Essays on Skills and Labour Market Outcomes of Immigrants and the Canadian Born

ESSAYS ON SKILLS AND LABOUR MARKET OUTCOMES OF IMMIGRANTS AND THE CANADIAN BORN

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LAY ABSTRACT

This essay comprises three chapters in the realm of labour economics and applied econometrics, with a focus on inequality of basic skills and labour market outcomes between immigrants and the Canadian-born, and gender inequality in the information and communication technology (ICT) sector. Chapters 1 and 2 study differences in general computer skills, literacy, and numeracy proficiency among immigrants (by immigration category) and the Canadian born (categorized by their parental place of birth). These two chapters also explore the rates of return to these fundamental skills in the Canadian labour market for above-mentioned categories of individuals. Chapter 3 examines the gender inequality in the Canadian ICT sector by contrasting general computer skills and analyzing differences in the rates of return to these skills as between men and women in the Canadian labour market.

ABSTRACT

Inequalities in basic skills and labour market outcomes between immigrants (by admission category) and the Canadian-born, and the underrepresentation of women in the information and communication technology (ICT) sector, are examined using Statistics Canada's 2012 Survey of Adult Skills, a product of the Organisation for Economic Cooperation and Development's Programme for the International Assessment of Adult Competencies.

Differences in basic ICT skills, and the rates of return to these skills in the Canadian labour market, between immigrants and Canadian non-immigrants, are the focus of the first chapter. Immigrants, especially men, are observed to be disproportionately employed in ICT industries and occupations. A measure of basic ICT skills is employed to document differences in skill levels and labour market earnings across immigration classes and categories of Canadians at birth. Adult immigrants, including those assessed by the points system, are found to have lower average ICT scores than Canadians at birth, although the rate of return to ICT skills is not statistically different between the two groups. Immigrants who arrived as children, and the Canadian-born children of immigrants, have similar outcomes to the children of Canadian-born parents.

Chapter 2 explores differences in literacy and numeracy skills, and the economic returns to these skills, for immigrants to Canada in different admission classes and their Canadian-born counterparts. First, respondents are grouped into three broad categories – adult and young immigrants, and the Canadian-born. Then, these individuals are classified into nine population subgroups: adult economic immigrants, adult refugees, adult family

reunification, other adult immigrants, adult temporary residents, young refugees, young non-refugee immigrants, and second- and third-generation Canadian-born individuals. The analysis suggests that both adult and young immigrants (those who arrived in Canada at age 13 or younger) do not perform as well on literacy and numeracy tests conducted in English or French as those born in Canada, although young immigrants have higher test scores than adult immigrants. Similar results are found for wages. Among immigrants, it is observed that economic immigrants tend to have the highest test scores and hourly wages, with refugees having the lowest. The wage returns to these basic skills are economically significant at the 25^{th}, 50^{th}, and 75^{th} quantiles of log hourly wages and the Canadian labour market rewards immigrants and the Canadian-born equally for their literacy and numeracy skills.

Chapter 3 explores why the proportion of women in Canada's ICT sector is well below their percentages in other science, technology, engineering, and mathematics (STEM) fields. A measure of basic ICT skills is used to study the skills gap and differences in returns to these skills between men and women. After controlling for appropriate covariates, Canadian women on average score higher than their male counterparts in basic ICT skills. However, women with the same ICT test scores are less likely than men to be employed in ICT occupations. Hourly wages in ICT occupations are lower for women, but the earnings gap in these occupations is not higher than those in the general labour market. Given the current and projected shortages of ICT professionals, women represent a large, yet untapped, pool of talent for this sector.

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"Có công mài sắt, có ngày nên kim"

(Vietnamese proverb)

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PREFACE

Chapter 1 is co-authored with Professor Arthur Sweetman. Chapter 2 is co-authored with Professor Richard E. Mueller from the Department of Economics at the University of Lethbridge. Chapter 3 is co-authored with Professor Richard E. Mueller and Wynonna Smoke, a Ph.D. student in the Department of Health Research Methods, Evidence, and Impact, McMaster University. I fully participated in all aspects of each chapter. Chapter 1 and Chapter 3 have been published in *Canadian Public Policy*.

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LIST OF ABBREVIATIONS

OECD	Organisation for Economic Cooperation and Development
PIAAC	Programme for the International Assessment of Adult Competencies
PSTRE	Problem Solving in Technology-Rich Environments
ICT	Information and Communication Technology
ICTC	Information and Communication Technology Council
STEM	Science, Technology, Engineering and Mathematics
CATA	Canadian Advanced Technology Alliance
CATA-WIT	Canadian Advanced Technology Alliance – Women in Technology
STATCAN	Statistics Canada
IRCC	Immigration, Refugee and Citizenship Canada

INTRODUCTION

Since at least the seminal work of Becker (1964), economists have been using educational attainment as a measure of human capital, and the rate of return to schooling has been well studied in the literature (surveys include Dickson and Harmon 2011 and Psacharopoulos and Patrinos 2018). Various econometric techniques have been devoted to understanding the causal impacts of the educational attainment on individuals' earnings (e.g., see Card 1999, 2001; Carneiro, Heckman, and Vytlacil 2011). However, this measure captures the human capital at the end of schooling and may not capture the process of learning and adapting to changes in everyday and workplace environments, nor any structural and technological changes in the post-education period (Hampf, Wiederhold, and Woessmann 2017). An alternative way to capture aspects of human capital is to measure varieties of cognitive skills directly. Hanushek and Woessmann (2008) point to the importance of these types of skills in determining wages of individuals in developed countries.

There is a growing number of studies exploring the returns to literacy and numeracy skills of the population of adults in Canada. Charette and Meng (1998) use the 1994 Literacy Skills Used in Daily Activities (LSUDA) survey to study the differences in literacy and numeracy skills and their labour market implications for native-born Canadians. They find that these skills have important roles in explaining labour market outcomes, such as labour market status, weeks worked, and income. Green and Riddell (2003), and Ferrer, Green, and Riddell (2006) use the 1994 International Adult Literacy Survey (IALS)[1] and

[1] Ferrer, Green, and Riddell (2006) also combine the IALS with the 1998 Ontario Immigrant Literacy Survey (OILS).

similarly conclude that the returns to literacy skills are statistically significant and that controlling for literacy skills reduces the returns to educational attainment. Green and Riddell (2013) combine the IALS and the 2003 International Adult Literacy and Life Skills Survey (IALSS) to study the effect of ageing on literacy skills across birth cohorts for Canada, the U.S., and Norway.

As Canada enters the digital and knowledge-based economy that is experiencing substantial technological change (e.g., automation, robotics, and blockchain technology to name a few) (Autor, Levy, and Murnane 2003; Acemoglu and Autor 2011; Autor 2015), assessments of the skills of the adult population from one or two decades ago would become obsolete and irrelevant to the current labour market. The successor of the previously mentioned large-scale assessments, which is Statistics Canada's 2012 Survey of Adult Skills – a product of the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) – gives a unique opportunity to investigate differences in foundational skills and their labour market outcomes. It is the most recent data set that includes large scale assessments of adults' basic skills and proficiencies.

The survey includes a wide range of demographic and labour market information on individuals in Canada aged 16 to 65. Three components of adult skills are literacy, numeracy and problem-solving in technology-rich environment (PSTRE). These are regarded as basic or foundational skills – "key information-processing competencies" – that are necessary to build other relevant and complex skills (OECD 2013a, 25). Moreover, PSTRE assesses individuals in three dimensions: the technology dimension, the task dimension, and the cognitive dimension. The measurement scale of these tests is from zero

to 500. According to the OECD (2013a, 59), these foundational skills measure individuals' competencies as follows:

> "**Literacy** is defined as the ability to understand, evaluate, use and engage with *written texts* to participate in society, to achieve one's goal, and to develop one's knowledge and potential.
>
> **Numeracy** is defined 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.
>
> **PSTRE** is defined as the ability to use digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks. The assessment 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."

Each respondent is randomly assigned two out of three components to complete. Literacy and numeracy scores are available for all respondents, whether they completed paper-based or computer-based assessments. However, PSTRE scores are only available to individuals who passed both computer-based assessments (CBA) core stages and completed CBA tests. For each component, ten plausible values are imputed using an item response theory utilizing information from the test items and observable characteristics provided in the background questionnaires. Refer to OECD (2013b) for more details on how these assessments are designed and conducted, and how test scores are imputed.

Despite coming from various socioeconomic backgrounds and having different motives for migrating, immigrants are often treated as one homogenous group in many studies due to the lack of data on immigration categories. Studies that compare the education and labour market performance of immigrants in various admission categories to those of native-born use mostly data from Canada and Australia, and mainly only refugees

in the case of the U.S. (e.g., see Green and Green (1995), Aydemir (2011), Goldmann, Sweetman, and Warman (2011), Sweetman and Warman (2014) and Hou (2017) for studies in Canada; Cobb-Clark (2000) and Chiswick, Lee, and Miller (2006) for studies in Australia; and, Card (1990) and Borjas and Monras (2017) for studies on Mariel Boatlift Cuban refugees in the U.S.).

Chapter 1 investigates differences in general-purpose technology or basic information communication and technology (ICT) skills – measured by the PSTRE – and their labour market implications across different subpopulation groups. This chapter also explores the intersection of immigration and the labour market demand for ICT skills, both advanced and generic technology skills, in the Canadian labour market, which is much discussed but not well understood.

