and proficiency levels and in the same field. The equivalent wage penalty is 7% less for overskilling, and 3% less for field-of-study mismatch. Among the Round 3 countries, Peru and the United States stand out for having one of the largest wage penalties for overqualification. Ecuador is unique in that none of the forms of mismatch analysed in this study is associated with differences in hourly wages.
- Proficiency in literacy, numeracy and problem solving in technology-rich environments is positively associated with several aspects of well-being identified using PIAAC. On average in OECD countries, proficiency in these

information-processing skills is positively associated with trust, volunteering, political efficacy and self-assessed health. The relationships with political efficacy and self-assessed health hold even after accounting for a range of socio-demographic characteristics. On the other hand, the association with trust becomes very small and that with volunteering is no longer statistically significant once individual characteristics are accounted for. The strength of the association varies across countries. With the exception of Hungary and the United States, the countries in Round 3 have weaker relationships between numeracy proficiency and non-economic outcomes than most of the other countries included in PIAAC. At the other end of the spectrum, all relationships are positive and statistically significant in the United States.

The results suggest that, independent of policies designed to increase participation in education and training, improvements in adults' skill levels may provide considerable economic and social returns for individuals and society as a whole. Improvements in adults' skill levels can be brought about by the teaching of literacy and numeracy in schools and by programmes for adults with poor literacy and numeracy skills and limited familiarity with information and communications technology (ICT), through training in the workplace, and greater use of skills in and outside work to avoid their deterioration.

SKILLS PROFICIENCY, LABOUR-MARKET STATUS AND WAGES

To the extent that workers' productivity is related to the knowledge and skills they possess, and that wages reflect such productivity, albeit imperfectly, individuals with greater skills should expect higher returns from their participation in the labour market and thus be more likely to participate. Most studies use individuals' past educational qualifications as a proxy for their current productive potential when investigating the returns to investments in human capital; until the release of the Survey of Adult Skills (PIAAC), only a few studies examined the return on actual skills (Leuven, Oosterbeek and van Ophem, 2004[2]; Tyler, 2004[3]). Since the release in 2013 of the first round of results, PIAAC has provided an opportunity to test, with validly comparable data, how information-processing skills influence individuals' employment chances and wages. Based on the countries and economies that participated in the first two rounds of PIAAC, an increase of one standard deviation in an individual's literacy proficiency (48 score points) is associated with a 0.8 percentage-point increase in the probability of being employed. An increase of one standard deviation in literacy proficiency is also associated with a 6% increase in hourly wages in these countries (OECD, 2016[4]). Other researchers have confirmed the labour-market value of skills (Hanushek et al., 2015[5]; Vignoles, 2016[6]).

Since three of the five countries that implemented the Survey of Adult Skills for the first time in 2018 are from Latin America, it is worth noting that several studies have looked at returns to education and skills in this region. They exploited skill surveys such as the World Bank Skills Towards Employment and Productivity survey (STEP; 2012) and the Peruvian Skills and Labor Market Survey (ENHAB; 2010) or simply data on educational attainment and wages or employment status. The findings generally suggest a decline in returns to educational attainment over time, particularly for upper secondary graduates (i.e. those scoring at Level 3 of the International Standard Classification of Education, ISCED), due to supply factors such as an increase in the number of graduates at this level, and demand factors such as a shift in demand towards higher education graduates (Manacorda, Sánchez-Páramo and Schady, 2010[7]). Using data for Colombia, Acosta, Muller and Sarzosa (2017[8]) found that cognitive skills are strongly related to higher earnings while socio-emotional skills are strongly correlated with participation in employment. In Peru, cognitive skills are found to increase wages, after controlling for educational attainment and socio-emotional skills (José Díaz, Arias and Tudela, 2014[9]). Consistent results are reported for Bolivia in Cunningham, Acosta and Muller (2016[10]).

This section reviews the relationship between skills proficiency, employment status and wages with particular focus on the Round 3 countries: Ecuador, Hungary, Kazakhstan, Mexico, Peru and the United States. Throughout the chapter, the OECD average refers to the OECD countries and economies that have implemented the survey, either in 2012 or 2015 or 2018.

Proficiency, education and employment

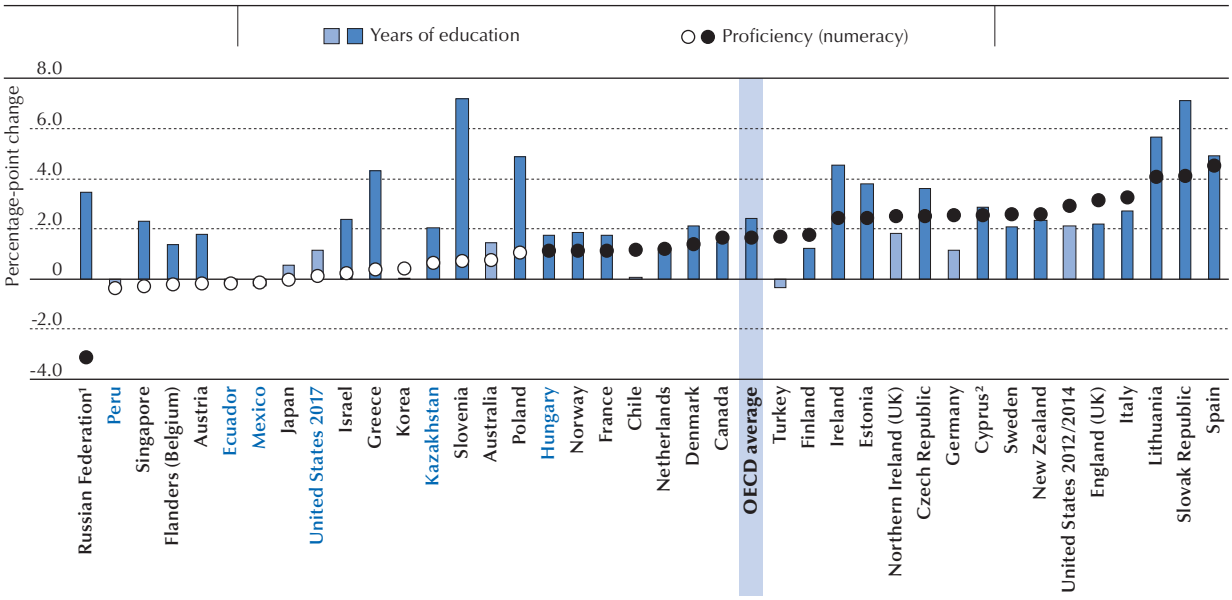
Findings from previous rounds of PIAAC have confirmed that proficiency in literacy and numeracy plays an important and independent role in determining success in the labour market, over and above the role played by formal education, although it is hard to identify how much this statistical association captures the true causal effect of skills on wages.[1]

Among the OECD countries and economies that have implemented the Survey of Adult Skills in any of the three rounds, an individual who scores one standard deviation higher than another on the numeracy scale (around 56 score points) is 1.6 percentage points more likely to be employed than unemployed (Figure 5.1). An increase in one standard deviation in the number of years in formal education (around 3.3 years) is associated with a 2.4 percentage-point increase in the

chances of being employed. Among the countries participating in PIAAC in the third round in 2018, only Hungary had similar results, with a positive association between employment rates and both numeracy proficiency and educational attainment. In Ecuador, Kazakhstan, Mexico, Peru and the United States there are low or negative returns to proficiency and education, which in most cases are not statistically significant.