The distribution of immigrants and the Canadian-born, aged 22 – 59, across ICT occupations, and self-reported usages of various technologies at work are documented. In the PIAAC 2012 immigrants are categorized into six subgroups based on their self-reported admission category and age-at-arrival. Canadians at birth are grouped into three subcategories based on their place of birth and parental place of birth. Young immigrants include those who arrived in Canada at age 12 or younger.

The analysis suggests that a one-standard-deviation increase in the basic ICT score translates into seven percent higher earnings for both genders. A considerable economic return in the labour market to having modest levels of even the basic ICT skills (as opposed to no ICT or very minimal skills) is observed, and this return is evident even when controlling for literacy and numeracy scores. Even though the measure of ICT skills

encompasses only fundamental tasks, it is evident that there is a very substantial earnings premium at the very low end of the scale. The analysis also points out that the Canadian labour market does seem to reward foundational ICT skills proficiency at an equal rate for both immigrants and the Canadian born.

The second chapter extends the analyses to study literacy and numeracy skills gaps between immigrants and the Canadian-born, and what role these skills play in addressing earnings gaps between these groups of individuals. Immigrants and Canadian non-immigrants, aged 25 to 65, are classified into the same nine population subgroups as in the previous chapter, except that the Canadians by birth who were born abroad to at least one Canadian-born parent are excluded. In this chapter, young immigrants include those who arrived in Canada at age 13 or younger. The group of young immigrants is defined differently in this chapter, compared to the previous one, to obtain a larger sample size so that these individuals can be separated into young refugees and young non-refugee immigrants. Differences in literacy and numeracy skills across population subgroups are examined between the subsamples of individuals with and without a university education and across quantiles of literacy and numeracy scores using the unconditional quantile method proposed by Firpo, Fortin, and Lemieux (2009). The effects of literacy/numeracy scores on earnings gaps between groups of immigrants and the Canadian-born are studied across the earnings distribution again using unconditional quantile regressions.

Both adult and young immigrants, on average, have lower literacy and numeracy scores than those born in Canada, although young immigrants are mostly educated in the Canadian education system. Economic immigrants, on average, have higher test scores and

earnings than immigrants who come under other categories, with refugees having the lowest amongst all categories. Test score differences between population subgroups are quantitatively unchanged across the distribution of skills for classes of immigrants who obtained higher levels of education (e.g., the economic immigrants), while those with lower levels of education experience a decreasing trend in the absolute value of test scores differences across quantiles (e.g., refugees). The returns to a one-standard-deviation increase in literacy and numeracy scores separately translate into eight to 13 percent increase in hourly wages. Furthermore, including these two scores in the earnings regressions reduces the returns to university education from 17 to 24 percent for both men and women, depending on specification. Finally, the results show that the labour market rewards immigrants, regardless of immigration category, and Canadian-born individuals similarly for their literacy or numeracy skills.

Lastly, Chapter 3 explores a different policy-oriented research question –why are women continuing to be underrepresented in Canada's ICT sector? The share of women in core information and communication technology occupations has remained stable at 23 to 25 percent since 2000 (ICTC 2009, 2013, 2016), even over this period when the number of young women at universities surpassed the number of young men. With the demand for ICT workers projected to increase over the next few years, women represent a largely untapped pool of talent. Despite the growing trend of women working in fields that were once considered male-dominated, both ICT education and the ICT industry seems to fail in attracting women. As defined in Chapter 1, basic ICT skills are proxied by the PSTRE scores in the PIAAC 2012. The analysis finds that, after controlling for numeracy and

literacy scores and appropriate demographic variables, women score higher on basic ICT tests than men. On average, women are less likely to be employed in the ICT occupations, even when they possess the same ICT skills. Within the ICT occupations, women, on average, earn less than men, and these earnings differences are like those in other occupations. This chapter also finds that the underrepresentation of women in ICT does not necessarily arise from the lack of natural ability and unfavourable employment conditions.

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CHAPTER 1 – BASIC INFORMATION COMMUNICATION TECHNOLOGY SKILLS AMONG CANADIAN IMMIGRANTS AND NON-IMMIGRANTS

1.1. INTRODUCTION

Information and communication technologies (ICTs) affect many aspects of people's daily lives and workplaces. In 2016, 76 percent of Canadians owned a smartphone, and 71 percent possessed a laptop or notebook computer (Statistics Canada 2017). Digital technologies have also changed the practices and operations of businesses and governments (OECD 2017), and having ICT-related skills is essential for workers to participate in the digital economy (ICTC 2016a; Cameron and Faisal 2016). ICT skills are sometimes categorized as specialist or advanced, generic, and complementary (OECD 2017; Spiezia, Koksal-Oudot, and Montagnier 2016). Specialist skills are required to produce ICT products and service those products. Generic ICT skills facilitate the use of ICT products and technologies to carry out tasks at home and work. Skills that complement ICT technologies permit individuals to efficiently execute a wide variety of tasks – ones that are not always directly categorized as ICT tasks – in technology-rich environments.

This paper focuses on the intersection of immigration and the labour market demand for ICT skills. As a major immigrant-receiving country, Canada is, in broad terms, interested in understanding immigrant integration into the digital economy because the demand for general-purpose technology skills (i.e., generic and complementary ICT skills)

is increasing (OECD 2017). Immigration is also sometimes posited as one avenue to address specialist/advanced ICT-related labour and skill shortages in the Canadian economy. For example, the Information and Communications Technology Council (ICTC 2016a) reports that 877,470 ICT professionals were employed throughout the economy as of December 2015, and proposes that 182,000 additional hires will be needed by 2019 (see also OECD 2017; ICTC 2011, 2016a; Nordicity 2012).[2] Given the data used in this analysis, there are limits to what can be said regarding the recruitment of ICT specialists, although some useful information is presented. In contrast, the data are well suited to the first, more broad-based goal of looking across immigration-related population subgroups to document levels of basic ICT skills and estimate the deployment and economic rates of return to such skills in the labour market.

Alongside projections of ICT labour and skill shortages, technology advances are simultaneously associated with decreasing future labour demand in general. Johal and Thirgood (2016) argue that approximately one million workers may lose their jobs in the next few decades, as a result of the rise of automation, and part-time or temporary jobs may replace many Canadians' full-time or permanent positions. Related to this, Acemoglu and Restrepo (2017) find that robots or computer-assisted technologies have a negative influence on employment and wages. They estimate that one extra robot per thousand workers reduces wages by 0.25 to 0.50 percent and employment by 0.18 to 0.34 percentage points. However, Autor (2015) argues that automation can be both a substitute and a

[2] Despite the shortage discourse, there is no consensus on how to measure either labour or skills shortages, and the historical track record of projecting shortages does not instill confidence among many labour market analysts (e.g., Freeman 2006; Barnow, Trutko, and Piatak 2013).

complement to labour. Coupled with the evidence discussed earlier, OECD (2017) suggests that the skills embodied in the workforce are a key concern for economic growth and emphasizes the importance of ICT-related skills (re-)training to facilitate the effective use of these technologies.

The intersection of the labour market integration of immigrants and the increasing demand for ICT skills, both advanced and generic, is much discussed but not well understood. Moreover, in Canada foreign-trained workers, including those in the ICT sector, face skill mismatches, including those resulting from differences in education systems, language barriers, and ethnic discrimination (ICTC 2016b; Warman, Sweetman, and Goldman 2015; Clarke and Skuterud 2016; Picot and Sweetman 2012).

We document the distribution of immigrants and Canadian-born individuals across ICT industries and occupations, as well as the self-reported use of various technologies in the workplace, including complex ICT skills and programming. Moreover, we use a direct measure of basic skills related to problem-solving in technology-rich environments from Statistics Canada's 2012 Survey of Adult Skills, which is a part of the OECD's Programme for the International Assessment of Adult Competencies (PIAAC; OECD 2012). This survey measures a combination of generic ICT skills and skills that are complementary to ICT. This direct measure is not intended to quantify specialist skills, although some observers might expect highly skilled ICT specialists to also have high levels of basic ICT skills. Indeed, if they do not, then such specialist workers' capacity to recover in the face of negative economic shocks may be limited, a phenomenon observed in the so-called ICT bust documented by Picot and Hou (2009). In the rapidly evolving ICT sector, career

advancement and employment transitions may also be affected if workers' skill sets, though advanced, are extremely narrow.

Of course, there is a high correlation between the ICT scores employed, numeracy, and English or French literacy. Moreover, the basic ICT test is written in English or French. Thus, the measured ICT scores likely also reflect other skills, especially English or French proficiency. As posited by Warman et al. (2015), it seems reasonable to assume that workplace language and communication skills mediate the use of other skills. Overall, these scores reflect the ability to undertake a range of basic ICT-related tasks in an English or French work (or home) environment, not the skills required for advanced ICT tasks.

We also extend the broad literature on immigrants' labour market integration. On this dimension, we distinguish between adult immigrants (i.e., the first generation) and child immigrants (termed the 1.5 generation). We also differentiate between Canadians at birth born outside of Canada who have at least one parent who is a Canadian citizen and, for those born in Canada, we distinguish between the children who have at least one immigrant parent (i.e., second-generation immigrants) and Canadian-born children of two Canadian-born parents (i.e., third-generation immigrants, or more accurately, the third-plus-generation). We also align our analysis with immigration policy by contrasting across immigration categories. Previous analyses by immigration categories (Aydemir 2013; Sweetman and Warman 2010, 2013) and immigrant generations (Sweetman and van Ours 2014) relative to domestic citizens at birth are relevant background. Finally, we also separately identify temporary residents (consisting of temporary workers, foreign students,

and others), given the increasing interest in this group (e.g., Sweetman and Warman 2014; El-Assal and Sweetman 2016).