Figure 5.1 ▪ **Effect of education and numeracy proficiency on the likelihood of being employed**

Marginal effects (as percentage point change) of a one standard deviation increase in years education and numeracy on the likelihood of being employed among adults not in formal education



Notes: The reference category is "unemployed". Results are adjusted for gender, age, marital and foreign-born status. One standard deviation in proficiency in numeracy for the active population is 56 score points. One standard deviation in years of education for the active population is 3.3 years. Statistically significant values (at the 5% level) are shown in a darker tone.

1. See note at the end of this chapter.

2. *Note by Turkey:*

The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Countries and economies are ranked in ascending order of the effect of proficiency on the likelihood of being employed.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A5.1(N).

StatLink https://doi.org/10.1787/888934020730

These relationships are calculated holding everything else constant. For instance, the relationship between proficiency and the probability of being in employment is computed by comparing the likelihood of being employed among adults with different proficiency but who have spent the same number of years in education and share the same socio-demographic characteristics. Such a calculation is possible because of the imperfect overlap of education and proficiency, as discussed in previous chapters.

The finding, in most countries including Hungary, that educational attainment is a better predictor of employment than numeracy proficiency suggests that it is harder for employers to judge workers' actual numeracy proficiency. As a result, employers are more likely to rely on readily available, albeit imperfect, signals such as educational qualifications. However, skills become a stronger predictor of labour-market outcomes as tenure in the job increases, a phenomenon called "employer learning", referring to the fact that employers learn about their employees' skills once they have been hired (OECD, 2014[11]).

The lack of a relationship between employment status and education and proficiency in Latin American countries is striking. It is, however, in line with previous studies on Latin American countries that have shown a stronger correlation of cognitive skills with earnings than with employment status (Cunningham, Acosta and Muller, 2016[10]; Acosta, Muller and Sarzosa, 2017[8]). The absence of strong social protection systems in these countries may lead to most adults engaging in any employment they can find, possibly in the informal sector (OECD, 2015[12]). More education and greater proficiency could therefore translate into higher-quality jobs, rather than a greater chance of being employed.

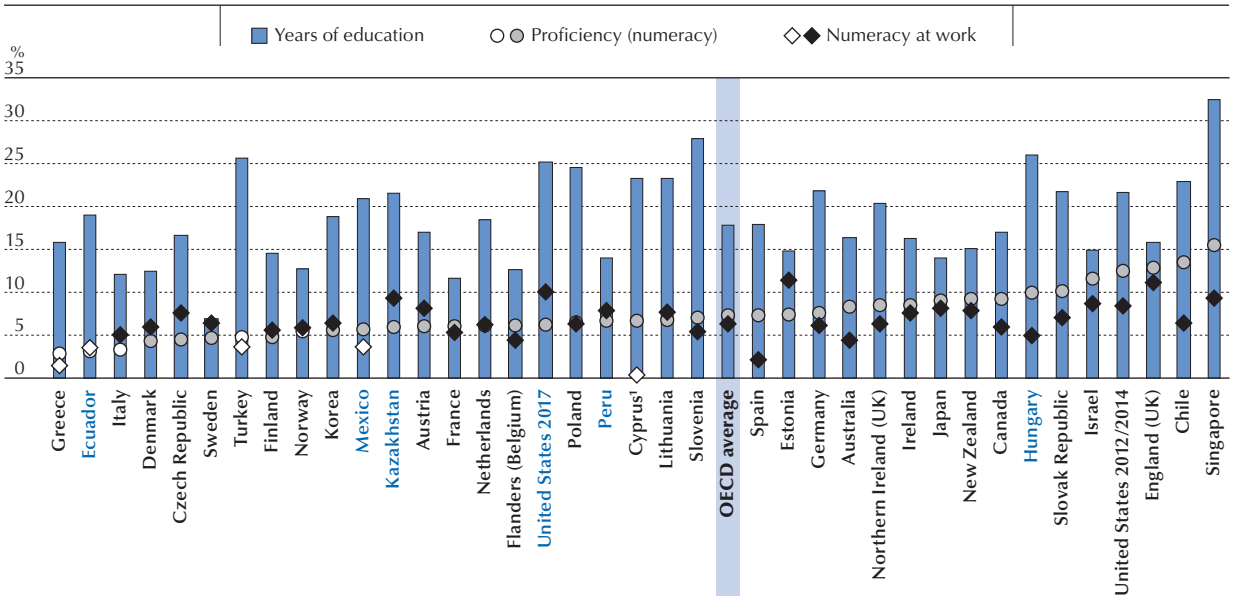
Numeracy proficiency, education and wages

Hourly wage levels are strongly associated with numeracy proficiency. This relationship is explored in Figure 5.2 after adjusting for several individual characteristics, including years of education. As with the likelihood of employment, it is difficult to determine the direction of causality. For instance, higher wages may be characteristic of occupations that favour workers acquiring skills through formal education. This section uses linear regression analysis to distinguish years of education from skills proficiency to help determine whether returns to education reflect the fact that highly educated individuals tend to have greater proficiency in information processing skills, or the fact that employers value their credentials.

Proficiency and schooling have significant and distinct effects on hourly wages. Across the OECD countries that have implemented the Survey of Adult Skills in any one of the three rounds, an increase in one standard deviation in numeracy proficiency is associated with a 7% increase in hourly wages, keeping years of education and other socio-demographic characteristics constant. An increase in years of education by one standard deviation brings about a bigger increase in hourly wages of about 18%, all else being equal. Returns to proficiency are above average in Hungary, while they are below average in Ecuador, Kazakhstan, Mexico, Peru and the United States. The relationship is weakest in Ecuador, where it is not statistically significant. Returns to years of education exceed the OECD average in all Round 3 countries, with the exception of Peru. Hungary shows the third highest returns to years of education of all participating countries, after Singapore and Slovenia. The results for Peru are strikingly close to those obtained by José Díaz, Arias and Tudela (2014[9]) using the ENHAB survey. In that study the authors showed that one standard deviation increase in cognitive skills was associated with a 9% increase in wages, while for years of education the increase was 15%. The figures for PIAAC are 7% and 14%.