Although we focus on basic ICT skills, research involving literacy and numeracy skills in the labour market, especially for immigrants, is relevant to this study. Green and Riddell (2003), using the Canadian portion of the 1994 International Adult Literacy Survey (IALS), find that controlling for literacy skills in earnings regressions reduces the coefficient on years of schooling. In their international comparison of the returns to numeracy skills, Hanushek et al. (2015) estimate that a one-standard-deviation increase in numeracy is associated with an 18 percent increase in earnings. At the intersection of these measured skills and immigration, Ferrer, Green, and Riddell (2006) observe that differences in literacy skills explain about two-thirds of the earnings gap between university-educated native-born individuals and immigrants and eliminate differences in the rate of return to education. At a more aggregate level, Li and Sweetman (2014) observe that for adult immigrants, higher average test scores for source country education systems are associated with higher rates of return to education in the Canadian labour market. Overall, this literature points to the high value placed on literacy and numeracy skills in the labour market and their correlation with rates of return to education.

Even though male immigrants who entered under the points system are more likely to have jobs involving complex ICT skills and computer programming, we observe that these individuals, together with other foreign-educated individuals, are on average less proficient according to our basic ICT measure than third-generation Canadians. This deficit is in general made stronger by controlling for characteristics including the highest level of

education attained. This may be consistent with the labour market fragility of immigrants in adjustments subsequent to a negative economic shock in the ICT sector, such as that documented by Picot and Hou (2009). In contrast, young immigrants – those who arrive in Canada at 12 years old or younger – have basic ICT proficiency comparable to third-generation Canadians, and second-generation Canadians on average have better problem-solving skills using digital tools than the third-generation. However, this advantage is entirely accounted for by different levels of education, consistent with Aydemir and Sweetman (2008). Overall, the results suggest that although adult immigrants disproportionately fill ICT-related positions, they are on average not as proficient in basic ICT skills as Canadians by birth and young immigrants.

More importantly, we observe an appreciable economic return in the labour market to having modest levels of even the basic ICT skills (as opposed to no ICT skills whatsoever or very minimal skills), and this return exists even after taking literacy and numeracy into account. That is, even though our measure of ICT skills encompasses only very basic tasks, our evidence suggests that there is a very substantial earnings premium at the very low end of the scale. This return exists even controlling for literacy and numeracy. Although our observations are non-causal, they point out the substantial potential economic value of ICT skills beyond the most basic levels for immigrants and non-immigrants alike. If the results reflect, even in part, a causal impact of these skills, then programs to provide very basic ICT skills would have a substantial rate of return. These skills could potentially be incorporated into the curriculum of English and French language training programs already offered to new immigrants at low (or zero) cost. Such basic skills seem to be associated

with workers who are far from specialists, but who engage in the digital economy in a manner that is rewarded in the labour market. Moreover, the introduction of these extremely basic skills could be incorporated into many skills training programs provided by, for example, the Employment Insurance Part II for the general population. This needs not to be an expensive undertaking; it could be accomplished by adjusting the curriculum of existing programs.

Our analysis suggests that a one-standard-deviation increase in the basic ICT score, on average, translates into seven percent higher earnings for both men and women. We also find that the labour market rewards foundational ICT skills proficiency at the same rate for immigrant and Canadian groups within gender. The earnings gaps between each immigrant category relative to third-generation Canadians are rendered statistically insignificant when controlling for ICT, literacy and numeracy test scores. Both young immigrants who undertake a substantial portion of their education in Canada and second-generation Canadians have similar problem-solving abilities in technology-rich environments as their third-generation counterparts and make a marked contribution to the ICT workforce.

The remainder of this chapter is organized as follows. Section 1.2 describes the data used in the analysis. Section 1.3 discusses the analytical framework. Section 1.4 discusses the results, and section 1.5 concludes.

1.2. DATA DESCRIPTION AND SUMMARY STATISTICS

We use Statistics Canada's 2012 Survey of Adult Skills, which is a product of the OECD's PIAAC (OECD 2012, 2013a, 2013b). It collects information on labour supply, wages, education, and a range of demographic characteristics. Crucially, it assesses three

"key information-processing competencies" of individuals by evaluating their proficiency in literacy, numeracy, and problem-solving in technology-rich environments (i.e., basic ICT skills; OECD 2013a). We focus on the last of these components, which assesses how effectively individuals use ICT tools to solve simple tasks, rather than measuring advanced ICT skills (Rouet et al. 2009). The measurement scale ranges from zero to 500. PIAAC 2012 uses classical item response theory and a multiple imputation method to derive ten plausible values for each test score. Also, a survey weight is provided for each respondent.

Appendix Table A.1.1 examines the correlation between the three tests for various subsamples of the data. The results are similar across subsamples. For the entire sample literacy and numeracy are the most highly correlated at 0.87, whereas numeracy and the basic ICT score are the least correlated at 0.75. It is unclear to what extent the tests measure the same underlying skills versus the degree to which distinct underlying skills are positively correlated across individuals.

Our sample for analysis includes 16,379 individuals aged 22-59 years, who have valid information on all relevant variables other than the ICT score. Among these, 13,547 have valid ICT scores.[3] For some of the analysis, we also categorize workers into ICT and non-ICT occupations and industries as defined in Appendix Table A.1.2. However, the sample size is too small to permit us to look at ICT occupations within ICT industries. Because of a concern that high earning outliers may be driving some of the results, in the body of this chapter we use data with the top half of one percent of earnings Winsorized.

[3] Only those who completed the computer-based core assessments are assessed for ICT skills because test takers need to at least be familiar with graphical interfaces. However, literacy and numeracy scores are available for a wider group because non-ICT respondents write paper-based literacy and numeracy assessments. A small number of people refuse to attempt the computer-based assessment.

That is, all earnings in the top 0.5 percent are capped at the 99.5 percentile of earnings. The Appendix presents a number of tables that do not use this restriction, and the results are, despite this concern, essentially unchanged.

By immigration status and sex, Table 1.1 displays mean test scores and employment distributions for ICT and non-ICT occupations and industries. Focusing first on the employment distribution across occupations for male immigrants, it can be seen in Table 1.1 that about 11.0 percent of immigrant men work in ICT occupations, compared to only about 5.2 percent of Canadian-born men. Male immigrants are disproportionately employed in ICT occupations. When the sample is restricted to those with an ICT score, the percentage of immigrant men in the ICT occupations increases to 13.7 percent, whereas the Canadian-born share increases only slightly to 5.8 percent. That the share of workers in ICT occupations increases, and increases more considerably for immigrants, reflects the dissimilar probabilities of respondents having insufficient skills to do the ICT test. These issues are pursued in Tables 1.2 and 1.7.

In contrast to men, immigrant and Canadian-born women are approximately equally likely to work in ICT occupations, but for both the probabilities are only about two percent. Looking at the test scores, workers in ICT occupations have higher basic ICT, literacy and numeracy scores compared with those not in ICT occupations. Also, in the ICT industry, Canadian-born individuals have higher average scores in all three categories than do immigrants.

Turning to industries, in the lower half of the table, immigrant men are again more likely to work in ICT than Canadian-born men, although the reverse is true for women.

Note that each industry includes a wide variety of occupations (e.g., an accountant or janitor might work for a firm in an ICT industry). The patterns of test scores are broadly similar for men by industry as occupation, but the pattern is less clear-cut for women.

In terms of immigration status, as depicted in the columns of Table 1.2, we classify the population into the nine exhaustive and mutually exclusive categories of refugees, points-based immigrants, family-reunification immigrants, and other immigrants (including, e.g., the live-in-caregiver stream and unknown or refused); temporary residents; young immigrants (arrived at age 12 years or younger regardless of their parents' immigration class); and Canadians by birth who are born abroad or are in the second- or third-generation. Separately, those who do not have basic ICT scores are grouped into four categories: no prior computer experience, failed ICT core tests, refused to attempt computer-based assessment, and others with no ICT score. Because Statistics Canada does not clearly define this last (very small) group, we exclude these individuals from our sample.

The percentage of each subgroup not taking the computer-based assessment, the distribution of scores of those taking it, and the population share of each subgroup are presented in Table 1.2. Approximately 38 percent of those in both refugee and family reunification categories did not take the ICT test (a dramatically higher rate than that for young immigrants or the second generation). Large differences in the distribution of levels of basic ICT skills can also be seen across these groups for those able and willing to take the test. Roughly 48–55 percent of young immigrants, the second generation, and Canadians by birth born outside of Canada are likely to score in the highest third of test

takers, whereas only seven percent of refugees and 15 percent of family reunification immigrants are likely to do so. Surprisingly, only 29 percent of points-based immigrants who wrote the test scored in the top third. Overall, there are dramatic differences in ICT usage and basic skills across these population categories. Although we can only speculate about the relationship between specialist ICT skills and these basic skills, some concerns may be warranted regarding ICT specialists, many of whom, as will be seen, are in the points-based immigrant stream and are unable to score in the highest category on this relatively simple test.

Table 1.3 shows average characteristics by population subcategory. The upper part of the table shows average literacy, numeracy, and basic ICT scores. Apart from those who arrived at a young age, immigrants (even points-based immigrants) have, on average, lower scores than the Canadian categories for all three tests. Looking at the demographic characteristics, the average age at immigration for young immigrants is around six years, so most received the bulk of their formative education in Canada. As has been observed previously (e.g., Sweetman and van Ours 2014), the Canadian education system appears quite effective in integrating young immigrants. For Canadians by birth born outside of Canada, age at immigration should be interpreted as the average age at which they permanently moved to Canada. Also notable is that temporary residents are, on average, five to 11 years younger than individuals in other categories. Immigrants in the refugee, family reunification, and other immigration categories, as well as temporary residents, have noticeably lower average wages than all the others. Finally, foreign-born individuals are much more likely to reside in large urban population centres; compared to the third

generation, these groups on average operate in relatively different labour markets and face different competition in the labour market.

Turning to education, in the bottom panel of Table 1.3, approximately 65 percent of points-based immigrants hold a bachelor's degree or higher, which is by far the highest proportion across categories and contrasts with their test scores further up the column. However, the educational distribution of the third generation and refugees is quite surprisingly similar, with only about 24-25 percent having at least a bachelor's degree. Among those with a postsecondary degree, the proportion whose field is in science, technology, engineering, or mathematics (STEM) is markedly higher among the points-based category than any other, with temporary residents having the second-highest share. Refugees with a college or trade diploma have a higher percentage with a STEM field of study than do either the second- or third-generation Canadians with diplomas. Most immigrants, except for young immigrants, complete their highest level of education outside of Canada. The vast majority of young immigrants and the second and third generation attain their highest level of education in Canada, with Canadians by birth born outside of Canada having an intermediate percentage.

The PIAAC includes a variety of useful questions regarding computer use at work that are analyzed in Table 1.4 for those employed at the time of the survey.[4] Each question is, or is converted into, a simple yes (dependent variable equals 1) or no (dependent variable equals zero) question, and the models are estimated using a linear probability model.[5]

[4] Appendix Table A.1.3 has a similar table for the larger set of those employed at any time during the 12 months before the survey. The results are similar.

[5] Nonlinear models, such as *probit*, are not used, given the plausible values aspect of the data and because heteroscedasticity of unknown form is a potential problem.

Coefficients from a set of age-adjusted regressions exploring differences across the population groupings are presented (with two sets of population subgroups, as seen in Table 1.4) with the female variable interacted with each of the population subgroup variables. The age variable is adjusted by subtracting 40 from each respondent's age so that the constant reflects the probability of a positive response for an average person in the omitted or comparison group: a 40-year-old male third-generation Canadian. All other population subgroup coefficients represent average age-adjusted differences relative to that category.

As seen in Table 1.4, among men, points-based and young immigrants and the second generation are statistically more likely than the Canadian-born third generation to use a computer at work, whereas refugees or family reunification immigrants are less likely to do so (with some groups collapsed for sample size considerations). With exceptions, this basic pattern continues for men across the next three columns looking at the use of email, spreadsheets, and word processors. Subsequent columns address highly skilled ICT tasks: whether respondents undertake computer programming at work or whether their job requires complex ICT skills. In these cases, point-based immigrants have a uniquely high probability of working in jobs requiring these more technical ICT skills – for points-based immigrants; this is a nontrivial difference illustrating immigrants' connection to the ICT sector (IRCC 2017). However, the differences across the other population subgroups are much smaller and statistically insignificant. Although they are more likely to use a computer at work, young immigrants and second-generation Canadians have an equal probability of working at jobs that require complex ICT skills compared to the third generation. Paradoxically, but perhaps consistent with the results seen in the previous

tables, points-based male immigrants are more likely to report lacking the requisite ICT skills for getting a new job or a promotion, although they report a similar (marginally higher) probability of having sufficient ICT skills for their current positions compared to the third generation.

Turning to women, the third generation is more likely to use a computer and to do word processing at work than their male counterparts, but less likely to program computers or to have a job requiring complex ICT skills. It is perhaps surprising that points-based female immigrants are not more likely to use computers at work than third-generation women, and they are less likely to be employed in jobs requiring complex ICT skills. Indeed, all female groups are less likely to have jobs requiring computer programming or complex ICT skills than third-generation men.[6]

For both sexes combined (because of the limited sample size), Figures 1.1 and 1.2 present nonparametric kernel density plots of the distribution of ICT scores for each of the immigrant groups compared, in each case, with the third generation, which serves as a benchmark. Figure 1.1 looks at the subpopulation with a high school diploma or less, and Figure 1.2 focuses on those with a bachelor's degree or higher. It is evident from these figures that analyses of the means of the distributions mask substantial heterogeneity.

Nevertheless, for some of these groups, the distributions have quite different shapes, with the differences almost everywhere being more substantial among those with a higher level of education (except for the young immigrants and the second generation, which have

[6] Appendix Tables A.1.4 and A.1.5 examine the probability of working in an ICT industry or occupation in a framework similar to that in Table 1.4. For men, points-based immigrants and other immigrants are more likely to work in an ICT industry, and points-based immigrants and young immigrants are more likely to work in an ICT occupation.

distributions virtually identical to those of the third generation in both education categories). Universally, the Canadian-born third generation with at least a bachelor's degree has a distribution of ICT skills, as measured by this OECD metric, that is equivalent to or to the right/higher than (stochastically dominates) those of the other groups. Interestingly, the distribution of ICT skills for points-based immigrants looks somewhat similar for those with high school and university education. Indeed, the distribution for both looks very similar to that for the third generation with high school but recall that the samples are restricted to those with sufficient skills to write the test.

1.3. EMPIRICAL FRAMEWORKS

Our analysis begins by examining the correlates of the basic ICT (i.e., problem-solving in technology-rich environments, or PSTRE, skills) scores by population subcategory. Subsequently, we look at earnings gaps across the categories, in turn looking at the subsample of those with basic ICT scores and then the entire population, documenting how the gaps alter when ICT skills are considered. In all cases, an alternative set of regressors are included to understand the associated relationships. These regressors are entered cumulatively from left to right, so the leftmost model is the base case and each subsequent model has the same regressors of that to its left plus additional ones. Interactions of various regressors are also undertaken in some specifications. The analysis is conducted separately for men and women.

First, for each self-reported sex we estimate:

$$\text{BasicICT}_i = \beta_0 + \boldsymbol{PopGroup_i\beta_1} + X_i\beta_2 + \epsilon_i, \quad (1.1)$$

by ordinary least squares (OLS), where $BasicICT_i$ are individual PSTRE scores. For interpretation, it is important to note that whereas in the descriptive statistics to this point we have presented simple test scores, in the regressions we standardize all three test score variables to mean zero and standard deviation of one.[7] Where relevant, therefore, the units of measure of the coefficients involve standard deviations of test scores. The nine population subgroups are represented by, **PopGroup**, a vector of indicators with the third generation omitted, and *X*, a vector of control variables which change across specifications. Covariates include age and age^2, education (below high school, high school diploma, post-secondary education (PSE) below Bachelor's (college or trade school), and PSE with a bachelor's degree or higher), and geography (11 provincial indicators and four urban-rural ones). We control for whether individuals obtained education in a foreign country and whether an individual graduated with a science, technology, engineering, or mathematics degree. The foreign education indicator is individuals' self-reported highest level of qualification attained outside of Canada. As indicated in Table 1.3, a large proportion of immigrants and a quarter of individuals who are Canadians by birth born outside of Canada obtained their highest level of education in a foreign country. A small percentage of second- and third-generation Canadians attained their education in a foreign country. By design, we do not account for years since migration, because we are interested in differences holding age constant. We address age at immigration (which is jointly collinear with years since migration and age) by separating our sample into adult and child immigrants. In some specifications, we include interactions between foreign education and the highest education

[7] We standardize the basic ICT test score using relevant statistics for individuals who have valid test scores.

attainment. The β's are coefficients to be estimated and ε is a possibly heteroskedastic error term. The vector of coefficient β_1 shows the average standard deviation PSTRE scores of each immigration category. Because PIAAC 2012 requires individuals to have computer skills and language ability to identify and solve problems given to them in PSTRE and because all test scores are highly correlated, β_1 picks up differences in both basic computer skills and language ability among immigrants and Canadian categories.[8] Because of the cross-sectional nature of our data, we are unable to clearly distinguish aging and cohort effects of the coefficient on age.

In the second part of the analysis, we estimate the following individual-level wage regression, by sex:

$$ln(\text{HourlyWage}_i) = \gamma_0 + \boldsymbol{BasicICT_i\gamma_1} + \mathbf{PopGroup}_i\,\boldsymbol{\gamma_2} + X_i\gamma_3 + \mu_i, \qquad (1.2)$$

where $\ln(HourlyWage_i)$ is the natural logarithm of gross hourly wages earned by individual *i*, the γ's are coefficients to be estimated and μ is a potentially heteroskedastic error term.[9] Hourly wages at the top 0.5 percent are recoded to CAD 112.98.[10] In subsequent specifications, the **BasicICT** and selected *X* variables are added to observe how the ***PopGroup*** coefficients change. Similarly, the **BasicICT** scores are standardized scores. Test scores are specified linearly; as shown later in Table 1.7 this misses an

[8] The mean standard deviation differences between immigration categories (β_1) can be biased due to measurement errors and omitted values. Measurement errors arise because of the imputation method of plausible values. Furthermore, omitted-variable bias may affect the results because of unobservable characteristics, such as personality traits, financial ability (partially helps determine immigration category and location of resident), and non-cognitive skills, could influence differences in basic ICT scores among these individuals.

[9] Self-employed respondents and individuals with missing hourly wage information are excluded in the earnings regressions.