Figure 5.2 ▪ **Effect of education, numeracy proficiency and numeracy use at work on wages**

Percentage change in wages associated with a change of one standard deviation in years of education, proficiency in numeracy and numeracy use at work



Notes: Hourly wages, including bonuses, in purchasing power parity-adjusted USD (2012). Coefficients from the ordinary least square regression of log hourly wages on years of education, proficiency and use of numeracy skills at work, directly interpreted as percentage effects on wages. Coefficients adjusted for age, gender, foreign-born status and tenure. The wage distribution was trimmed to eliminate the 1st and 99th percentiles. One standard deviation in proficiency in numeracy for the active population is 56 points. One standard deviation in years of education is 3.3 years. One standard deviation in numeracy at work is 0.27 points. The analysis excludes the Russian Federation because wage data obtained through the survey do not compare well with those available from other sources. Hence further checks are required before wage data for this country can be considered reliable. Statistically significant values (at the 5% level) are shown in a darker tone.
1. See note 2 under Figure 5.1.
Countries and economies are ranked in ascending order of the effect of numeracy proficiency on wages.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A5.2(N).
StatLink https://doi.org/10.1787/888934020749

Part of the effect of proficiency on hourly wages may be based on the type of tasks and responsibilities workers are expected to carry out in their job. In addition to years of education and skills proficiency, the analysis behind Figure 5.2 considers the use of numeracy skills at work. Workers in jobs that require more intense use of numeracy also earn higher wages. Including skills use at work also serves to show that the effect of skills proficiency is not driven by selection effects. It is not that more proficient workers earn more because they are selected into more skill-intensive jobs. They

earn higher wages than less proficient workers who hold jobs with similar skill requirements. Interestingly, while the use of numeracy at work is correlated with hourly wages in Hungary and the United States, this is not the case in Ecuador, Kazakhstan, Mexico and Peru.

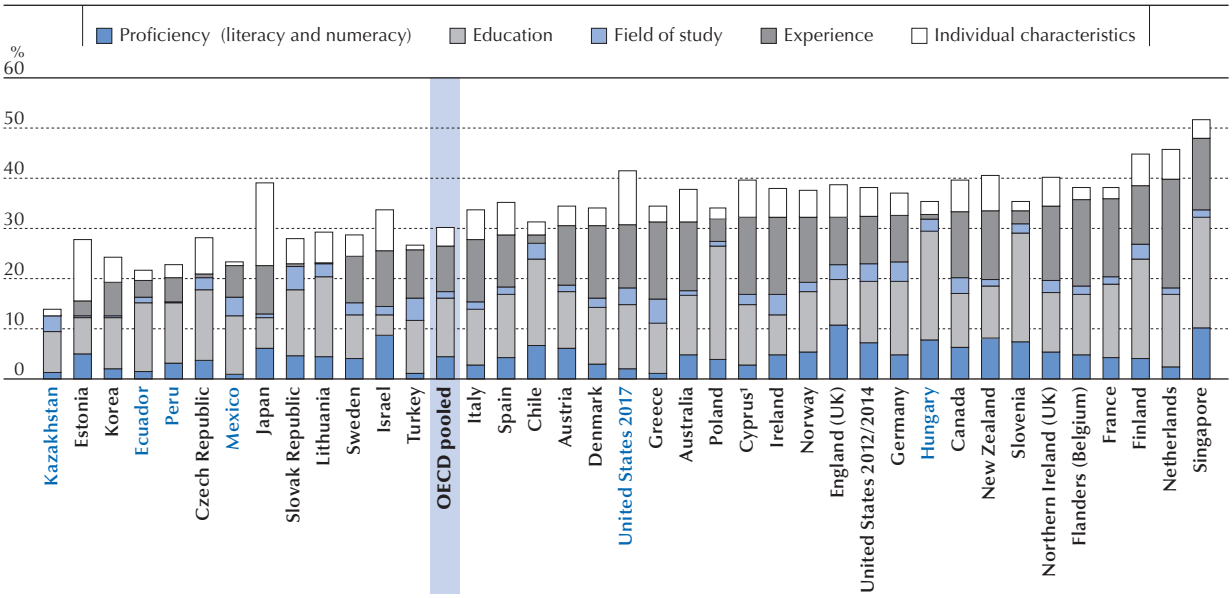
Overall, the number of years of education tends to have a smaller impact on wages in countries with a more compressed wage distribution, such as the Nordic countries, Italy and Flanders (Belgium) (OECD, 2015[13]; OECD, 2015[12]). In contrast, greater educational attainment is associated with significantly higher wages in Germany, Chile, Mexico and Turkey, all of which have relatively high earnings inequality. However, this only suggests a link between the earnings distribution and returns to education, as other factors affect the ranking of countries. For instance, Slovenia – where earnings inequality is relatively low – shows relatively high returns to education.

The relative contribution of education, proficiency and other factors to the variation in individual wages

As shown in Figure 5.2, educational attainment and proficiency in information-processing skills contribute independently to explaining individuals' wages. To compare the size of their contribution, the analysis conducted above looked at how one standard deviation in educational attainment or skills proficiency relates to wages. A better way to compare is to look at how much of the variance in wages each variable explains (OECD, 2014[11]). Figure 5.3 does precisely this, comparing the relative importance of proficiency and years of education and other variables reflecting job- and field-specific knowledge such as work experience and field of study. Together these variables explain about 26% of the variance in wages while individual characteristics like gender, migrant status, marital status and the language spoken at home contribute an additional 4%, on average across OECD countries. Information-processing skills contribute 4.5%, educational attainment explains 12%, field of study 1% and experience 9%. In Ecuador, Mexico and Peru, these human capital variables account for about 20% of the variation in hourly wages, below the OECD average. In Kazakhstan, these factors account for only 13% of the variation in hourly wages. On the other hand, they account for about one-third of the variation in Hungary and the United States, almost 8 percentage points more than the OECD average.