[10] In additional regressions that are shown in Appendix Table A.1.12 and A.1.13, we used hourly wages that are not recoded. The results remain essentially unchanged.

important nonlinearity, but experiments with various specifications find it to be a compact approach to presenting the results that does not appreciably affect the findings of interest. The coefficient γ_1 can be interpreted as the percentage change in hourly wages with a one-standard-deviation increase in basic ICT scores. Equation 1.2 is estimated on two distinct sub-samples of respondents with valid hourly wages: initially those with an ICT score and subsequently the entire population, using as regressors those variables at the top of Table 1.2 that indicate why individuals do not have an ICT score. Contrasting across these two regressions allows us to understand the labour market outcomes of those without ICT scores relative to those with them. Of relevance to both models is that the survey design and prerelease data preparation are quite complex (and somewhat opaque). Notably, no individual has a single **BasicICT** score. Rather, everyone has ten individual-specific "plausible values" for PSTRE. These plausible values are designed to provide information not about individuals, but about the subpopulations they represent. Thus, estimated coefficients are calculated using all ten plausible values, and the delete-one jackknife method is used to calculate standard errors for inference.[11]

We further look at the sample of individuals with valid hourly wage, regardless of whether they have valid basic ICT scores. We separate individuals into six categories: no prior computer experience, failed ICT core test, refused to take computer-based tests, low basic ICT scores (< 241 points), medium basic ICT scores (241 to < 291 points), and high basic ICT scores (≥ 291). Other covariates are described as above.

[11] Please refer to OECD (2013a) for the recommended jackknife procedure to obtain coefficients and standard errors.

1.4. RESULTS

1.4.1. Differences in basic ICT scores between immigrant and Canadian-by-birth categories

In Table 1.5, we compare ICT scores for different subpopulation groups with those of the third generation. Columns 1 and 5 show base OLS results for men and women, respectively, controlling only for age and its square. Consistent with the findings in Table 1.2, adult immigrants are found to have lower average ICT scores compared to third generation Canadians. Perhaps surprising, given the results in Tables 1.3 and 1.4 showing that they have higher levels of education, points-based immigrants are more likely to work in jobs requiring complex ICT skills and to live in urban areas; among immigrants selected through the points system, for which the principal applicant (most commonly a man for families) is assessed, men score about 0.18, and women score about 0.41 standard deviations below those of third-generation Canadians of the same age, which is an appreciable gap.[12] Among both men and women, all adult immigrants and temporary residents score lower than third-generation Canadians. In contrast, young immigrants and Canadians born overseas have point estimates that are positive in three of four instances, although the coefficients are not statistically significantly different from zero. This is consistent with Schaafsma and Sweetman (2001) and Hou and Bonikowski (2016), who suggest that young arrivals have, on average, outstanding labour market outcomes. Second-

[12] We thank a referee for suggesting that the ICT score deficiency may be concentrated among immigrants not working in jobs using ICT skills. Appendix Tables A.1.6 and A.1.7 in turn look at the differences in basic ICT scores for individuals who use a computer or who use programming and complex ICT skills at work. The coefficients for immigration subgroups remain negative, but some are no longer statistically significant at conventional levels. However, the coefficients for points-based immigrants are statistically significantly negative for men and (usually) for women. The ICT skill gap appears to exist in various contexts.

generation women score statistically significantly higher than their third-generation counterparts of the same age.[13]

Adding control variables for highest educational attainment, plus province and rural-urban residence, in columns 2 and 6 of Table 1.5 increases the magnitude of the gaps for all adult immigrant categories. Immigrants have, on average, not only lower scores controlling just for age but much lower scores relative to the third generation given their education and location of residence.

Columns 3 and 7 introduce a coefficient for having a STEM degree, as well as interactions between the education variables with having received one's highest level of education outside of Canada. Universally, the population subgroup test score gaps narrow relative to the previous columns. The coefficients on foreign education level for both sexes are negative but statistically insignificant. Recall from Table 1.3 that just less than 75 percent of points-based immigrants completed their highest level of schooling outside of Canada and that the share for all the other groups, except temporary residents, is lower.[14]

[13] An F-test of the interaction between working in an ICT industry (occupation) and the population subgroups suggests that coefficients on these interaction terms are jointly insignificant. That is, there are no statistically significant differences in the pattern of ICT test scores across population subgroups for those working in and outside of these industries (occupations). Of course, this could be partly due to small sample sizes.

[14] Appendix Table A.1.8 explores relationships with the countries where the highest education was attained. We group countries of highest education into Canada, English-speaking countries (United Kingdom, United States, Australia, etc.), non-English speaking European countries, East and Southeast Asia, the rest of Asia, and other countries (including missing). When country grouping variables are added, the coefficients on the population subgroups remain similar to those in Table 1.5. However, individuals with foreign education, except for those who obtained their degrees in English-speaking countries, who have higher scores without conditioning on education, now score significantly lower on basic ICT compared with their counterparts who obtained their highest degree in Canada. The difference in basic ICT scores between individuals who obtained their education in Canada versus other English-speaking countries is accounted for when we control for level of education. The differences are generally larger for women than men. We also interact level of highest education with the country groupings. However, the sample size is small and the coefficients on most interaction terms are (except for the English-speaking group) negative but not statistically significant.

Men with a Canadian university-level STEM degree and women with a college or trade school diploma or university degree in STEM have higher ICT scores. The estimates for the interaction of STEM with foreign education are negative, economically large, and statistically significant for men with university education. For women, the point estimates are negative but not statistically significant. Overall, except for men with Canadian STEM diplomas at a college or trade school, this seems to suggest that those with Canadian STEM credentials have higher ICT scores than those without such credentials. However, this is, surprisingly, not the case for those with foreign STEM degrees or diplomas. Foreign university degrees, those in STEM for men, appear to be associated with appreciably lower basic ICT scores than those with similar Canadian degrees.

Finally, columns 4 and 8 introduce the literacy and numeracy scores as predictors of ICT scores. As noted earlier, the three are highly correlated. Thus, the R-squared for both regressions is substantially higher than for those previously estimated. Adding these two variables renders all other coefficients statistically insignificant for men, except for – quite importantly – the interaction for men who have a foreign university degree in STEM, for which the coefficient remains large and statistically significantly negative. Foreign university STEM degree holders appear to have deficits in basic ICT skills that go beyond literacy and numeracy.

The relationship for women is somewhat different. The points-based and family reunification category coefficients remain statistically significantly negative, as does the bachelor's coefficient. The pattern of ICT skills is different for men and women; that is not

surprising given the evidence in the preceding tables regarding the differing propensity to work in ICT.

These results imply that points-based immigrants and those with foreign, especially non-English, university degrees in STEM, appear not to be as proficient in using digital technologies to solving problems as the Canadian educated. It is worth recalling that this is part of the OECD's international measurement effort and is not measuring Canada-specific ICT skills. Nevertheless, in the Canadian context, the tests are written in English or French, and English or French language difficulties may obscure the ability to communicate the existence of basic ICT skills. Since Canadian workplaces rely on knowing English/French, any such skills that are not captured by this measure (should they exist) may not be readily usable in the workplace. Similar to the argument in Warman et al. (2015), language skills may mediate the applicability of other skills. However, there may be situations in which workplace communication need not be in English or French, although this likely limits relevant workers' range of job opportunities.

1.4.2. Earnings gaps with and without controlling for basic ICT scores

1.4.2.1. Individuals with valid hourly wage and basic ICT scores

Table 1.6 shows results pertaining to the determinants of log hourly wages by sex. In this analysis, we include in the sample individuals who have valid ICT scores and hourly wages.

The estimates in columns 1 and 5 of Table 1.6 compare earnings across population categories conditional only on age.[15] Subsequent columns introduce additional controls, and the analysis is, in part, interested in changes in the population category coefficients across specifications. Controlling only for age, male and female points-based immigrants have hourly wages comparable to those of the third generation. Family reunification and temporary residents have lower hourly earnings than the third generation. For women, additional coefficients are statistically significant.[16]

Columns 2 and 6 add controls for education, including interactions with foreign-education, and the province and rural-urban residence. The gaps relative to the third generation for points-based male immigrants grow more negative and become statistically significant. This largely reflects points-based immigrants having higher levels of education. Once controls for education are added, points-based immigrants are expected to have higher earnings.

We introduce basic ICT scores in columns 3 and 7. A one-standard-deviation increase in ICT scores is associated with about a seven-percent increase in wages, with both men and women receiving identical rates of return on ICT skills. Additional specifications akin to columns 3 and 7 introduce interactions of each of the nine population categories with the ICT skills measure. F-tests fail to reject the null hypothesis that the rate of return to ICT skills is the same for all the population groups (p-value = 0.678 for men and 0.720

[15] See also Appendix Table A.1.9 for similar regressions where the first two specifications have a larger sample size since observations with missing data for regressors used in the final two models are not excluded. A larger number of coefficients are statistically significant.
[16] The Appendix Table A.1.9 has a larger number of statistically significant results.

for women). The labour market also seems to reward these skills at an equal rate for all groups within each sex.