Figure 5.3 ▪ **Contribution of education, literacy and numeracy to the variation of hourly wages**

Contribution of each factor to the percentage of the explained variance (R-squared) in hourly wages



Notes: Results obtained using a regression-based decomposition following the methods in Fields (2004[14]). Each bar summarises the results from one regression and its height represents the R-squared of that regression. The sub-components of each bar show the contribution of each factor (or set of regressors) to the total R-squared. The Fields decomposition is explained in more detail in Box 5.4 of the OECD *Employment Outlook 2014* (OECD, 2014[11]). The dependent variable in the regression model is the log of hourly wages, including bonuses in purchasing power parity-adjusted USD (2012). The regressors for each factor are: years of working experience and its squared term for "experience"; proficiency in literacy and numeracy for "proficiency"; years of education for "education"; and gender, marital status, migration status and language spoken at home for "individual characteristics".
The analysis excludes the Russian Federation because wage data obtained through the survey do not compare well with those available from other sources. Hence, further checks are required before wage data for this country can be considered reliable.
1. See note 2 under Figure 5.1.
Countries and economies are ranked in ascending order of the sum of the contributions of education, proficiency, field of study and experience.
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A5.3.
StatLink https://doi.org/10.1787/888934020768

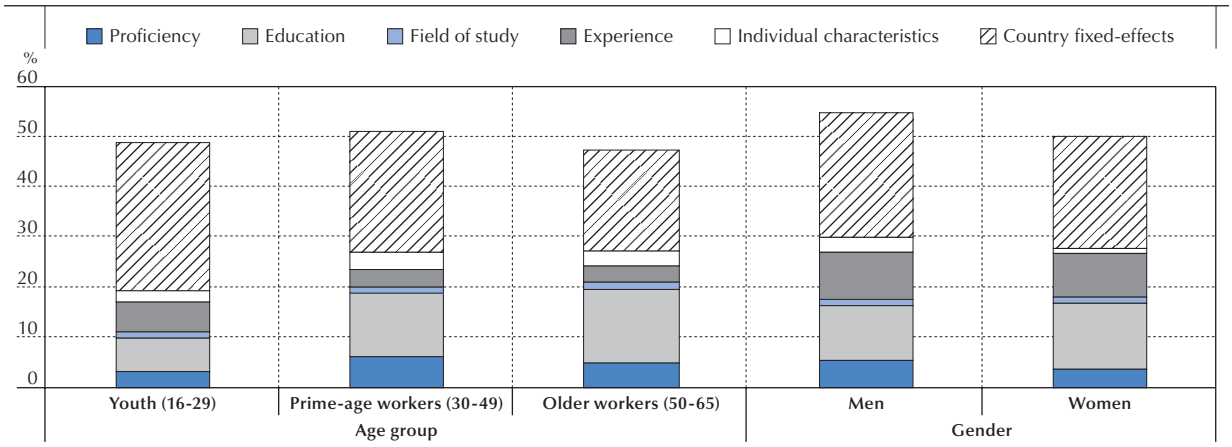
The contribution of information-processing skills to the variance of hourly wages is greatest in England (United Kingdom) and Singapore where it exceeds 10%. The contribution of literacy and numeracy proficiency is also high in Hungary, where it is close to 8%, while it is low in Ecuador, Kazakhstan, Mexico, Peru and the United States, which are all at the bottom end of the scale. Overall, years of schooling are more important in understanding the returns to human capital than proficiency. Hungary is one of five countries where years of education account for 20% or more of the variance of wages. The variance in hourly wages explained by years of education in Kazakhstan is relatively small while is it slightly above average in Ecuador and the United States and very close to the average in Peru and Mexico. Comparing the share of variance explained by proficiency and years of education, only in Israel and England (United Kingdom) does proficiency contribute more to the variance of wages than years of schooling. In all Round 3 countries, years of education appear to play a bigger role in explaining returns to human capital than proficiency, although, with the exception of Hungary, both factors explain a relatively small portion of the variance compared with other countries. Finally, Mexico stands out in the analysis as one of the countries where field of study contributes the most to the variation in hourly wages. Differences among countries in the magnitude of these effects are likely to be influenced by how wages are distributed across occupations and, in turn, by the labour-market institutions, such as minimum wages and unions, that affect that distribution.

The relative importance of different human capital factors across age groups and gender is presented in Figure 5.4. Information-processing skills explain a larger share of the variance in wages among 30-49 year-old and 50-65 year-old workers than among younger ones (16-29 year-olds), on average across participating OECD countries. Across all countries participating in the survey, and net of differences between countries, proficiency in numeracy and literacy explains 3% of the variance in wages among 16-29 year-olds, 6% among 30-49 year-olds and 5% among 50-65 year-olds. This is in line with the concept of "employer learning" (OECD, 2014[11]; Pinkston, 2009[15]). Overall, human capital components (proficiency, education, field of study and experience) explain a larger portion of the variance in hourly wages for 30-65 year-olds than for the youngest workers.

Interestingly, credentials are found to play a bigger role in explaining returns to human capital for women than for men. Years of education and field of study account for 14.5% of the variance in hourly wages for women, compared with 12% for men. On the other hand, experience and proficiency play a bigger role for men than for women.

Figure 5.4 ▪ **Contribution of education, literacy and numeracy to the variation of hourly wages, by age group and gender**

Contribution of each factor to the percentage of the explained variance (R-squared) in hourly wages in OECD countries participating in the Survey of Adult Skills (PIAAC)



Notes: The dependant variable is the log of hourly wages, including bonuses, in purchasing power parity-adjusted USD (2012). The factors are: years of work experience and a squared term; proficiency in literacy and numeracy; years of education; and demographic variables (gender, marital status, immigrant background and the language spoken at home).
Results obtained using regression-based decomposition through the formulae proposed by Fields (2004[14]). Each bar summarises the results from one regression and the height of each bar represents the total R-squared for that regression. The subcomponents of each bar show the contribution of each factor (or set of regressors) to the R-squared. The Fields decomposition is explained in more detail in Box 5.4 of the OECD *Employment Outlook 2014* (OECD, 2014[11]).
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Tables A5.4 and A5.5.
StatLink https://doi.org/10.1787/888934020787

MISMATCHES BETWEEN WORKERS' SKILLS AND JOB REQUIREMENTS AND THE IMPACT ON WAGES

Ensuring a good match at the aggregate level between the skills acquired in education and on the job and those required in the labour market is essential if countries want to make the most of their investments in human capital. It is also a desirable outcome for individuals who have themselves invested in education. A mismatch between workers' skills and the demands of their job has potentially significant economic implications. For individuals, it affects job satisfaction and wages. For employers, it increases the rate of turnover and may reduce productivity. At the macroeconomic level, mismatches increase unemployment and reduce growth through the inefficient use of human capital and/or a reduction in productivity (McGowan and Andrews, 2015[16]). That said, some level of mismatch is inevitable. Requirements for skills and qualifications are never fixed. The task content of jobs changes over time in response to technological and organisational change, the demands of customers, and in response to the evolution of the supply of labour. Young people leaving education and people moving out of unemployment, for example, may take jobs that do not necessarily fully match their qualifications and skills. Thus, for a number of reasons, some workers are likely to be employed in jobs for which they are too highly qualified and others may be in jobs, at least temporarily, for which they lack adequate schooling.