Literacy and numeracy test scores are introduced in columns 4 and 8. Of course, these are highly collinear with each other and with the ICT scores. Nevertheless, a one-standard-deviation increase in numeracy scores translates into eight percent and five percent higher in earnings for men and women respectively, even when ICT skills and literacy are considered. Numeracy appears to have a strong independent and appreciable impact on earnings. Controlling for all test scores renders all the population group coefficients statistically insignificant. However, having a foreign education, especially PSE, continues to be associated with lower earnings.[17]

Looking at the education control variables, even with all three test scores in the regression, education, and particularly university education, still affects earnings as does having a STEM diploma at a college or trade school for men. The value of higher education goes beyond basic test scores. Almost universally, foreign education seems to have a lower return than that obtained in Canada. Although specified differently, rendering the results not entirely comparable, these results differ qualitatively from some of the earlier literature

[17] In additional regressions, not presented, like columns (2) and (6) of Table 1.6, we introduce a dummy variable indicating whether an individual works in an ICT industry and interaction terms between this indicator and the immigration classes. men who work in the ICT industry obtain a 10-percent premium compared to their counterparts in other industries. In contrast, women working in ICT do not enjoy such a premium. These results remain unchanged when controlling for covariates as in columns (3) and (7) or columns (4) and (8). For men, an F-test cannot reject that Canadians and immigrants have the same earnings in the ICT industry (p-values from 0.25 to 0.44 for different specifications). Similarly, for women, p-values range from 0.15 to 0.34 for different specifications. None of the individual coefficients on the interaction terms for women remains statistically significant, except for that of young immigrants.

such as Ferrer, Green and Riddell (2006), who find that test scores explain much of the difference in the rates of return to education for immigrants and the Canadian-born.[18]

1.4.2.2. Individuals with valid hourly wage, but ICT score may be missing

Table 1.7 is similar to Table 1.6, but it includes respondents who did not write the ICT test and also relaxes the linear specification of ICT scores. We separate individuals into six mutually exclusive and exhaustive categories: no prior computer experience; failed ICT core test; refused to take computer-based tests; and low (< 241 points; the omitted or reference group), medium (241 to < 291 points), and high (≥ 291) basic ICT scores. As in Table 1.6, the first column for each sex does not control for the education and geographical variables; these covariates are added in columns 2 and 5, and those for literacy and numeracy scores are subsequently included in columns 3 and 6.[19]

In these regressions, those undertaking the basic ICT tests, and scoring in the bottom category, are the base group against which others are compared. In column 1, men who reported no computer experience have the lowest earnings of all six categories, and those who refused the preliminary ICT test that would determine whether the computer-based test was feasible to have earnings comparable to the lowest scoring group. In contrast, the coefficients for all three reasons for not taking the computer-based test are not statistically

[18] One concern expressed by a referee is that the test scores, and particularly the basic ICT test score, measured skills that are sufficiently basic to have little systematic variation among Canadian university-educated workers, and no influence on their earnings. We address this issue in Appendix Table A.1.10, which restricts the sample to Canadian and young immigrant workers with exactly a bachelor's degree. For each of the three test scores, two regressions are run: first controlling only for age and second with a larger set of controls. For all three test scores, in the model controlling only for age, the rate of return to each is positive and statistically significant. In each case, the coefficient is slightly attenuated with additional control variables, and it becomes statistically insignificant for basic ICT and literacy but remains to significant for numeracy. Overall, we take this as evidence that these measures have some information value even for this small, homogeneous and highly educated sub-group.

[19] See Appendix Table A.1.11 for similar specifications but with alternative functional forms.

significant for women (although the coefficient for those with no computer experience is estimated very imprecisely). That indicates that, for women, the earnings of these three categories of those for whom we do not have an ICT score are on average not statistically different from those in the lowest ICT score category (< 241 points), whereas having no computer experience seems deleterious for men.

The results in Table 1.7 also suggest that higher than minimum basic ICT scores leads to markedly higher earnings. Interestingly, the ICT coefficients for men and women are broadly similar. Although attenuated compared to the models in columns 1 and 4, the earnings advantage persists when we control for education in columns 2 and 5 and, remarkably, even when we control for both literacy and numeracy skills in columns 3 and (6). The last results contrast with those from Table 1.6, where the return to basic ICT skills was rendered statistically insignificant by the introduction of literacy and numeracy. We attribute the difference to functional form issues. It seems plausible that there are nonlinearities that cannot be captured in a low-order polynomial. Having very low levels of ICT skills is associated with a substantial earnings deficit: if there is a causal link, the attainment of quite modest ICT skills would bring appreciable benefits.

Turning to the population subgroup coefficients, for both sexes, the pattern of coefficients in columns 1 and 4 show that most immigrant groups have negative point estimates that are sometimes quite large and statistically significant. However, and in contrast to the earlier results, both points-based and young immigrants now have coefficients that are small and statistically insignificant. Also, except for second-generation female Canadians in the absence of controls, the coefficients for the two Canadian groups

included in the regression are not different from the omitted third generation. The coefficients on education, although somewhat different from those in Table 1.6, tell a similar story except for university graduates in STEM, for which the coefficient is now close to zero and statistically insignificant. Men with foreign degrees, and especially foreign STEM diplomas at the college or trade school level, appear to have sizable earnings deficits even after controlling for the various measures of skills.

1.5. CONCLUSION

This essay focuses on the basic ICT skills used in everyday life rather than advanced ICT skills used by experts, although it is hard to believe that individuals would have advanced skills without these foundational ones. At least, highly specialized individuals able to use specific advanced ICT skills without basic skills are likely to have few opportunities for advancement and alternatives in the labour market should their current employment end. We look at individual proficiency in ICT in all sectors of the economy, as opposed to just ICT industries and occupations, although we also address those areas. The data suggest that basic ICT skills are broadly valued in the labour market – their reputation as general-purpose technology seems warranted. Higher basic ICT skills are associated with appreciable increases in earnings. Of course, these skills are highly correlated with a range of other skills.

The data show that male immigrants are disproportionately likely to be working in ITC occupations and industries. Even so, on average their basic ICT skills level is not as high as that of Canadian-born individuals. Although we can say nothing about exceptional individuals (industry leaders) in this type of analysis, the broad-based ability to solve

problems in the technology-rich environment should be of concern to government and all of society. This chapter demonstrates that the labour market rewards basic ICT proficiency equally across immigrant status and sex. However, the data suggest that immigrants educated outside of Canada – even those entering in the points-based class – are, on average, not as proficient in basic ICT skills as third-generation Canadians. This may be hindering their integration into the labour market. One interpretation of these findings is that adult immigrants would benefit from even minimal levels of basic ICT skills development. Such training might, for example, be built into the curriculum of the language training courses offered to new immigrants. Indeed, all Canadians without such skills would benefit from such training, which could be introduced into programs, such as those provided by Employment Insurance Part II, perhaps at a minimal cost. However, young immigrants and second-generation immigrants have excellent outcomes that are on par with the third generation.

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Table 1.1. Average test scores and employment distribution in ICT occupations and industries

	Male				Female			
	Immigrant		Canadian Born		Immigrant		Canadian Born	
	ICT	Non-ICT	ICT	Non-ICT	ICT	Non-ICT	ICT	Non-ICT
Occupations								
Basic ICT	297.96	271.21	318.45	286.28	292.42	264.86	303.47	286.26
s.d.	41.19	47.34	36.31	44.88	33.19	47.74	34.23	42.72
s.e.	(4.94)	(2.50)	(3.93)	(1.10)	(9.75)	(2.42)	(5.53)	(1.26)
Literacy	294.60	268.45	311.31	287.06	289.29	263.29	301.91	285.47
s.d.	42.12	47.52	37.08	44.99	45.26	47.73	31.60	43.59
s.e.	(5.17)	(2.17)	(4.43)	(1.12)	(12.58)	(2.10)	(4.72)	(1.15)
Numeracy	304.34	271.61	313.47	287.48	285.91	255.23	291.51	272.45
s.d.	43.55	52.67	41.63	48.47	43.11	51.59	35.67	46.62
s.e.	(5.04)	(2.53)	(5.21)	(1.14)	(10.82)	(2.20)	(5.26)	(1.22)
Empl. Distn.-With ICT score (%)	13.67	86.33	5.77	94.23	2.79	97.21	2.31	97.69
Empl. Distn.-All (%)	10.93	89.07	5.17	94.83	2.11	97.89	2.13	97.87
Industries								
Basic ICT	295.40	271.04	310.49	263.78	287.36	285.62	302.43	285.20
s.d.	39.45	47.83	39.48	47.76	39.92	44.96	38.63	42.67
s.e.	(4.48)	(2.50)	(3.64)	(1.08)	(5.63)	(2.54)	(3.22)	(1.29)
Literacy	293.05	268.11	309.28	261.92	288.62	286.12	300.53	284.49
s.d.	41.92	47.66	40.25	47.64	43.27	44.83	37.59	43.67
s.e.	(4.11)	(2.14)	(3.81)	(1.08)	(5.57)	(2.28)	(3.11)	(1.18)
Numeracy	300.08	271.62	309.65	253.73	283.65	286.65	288.80	271.42
s.d.	45.52	52.78	46.62	51.30	47.07	48.14	40.72	46.71
s.e.	(4.60)	(2.65)	(4.03)	(1.18)	(6.75)	(2.35)	(3.52)	(1.32)
Empl. Distn.-With ICT score (%)	15.68	84.32	10.10	89.90	7.86	92.14	8.45	91.55
Empl. Distn.-All (%)	12.73	87.27	9.05	90.95	6.34	93.66	7.93	92.07

Source: PIAAC 2012. Authors' calculations.

Notes: ICT occupations and industries defined in Appendix Table A.1.1. Weighted sample of 16,379 for the "all" employment distribution and 13,447 elsewhere. Empl. Distn.=Employment Distribution; s.d.=standard deviation; s.e.=standard error.