Mismatches in the Survey of Adult Skills

The Survey of Adult Skills (PIAAC) offers a unique source of data regarding aspects of skills and qualifications mismatches as it includes information on workers' qualifications and experience, their perceptions of the qualification requirements of their jobs, the task composition of their jobs, and their proficiency in key information-processing skills. This section examines three types of mismatches: in qualifications, field of study and skills. These are defined in Box 5.1 below. While these measures focus on different aspects of mismatches, they overlap to some extent, just as education levels, fields of study and skills do. For instance, graduates who face difficulties finding work in their field of study may accept a job in a different field and below their level of qualification because they lack some of the specific knowledge required by that job. In this case, they would be mismatched by field of study and overqualified.

Box 5.1 **Measuring mismatches in qualifications, skills and fields of study in the Survey of Adult Skills**

In general, and for every type of mismatch, there are several measurement strategies. Surveys can ask respondents about their own appraisal with regards to mismatch (subjective measures), or compare respondents to what is common in their country (statistical approaches) or what is, by definition, appropriate (normative approaches). Each type of measure has its advantages and disadvantages.

Qualification mismatches arise when workers' educational attainment levels are higher or lower than required for their jobs. If they are more highly educated than their job requires, workers are classified as overqualified; if the opposite is true, they are classified as underqualified. In PIAAC, workers are asked what would be the usual qualifications, if any, "that someone would need to get (their) type of job if applying today". The answer to this question is used as each worker's qualification requirement and compared to their actual qualification to identify mismatches. Although they can be biased by individual perceptions and period or cohort effects, these kind of self-reported qualification requirements have the advantage of being job specific rather than assuming that all jobs with the same occupational code require the same level of qualification.

Skills mismatches arise when workers have skills levels that are higher or lower than required for their jobs. If they have greater skills than the maximum their job requires, workers are classified as overskilled; if their skills are below the minimum, they are classified as underskilled. For the purpose of this chapter, skill requirements at work, the key term in the measurement of skills mismatch, are derived following Pellizzari and Fichen (2013[17]). The maximum and minimum skill score required for each occupation are defined based on the proficiency of respondents who are classified as well matched to their job. The well matched are workers who replied that they do not feel they "have the skills to cope with more demanding duties than those they are required to perform in their current job" and who also replied that they do not "need further training in order to cope well with their personal duties". This measure of skills mismatch is robust to reporting bias, such as overconfidence, and it does not impose the strong

...

assumptions needed to directly compare proficiency and skills use. However, this approach does not measure all forms of skills mismatch; rather, it focuses on mismatches in the proficiency domains assessed by the Survey of Adult Skills, leaving out mismatches related to job-specific skills or involving generic skills.

Field-of-study mismatches arise when workers are employed in a different field from the one they have specialised in. The matching is based on a list of occupations, narrowly defined using the International Standard Classification of Occupations (3-digit ISCO classification) that are considered an appropriate match for each field of study. Workers who are not employed in an occupation that is considered a good match for their field are counted as mismatched. The list of fields and occupations used in this chapter can be found in Annex 5 of the 2014 edition of the OECD Employment Outlook (OECD, 2014[11]). The list is largely based on that developed by Wolbers (2003[18]) but has been adapted to the ISCO 08 classification (Montt, 2015[19]).

Sources:
OECD (2017[20]), *Getting Skills Right: Skills for Jobs Indicators*, https://dx.doi.org/10.1787/9789264277878-en; OECD (2014[11]), *OECD Employment Outlook 2014*, https://dx.doi.org/10.1787/empl_outlook-2014-en; Montt (2015[19]), "The causes and consequences of field-of-study mismatch: An analysis using PIAAC", https://dx.doi.org/10.1787/5jrxm4dhv9r2-en; Pellizzari and Fichen (2013[17]), "A new measure of skills mismatch: Theory and evidence from the Survey of Adult Skills (PIAAC)", https://dx.doi.org/10.1787/5k3tpt04lcnt-en; Wolbers (2003[18]), "Job mismatches and their labour-market effects among school-leavers in Europe", www.socsci.ru.nl/maartenw/esr03-3.pdf.

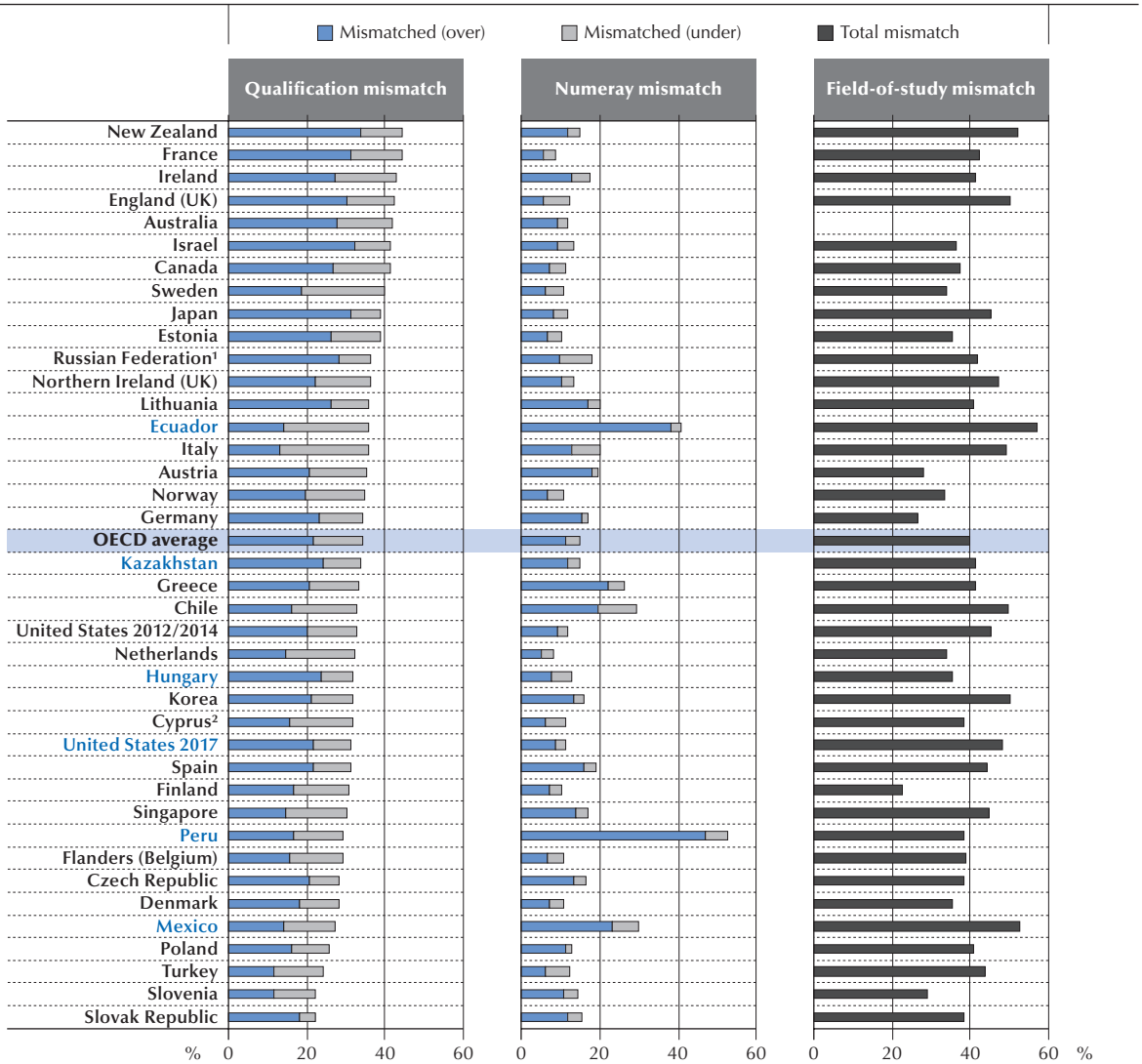
The main piece of information needed to determine whether workers are over- or underqualified is to measure the level of education required in their jobs. PIAAC asks workers what qualification they consider would be necessary to get their job today. The comparison between workers' qualifications and this self-reported requirement shows that, on average, 22% of workers are overqualified while about 12% are underqualified (Figure 5.5). The incidence of qualification mismatch varies significantly across countries. In all Round 3 countries except Ecuador and Kazakhstan, the overall qualification mismatch rate is lower than in the OECD average. Kazakhstan has an overall rate very close to the OECD average, although the composition is slightly different with overqualification playing a bigger role than on average. Ecuador has a relatively high overall rate and is one of only five PIAAC countries, where being underqualified is more common than being overqualified. This could reflect rapid growth in the demand for higher qualifications not matched by an equivalent increase in graduate numbers.

PIAAC also identifies workers who are overskilled or underskilled by comparing their proficiency score in a given domain to the maximum and minimum score required by their occupation (see Box 5.1). Workers are overskilled in a domain if their score is higher than the maximum score required and they are underskilled if their score is lower than the minimum score required. In Hungary, Kazakhstan and the United States, the overall incidence of skill mismatch is at or below the rate observed in the OECD on average. By contrast, Latin American countries stand out, with incidences that are well above average. This applies to Ecuador, Mexico and Peru from Round 3 but also to Chile from Round 2 and is mostly due to an above-average incidence of overskilling. One possibility is that skill requirements are weighed down by the low skill levels of workers on average. This would make highly skilled individuals stand out even in occupations that would normally require higher-level qualifications and competencies. Although measured differently, this finding is in line with the relatively limited use of literacy and numeracy in the workplace in these countries.

Chile, Ecuador, Mexico and the United States have a relatively high incidence of mismatches by field of study, whereby workers are in jobs that are not related to their field of study. The incidence of field-of-study mismatch is 10 percentage points above the OECD average of 40% in Chile, 17 percentage points higher in Ecuador, 12 percentage points in Mexico and 8 percentage points in the United States. This could be due to a poorer alignment of education choices with labour-market needs as well as to the predominantly general nature of secondary education. Findings by the Inter-American Development Bank (Novella et al., 2019[21]; Rucci, 2017[22]) suggest that, in Latin American countries, the alignment between the content of education and training and labour-market requirements may be particularly poor. Statistically, a high incidence of field-of-study mismatch could also be due to a relatively small sample size, since these countries have a very large share of adults with only a general upper secondary education who by definition are excluded from the field-of-study analysis (Montt, 2015[19]).

Figure 5.5 ■ **Mismatches in qualifications, numeracy and fields of study**

Percentage of mismatched workers, by type of mismatch



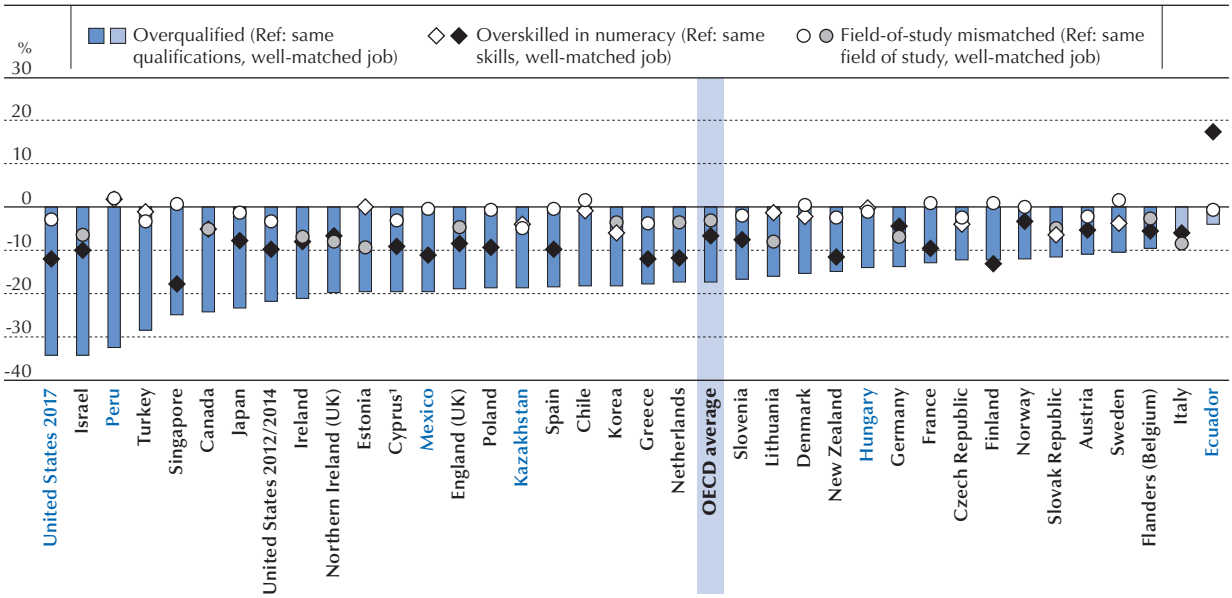
Notes: Field-of-study mismatch is unavailable for Australia due to the unavailability of ISCO 3-digit information for Australian workers in the Survey of Adult Skills (PIAAC).
1. See note at the end of this chapter.
2. See note 2 under Figure 5.1.
Countries and economies are ranked in descending order of the prevalence of qualification mismatch (overqualification or underqualification).
Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A5.6.
StatLink https://doi.org/10.1787/888934020806