Table 1.2. Percentage of individuals across different levels of basic information and communication technology (ICT) by subpopulation category

	Refugee	Points-Based Immig.	Family Reuni-fication	Other Immig. Programs	Temp. Resident	Young Immig.	Canadians by Birth Born outside Canada	Second Gen. Canadian	Third Gen. Canadian
Reason for not taking computer-based tests									
- No computer experience	11.86	1.40	10.76	2.93	2.91	2.43	4.27	1.02	3.70
- Failed ICT core tests	15.37	10.23	13.43	8.08	9.06	4.32	1.48	3.59	4.75
- Refused computer-based assessments	11.06	5.80	14.01	7.31	7.04	3.99	8.84	4.11	5.56
Subtotal	38.29	17.43	38.21	18.32	19.01	10.74	14.58	8.72	14.01
Levels of basic ICT test scores									
< 241 (low)	29.12	19.13	23.29	23.77	26.89	10.60	10.29	9.77	12.94
241 to < 291 (medium)	25.15	34.93	23.80	27.26	25.09	30.56	20.34	29.68	32.39
≥ 291 (high)	7.44	28.51	14.71	30.65	29.03	48.10	54.79	51.82	40.67
Population shares	1.67	8.08	7.75	1.67	1.98	4.96	1.56	14.94	57.39

Source: PIAAC 2012. Authors' calculations.

Notes: These are weighted percentages of 16,379 individuals, aged 22 to 59, for each category of immigrants across different levels of basic ICT scores. Second generation Canadians are individuals who were born in Canada to at least one foreign-born parent. This category excludes Canadians who were born overseas to at least one foreign-born parent. Third generation Canadians are individuals who were born in Canada to Canadian-born parents. Young immigrants are defined as immigrants who arrived aged 12 or younger in all immigration classes. Immigrants in other categories are 13 or older when they arrived in Canada. Immig. = immigrant; Gen. = generation; Temp. = Temporary

Table 1.3. Average characteristics of individuals by subpopulation category

	Refugee	Points-Based Immig.	Family Reuni-fication	Other Immig. Programs	Temp. Resident	Young Immig.	Canadians by Birth Born outside Canada	Second Gen. Canadian	Third Gen. Canadian
Average test scores									
Literacy	225.58	267.39	235.31	266.09	242.49	281.96	278.42	290.53	281.78
s.d.	55.59	49.66	55.70	48.96	60.01	48.53	54.23	44.78	46.95
Numeracy	220.27	270.17	223.70	257.53	238.92	273.61	275.53	279.54	274.01
s.d.	56.70	55.25	61.17	53.22	66.42	55.32	59.40	51.56	51.32
Basic ICT	242.29	273.08	256.88	267.71	262.85	290.63	295.38	293.23	285.56
s.d.	45.22	44.44	46.82	50.56	52.23	42.55	45.49	42.09	44.12
Demographic characteristics									
Average hourly wage	21.77	29.23	21.48	23.16	20.83	30.28	26.46	29.40	28.16
Average age	44.48	42.60	42.15	42.41	33.33	38.54	39.80	39.94	41.46
Average age at immigration	28.31	31.29	25.38	26.54	27.80	6.02	12.76	n/a	n/a
Proportion of male	0.63	0.54	0.42	0.47	0.48	0.49	0.50	0.51	0.51
Proportion living in									
Small urban population center	0.01	0.02	0.02	0.04	0.03	0.06	0.06	0.10	0.16
Medium urban population center	0.03	0.03	0.02	0.04	0.03	0.04	0.07	0.08	0.12
Large urban population center	0.96	0.93	0.93	0.84	0.93	0.85	0.76	0.67	0.49
Education characteristics									
< HS	12.18	3.60	18.09	9.05	12.40	5.70	10.94	6.45	11.25
HS	26.15	8.98	23.37	11.71	22.70	17.10	23.56	20.85	22.79
College/Trade (C/T)	36.71	22.41	27.87	33.68	21.41	39.80	34.91	41.26	41.84
≥ Bachelor's degree	24.97	65.01	30.67	45.58	43.49	37.39	30.60	31.44	24.13

(continued)

Table 1.3. continued

	Refugee	Points-Based Immig.	Family Reuni-fication	Other Immig. Programs	Temp. Resident	Young Immig.	Canadians by Birth Born outside Canada	Second Gen. Canadian	Third Gen. Canadian
Proportion STEM									
College or Trade	0.17	0.08	0.12	0.08	0.11	0.13	0.16	0.13	0.14
≥ Bachelor's degree	0.05	0.31	0.09	0.14	0.18	0.10	0.08	0.07	0.05
Proportion with foreign education	0.65	0.74	0.72	0.69	0.83	0.07	0.25	0.02	0.01
Population shares	1.67	8.08	7.75	1.67	1.98	4.96	1.56	14.94	57.39

Source: PIAAC 2012. Authors' calculations.

Notes: These are weighted percentages and means for 16,379 individuals from 22 to 59 years old, by immigration category. Average test scores are calculated using all plausible values and replicate weights available in PIAAC. Average ICT scores are calculated for sub-sample of individuals who attempted the computer-based assessments. A small urban population center has a population of 1,000 to 29,999 habitants. A medium urban population center has a population of 30,000 to 99,999 habitants. A large urban population center has a population of 100,000 habitants or greater. Average hourly wages are calculated for individuals who self-reported positive earnings at the time of survey. Gen. = generation; HS = high school; ICT = information and communication technology; Immig. = immigrant; n/a = not applicable; STEM = science, technology, engineering, and mathematics.

Table 1.4. Probability of ICT used at work for individuals employed at time of survey

	Probability of using					Probability of reporting ICT skills		
	Computer at Work[1]	Email[2]	Excel[3]	Word[4]	Programming[5]	Complex[6]	Sufficient[7]	Lacking[8]
Male								
Points-based immigrants	0.132***	0.045	0.096**	0.119***	0.153***	0.115***	0.023	0.137***
	(0.023)	(0.025)	(0.032)	(0.026)	(0.034)	(0.030)	(0.016)	(0.029)
Refugees or family reunification immigrants	-0.138***	-0.173***	-0.187***	-0.166***	0.017	0.029	-0.078*	0.105**
	(0.037)	(0.043)	(0.048)	(0.045)	(0.037)	(0.036)	(0.037)	(0.033)
Other Immigrants or temporary residents	-0.059	-0.031	-0.000	0.060	0.083	0.126*	0.030**	0.054
	(0.062)	(0.055)	(0.059)	(0.050)	(0.055)	(0.064)	(0.011)	(0.043)
Young Immigrants	0.099*	0.001	0.082	0.094*	0.063	0.097	-0.013	0.010
	(0.044)	(0.049)	(0.051)	(0.044)	(0.049)	(0.051)	(0.033)	(0.024)
Second Generation	0.077**	0.050*	0.044	0.076**	0.035	-0.005	0.009	0.018
	(0.025)	(0.023)	(0.032)	(0.027)	(0.030)	(0.019)	(0.017)	(0.017)
Female								
Points-based immigrants	-0.034	-0.021	-0.120**	-0.060	-0.148***	-0.147***	-0.047	0.019
	(0.031)	(0.036)	(0.046)	(0.041)	(0.039)	(0.032)	(0.033)	(0.047)
Refugees or family reunification immigrants	-0.023	0.103	0.027	0.107	-0.081	-0.092*	0.061	0.056
	(0.054)	(0.055)	(0.058)	(0.060)	(0.043)	(0.045)	(0.038)	(0.045)
Other Immigrants or temporary residents	0.058	-0.055	-0.218**	-0.227**	-0.130	-0.175*	-0.007	0.037
	(0.075)	(0.090)	(0.080)	(0.079)	(0.071)	(0.070)	(0.020)	(0.066)
Young Immigrants	0.023	0.089	-0.132	0.047	-0.154**	-0.142*	0.008	0.036
	(0.048)	(0.059)	(0.072)	(0.058)	(0.054)	(0.055)	(0.039)	(0.047)

(continued)

Table 1.4. continued

	Probability of using					Probability of reporting ICT skills		
	Computer at Work[1]	Email[2]	Excel[3]	Word[4]	Programming[5]	Complex[6]	Sufficient[7]	Lacking[8]
Second Generation	0.083**	0.017	-0.029	0.028	-0.112***	-0.062**	0.010	-0.002
	(0.028)	(0.025)	(0.044)	(0.028)	(0.033)	(0.022)	(0.017)	(0.022)
Third Generation	0.125***	0.028*	-0.029	0.055**	-0.089***	-0.062***	0.007	0.017*
	(0.014)	(0.013)	(0.020)	(0.018)	(0.015)	(0.012)	(0.008)	(0.008)
Age - 40	0.037***	0.024***	0.040***	0.026***	0.014**	0.013***	0.003	0.007
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.003)	(0.003)	(0.004)
$(Age - 40)^2/100$	-0.046***	-0.028***	-0.049***	-0.032***	-0.021***	-0.018***	-0.007	-0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.004)	(0.004)	(0.005)
Constant	0.795***	0.882***	0.775***	0.782***	0.189***	0.129***	0.951***	0.057***
	(0.013)	(0.013)	(0.016)	(0.015)	(0.014)	(0.011)	(0.007)	(0.007)
N	11072	8694	8689	8693	8689	8687	8692	8681
R^2	0.060	0.027	0.029	0.029	0.046	0.040	0.024	0.032
Adjusted R^2	0.059	0.025	0.028	0.028	0.044	0.038	0.022	0.031