The effect of mismatches on wages

Overqualification has a stronger negative effect on real hourly wages than mismatches in skills or field of study, when workers are compared with equally qualified and equally proficient well-matched counterparts (Figure 5.6). On average across OECD countries and economies, overqualified workers earn about 17% less than well-matched workers with the same qualification and proficiency levels and in the same field of study. The equivalent wage penalty for overskilling is 7%, and for field-of-study mismatches it is 3%. While the negative correlation between overqualification and wages is consistent and statistically significant across the vast majority of countries, this is not the case for overskilling and field-of study mismatch. In Kazakhstan, Mexico, Peru and the United States, the wage penalties related to overqualification are above average, particularly in Peru and the United States where the hourly wages of overqualified workers are more then 30% lower than the hourly wages of well-matched workers who have the same level and field of qualification and the same proficiency in numeracy. None of the mismatch variables are associated with changes in hourly wages in Ecuador. Finally, the wage penalty associated with overqualification in Hungary is below the OECD average, while over-skilling and field-of-study mismatch do not have any statistically significant association with hourly wages.

Figure 5.6 ■ **Effect of mismatches in qualifications, numeracy and fields of study on wages**

Percentage difference in wages between overqualified, overskilled or field-of-study mismatched workers and their well-matched counterparts



Notes: Coefficients from ordinary least squares regression of log hourly wages on mismatch directly interpreted as percentage effects on wages. Coefficients adjusted for years of education, age, gender, marital status, working experience, tenure, foreign-born status, establishment size, contract type, hours worked, public sector dummy, proficiency in numeracy and numeracy use at work. The wage distribution was trimmed to eliminate the 1st and 99th percentiles. The regression sample includes only employees. The analysis excludes the Russian Federation because wage data obtained through the survey do not compare well with those available from other sources. Hence further checks are required before wage data for this country can be considered reliable. The analyses exclude Australia because the unavailability of ISCO 3-digit information for Australian workers in the Survey of Adult Skills (PIAAC) means field-of-study mismatch data were unavailable. Statistically significant values (at the 5% level) are shown in a darker tone.

1. See note 2 under Figure 5.1.

Countries and economies are ranked in ascending order of the effect of overqualification on wages.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A5.7.

StatLink https://doi.org/10.1787/888934020825

This evidence should not be interpreted as suggesting that having skills in excess of those required at work is not valued at all on the labour market. On average across countries, overqualified workers earn about 4% more than well-matched workers in similar jobs. In other words, tertiary graduate who hold jobs requiring only an upper secondary qualification will earn less than if they were in jobs requiring a tertiary qualification, but more than upper secondary graduates in jobs requiring upper secondary qualifications.

Qualification and skills mismatches may both have distinct effects on wages, even after adjusting for both qualification level and proficiency scores, because jobs with similar qualification requirements may have different skill requirements. This may happen because employers can evaluate qualifications but they cannot measure skills directly. In addition, the kinds of mismatches in skills captured by the two indicators are different: the survey's indicators of skills mismatch are based on numeracy, literacy and problem solving, while skills mismatches captured by qualification-based indicators may be interpreted as more general and may be based, for example, on the level of job-specific skills.

NON-ECONOMIC OUTCOMES OF INFORMATION-PROCESSING SKILLS

While employability and wages are important for individual well-being, non-economic factors also contribute both to individual well-being and to the smooth functioning of societies. PIAAC collects information on four non-economic outcomes: the level of trust in others; participation in associative, religious, political, or charity activities (volunteering); the sense of being able to influence the political process (i.e. political efficacy); and self-assessed health conditions.

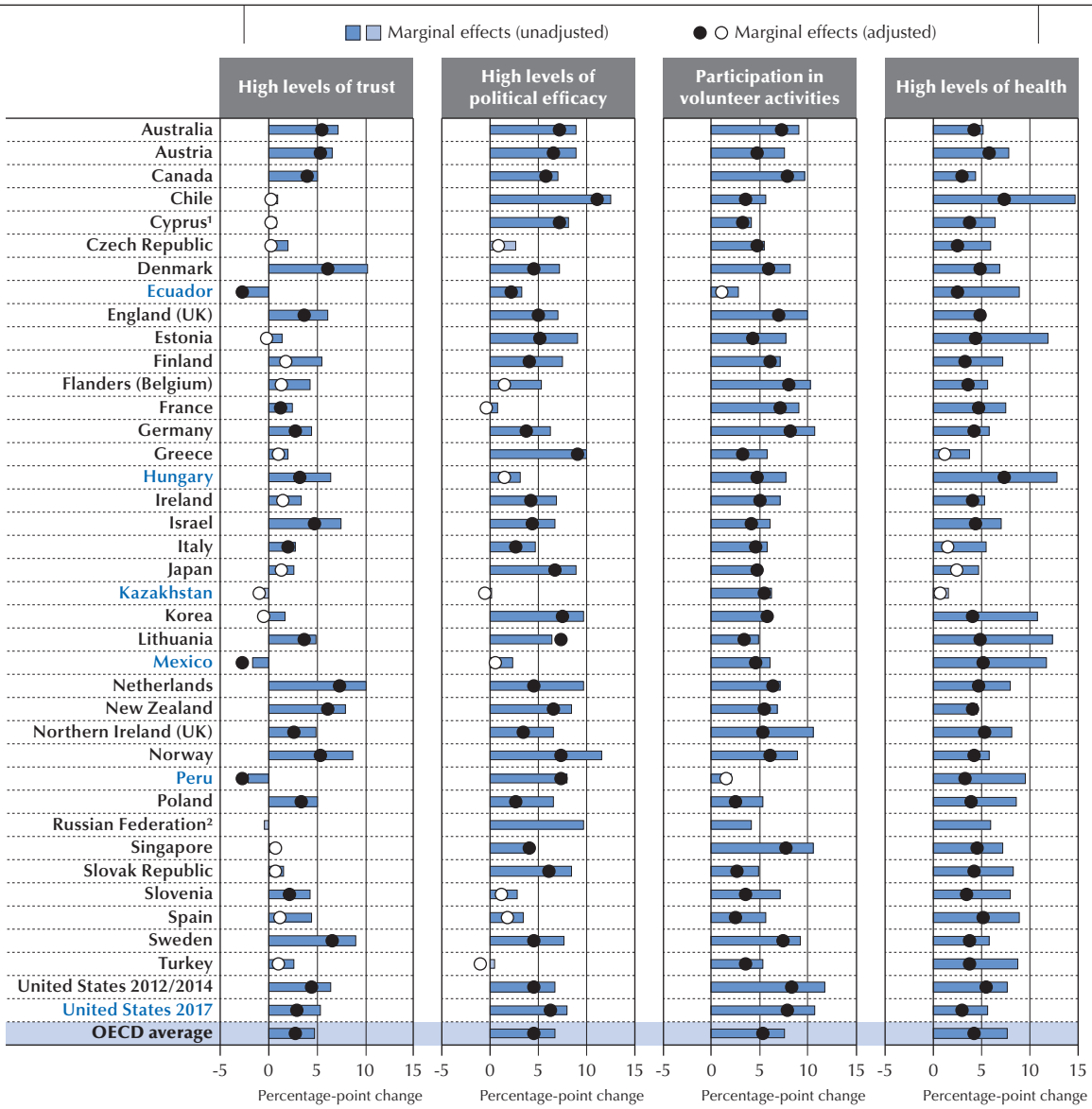
Trust, volunteering and political efficacy are variables collected in many surveys, such as the World Value Survey (www.worldvaluessurvey.org) and the European Social Survey (www.europeansocialsurvey.org). They are often used as proxies to measure social capital in the extensive economic and sociological literature that has investigated the link between social capital (and cultural traits) and long-term economic development (OECD, 2016[4]). The Survey of Adult Skills offers a unique opportunity to better understand the relationships between education, skills proficiency and widely used measures of social capital and individual well-being. Depending on the subjective value attached to the various non-

economic outcomes, they can be seen as either interesting outcomes in themselves, or, in light of the vast literature on the relationship between social capital and economic growth, as mediating variables in studying the relationship between skills proficiency and economic outcomes.

As Figure 5.7 illustrates, on average in the OECD, proficiency in information-processing skills is positively associated with trust, volunteering, political efficacy and self-assessed health. The relationships with political efficacy, self-assessed health and volunteering hold even after accounting for the usual range of socio-demographic characteristics. On the other hand, the association with trust becomes very small and, in many instances, is no longer statistically significant once individual characteristics are accounted for.

Figure 5.7 ▪ **Effect of numeracy proficiency on positive social outcomes**

Marginal effects (as percentage-point change) of one standard deviation increase in numeracy proficiency score on the probability to report high- and low- levels of trust and political efficacy, good to excellent health, or participating in volunteer activities



Notes: Statistically significant differences are marked in a darker tone. Adjusted differences are based on a regression model and take account of differences associated with the following variables: age, gender, education, immigrant and language background and parents' educational attainment. Adjusted differences for the Russian Federation are missing due to the lack of language variables. One standard deviation in proficiency in numeracy for the total population is 52 score points.

1. See note 2 under Figure 5.1.
2. See note at the end of this chapter.

Countries are listed in alphabetic order.

Source: Survey of Adult Skills (PIAAC) (2012, 2015, 2018), Table A5.8(N).

StatLink https://doi.org/10.1787/888934020844

The strength of the association differs among countries. With the exception of Hungary and the United States, countries in Round 3 have weaker relationships overall between proficiency in numeracy and non-economic outcomes than most of the other countries included in PIAAC. In Ecuador and Peru, only political efficacy and health outcomes are positively associated with proficiency, while in Mexico only volunteering and self-reported health bear a positive association with proficiency. In Kazakhstan, only participation in volunteering activities bears any relationship with numeracy proficiency, once controls are applied. On the other hand, in Hungary, only political efficacy is not correlated with numeracy proficiency and all relationships are positive and statistically significant in the United States.

SUMMARY

Proficiency in literacy, numeracy and problem solving in technology-rich environments is positively and independently associated with the probability of participating in the labour market and being employed, and with higher wages. Proficiency in these information-processing skills is also positively associated with other important aspects of well-being, notably health and beliefs about one's impact on the political process. The findings in this chapter, along with those in Chapter 3, also highlight the distinction between qualification and skills: some workers have lower proficiency in skills than would be expected given their educational level, either because they performed poorly during their initial education or because their skills have declined over time. This can lead to significant mismatches, particularly as skills are difficult for employers to gauge and qualifications are routinely used as signals of individual ability. The resulting mismatch between the skills a worker possesses and those required at work is associated with a sizeable reduction in wages.

The relationship between numeracy proficiency and labour market outcomes is weaker than average in several Round 3 countries, notably in Latin America. In these countries, years of education are a better predictor of wage outcomes than numeracy proficiency but are weakly correlated to the likelihood of being employed. Overskilling and mismatches in fields of study are also more common in these countries than on average, suggesting poor alignment between their education systems and labour-market needs. The picture is more mixed for Kazakhstan, where some indicators point to a weak association between skills and labour market outcomes while others are in line with the OECD average. Of all the Round 3 countries, Hungary and the United States tended to perform the closest to the OECD average.

Overall, the results suggest that investments in improving adults' proficiency in literacy, numeracy and problem solving in technology-rich environments may have significant benefits. Independent of policies designed to increase participation in education and training, improvements in the teaching of literacy and numeracy in schools and programmes for adults with poor literacy and numeracy skills and limited familiarity with ICTs may result in considerable economic and social returns for individuals and for society as a whole.

Note

1. For example, employment may itself favour the acquisition of skills or prevent the depreciation of workers' skills that are not put to use whilst unemployed.

A note regarding the Russian Federation

The sample for the Russian Federation does not include the population of the Moscow municipal area. More detailed information can be found in the *Technical Report of the Survey of Adult Skills, Third Edition* (OECD, 2019[23]).

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Annex A

Skills Matter: Additional Results from the Survey of Adult Skills

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ANNEX A

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ADDITIONAL RESULTS FROM THE SURVEY OF ADULT SKILLS

In the wake of the technological revolution that began in the last decades of the 20th century, labour-market demand for information-processing and other high-level cognitive and interpersonal skills has been growing substantially. The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), was designed to provide insights into the availability of some of these key skills in society and how they are used at work and at home. The first survey of its kind, it directly measures proficiency in three information-processing skills: literacy, numeracy and problem-solving in technology-rich environments.

This volume reports results from the 33 countries and regions that participated in the first and second round of the survey in 2011-12 and in 2014-15, while placing special emphasis on the results from the third and final round of the first cycle of PIAAC in 2017-18, which included 6 countries (Ecuador, Hungary, Kazakhstan, Mexico, Peru and the United States). It describes adults' proficiency in the three information-processing skills assessed, and examines how proficiency is related to labour-market and social outcomes. Another related report, *The Survey of Adult Skills: Reader's Companion, Third Edition*, describes the design and methodology of the survey and its relationship to other international assessments of young students and adults.

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- *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*
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