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The overall sample includes 16,379 individuals, aged 22-59. In each column, we control for standardized age and its quadratic form (Age-40 and $(Age-40)^2/100$). We only include individuals who are currently employed at the time of survey. However, we have dropped individuals who have missing information for each respective column. We used the ordinary last squares method to calculated point estimates using all plausible values of basic ICT scores in PIAAC 2012. ICT = information and communication technologies. Each column corresponds to each of the following survey questions:

1. "Do you use a computer in your current job?" (1 – Yes, and 0 – No)
2. "In your current job, how often do you usually use email?" (1 – some usage of email (from less than once a month to every day), and 0 – never used)
3. "In your current job, how often do you usually use spreadsheets software, for example, Excel?" (1 – some usage of Excel (from less than once a month to every day), and 0 – never used)
4. "In your current job, how often do you usually use a word processor, for example, Word?" (1 – some usage of Word (from less than once a month to every day), and 0 – never used)
5. "In your current job, how often do you usually use a programming language to program or write computer code?" (1 – some usage of programming language (from less than once a month to every day), and 0 – never used)
6. "What level of computer use was needed to perform your current job?" (1 – for individuals who answered "complex, and 0 – for everyone else (straightforward and moderate))
7. "Do you think you have the computer skills you need to perform your current job well?" (1 – Yes, and 0 – everyone else)
8. "Has a lack of computer skills affected your chances of being hired for a job or getting a promotion or a pay raise?" (1 – Yes, and 0 – everyone else)

Table 1.5. Determinants of basic ICT scores, for individuals with positive self-reported earnings

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy				0.614***				0.590***
				(0.032)				(0.028)
Numeracy				0.229***				0.230***
				(0.036)				(0.030)
Points-based immigrants	-0.180*	-0.547***	-0.421***	-0.032	-0.413***	-0.566***	-0.532***	-0.207*
	(0.078)	(0.080)	(0.116)	(0.089)	(0.097)	(0.094)	(0.123)	(0.094)
Refugee	-0.717**	-0.797***	-0.756**	-0.067	-1.220***	-1.238***	-1.208***	-0.359
	(0.252)	(0.242)	(0.255)	(0.160)	(0.283)	(0.301)	(0.341)	(0.195)
Other immigration program	-0.022	-0.269	-0.239	0.015	-0.455**	-0.555***	-0.493**	-0.139
	(0.210)	(0.215)	(0.190)	(0.144)	(0.164)	(0.162)	(0.176)	(0.154)
Family reunification	-0.551***	-0.667***	-0.594***	0.015	-0.813***	-0.875***	-0.822***	-0.240*
	(0.125)	(0.121)	(0.137)	(0.087)	(0.115)	(0.104)	(0.118)	(0.098)
Temporary residents	-0.338	-0.506*	-0.356	0.090	-0.924***	-0.964***	-0.907***	-0.290
	(0.205)	(0.199)	(0.193)	(0.146)	(0.227)	(0.217)	(0.248)	(0.163)
Young immigrants	0.050	-0.048	-0.116	0.077	-0.036	-0.114	-0.186	-0.004
	(0.134)	(0.134)	(0.140)	(0.105)	(0.121)	(0.119)	(0.123)	(0.103)
Canadians by birth born outside Canada	0.180	0.095	0.030	0.061	0.127	0.054	0.017	0.008
	(0.208)	(0.241)	(0.231)	(0.154)	(0.188)	(0.184)	(0.184)	(0.174)
Second-generation Canadians	0.130	0.074	0.010	0.059	0.168**	0.103	0.038	0.008
	(0.066)	(0.065)	(0.070)	(0.044)	(0.064)	(0.061)	(0.063)	(0.043)
Age	0.030	0.005	0.016	-0.006	0.049**	0.021	0.025	0.003
	(0.019)	(0.017)	(0.017)	(0.013)	(0.019)	(0.018)	(0.018)	(0.016)
$Age^2/100$	-0.059*	-0.030	-0.043*	-0.007	-0.088***	-0.049*	-0.053*	-0.020
	(0.024)	(0.022)	(0.021)	(0.016)	(0.023)	(0.022)	(0.022)	(0.019)

(continued)

Table 1.5. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education								
< High school		-0.762***	-1.028*	-0.405		-0.724***	-0.528	-0.173
		(0.113)	(0.463)	(0.425)		(0.120)	(0.337)	(0.377)
College or trade school		0.208**	0.149	-0.023		0.145*	0.126	-0.056
		(0.071)	(0.101)	(0.058)		(0.057)	(0.065)	(0.054)
≥ Bachelor's degree		0.718***	0.576***	-0.134		0.542***	0.510***	-0.139*
		(0.072)	(0.090)	(0.076)		(0.058)	(0.060)	(0.059)
College/trade graduates with STEM			0.080	-0.006			0.269**	0.096
			(0.090)	(0.056)			(0.102)	(0.076)
≥ Bachelor's degree with STEM			0.323***	0.140			0.305**	0.060
			(0.096)	(0.075)			(0.113)	(0.081)
Individuals with missing fields of study			0.303	0.281			-0.173	0.039
			(0.440)	(0.414)			(0.337)	(0.381)
Interaction								
< High school x foreign education			-0.884	-0.664			-0.160	-0.038
			(1.062)	(0.653)			(0.486)	(0.253)
High school x foreign education			-0.509	-0.118			-0.313	0.041
			(0.261)	(0.205)			(0.208)	(0.159)
College/trade x foreign education			-0.415*	-0.193			-0.133	0.025
			(0.207)	(0.156)			(0.167)	(0.128)
≥ Bachelor's degree x foreign education			-0.057	0.041			-0.238*	0.063
			(0.144)	(0.099)			(0.121)	(0.083)
College or trade school x STEM x foreign education			0.317	0.170			-0.690	-0.169
			(0.268)	(0.193)			(0.687)	(0.380)
≥ Bachelor's degree x STEM x foreign education			-0.495**	-0.270*			-0.139	0.002
			(0.171)	(0.128)			(0.185)	(0.135)
Missing field of study x foreign education			n/a	n/a			n/a	n/a
			n/a	n/a			n/a	n/a

(continued)

Table 1.5. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Other covariates:								
Provinces	N	Y	Y	Y	N	Y	Y	Y
Rural-urban indicators	N	Y	Y	Y	N	Y	Y	Y
Constant	-0.079	0.209	0.138	0.439	-0.364	-0.101	-0.079	0.370
	(0.359)	(0.331)	(0.314)	(0.246)	(0.373)	(0.354)	(0.357)	(0.291)
N	4434	4434	4434	4434	5109	5109	5109	5109
R^2	0.073	0.208	0.236	0.725	0.150	0.240	0.268	0.718
Adjusted R^2	0.071	0.206	0.230	0.723	0.149	0.239	0.263	0.716

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores and positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table 1.6. Determinants of log hourly wage

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy				0.001				0.026
				(0.033)				(0.029)
Numeracy				0.082***				0.050*
				(0.024)				(0.025)
Basic ICT			0.072***	0.013			0.073***	0.018
			(0.013)	(0.022)			(0.012)	(0.025)
Points-based immigrants	-0.037	-0.137*	-0.106*	-0.100	-0.041	-0.062	-0.024	-0.028
	(0.033)	(0.054)	(0.054)	(0.054)	(0.043)	(0.055)	(0.054)	(0.055)
Refugee	-0.198	-0.192	-0.137	-0.118	-0.299**	-0.260**	-0.172	-0.164
	(0.106)	(0.102)	(0.099)	(0.094)	(0.115)	(0.088)	(0.097)	(0.102)
Other immigration program	-0.238	-0.310	-0.293	-0.276	-0.118**	-0.107	-0.072	-0.066
	(0.153)	(0.182)	(0.184)	(0.180)	(0.045)	(0.060)	(0.060)	(0.061)
Family reunification	-0.182***	-0.175**	-0.132*	-0.106	-0.199***	-0.155**	-0.095	-0.089
	(0.052)	(0.057)	(0.059)	(0.057)	(0.050)	(0.060)	(0.058)	(0.058)
Temporary residents	-0.210*	-0.225	-0.199	-0.175	-0.298***	-0.241*	-0.175	-0.170
	(0.100)	(0.115)	(0.115)	(0.113)	(0.080)	(0.110)	(0.103)	(0.101)
Young immigrants	0.111	0.060	0.068	0.086	0.093	0.017	0.031	0.037
	(0.061)	(0.069)	(0.067)	(0.065)	(0.054)	(0.051)	(0.052)	(0.051)
Canadians by birth born outside Canada	-0.009	-0.067	-0.070	-0.073	0.062	-0.010	-0.012	-0.014
	(0.104)	(0.091)	(0.088)	(0.088)	(0.091)	(0.088)	(0.088)	(0.090)
Second generation Canadians	0.006	-0.051	-0.051	-0.042	0.093**	0.021	0.018	0.018
	(0.039)	(0.039)	(0.040)	(0.039)	(0.029)	(0.027)	(0.026)	(0.026)
Age	0.085***	0.074***	0.073***	0.072***	0.085***	0.070***	0.068***	0.068***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.007)	(0.007)	(0.007)
$Age^2/100$	-0.087***	-0.074***	-0.071***	-0.071***	-0.094***	-0.073***	-0.069***	-0.069***
	(0.011)	(0.010)	(0.010)	(0.010)	(0.011)	(0.009)	(0.009)	(0.009)

(continued)

Table 1.6. continued

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education								
< High school		-0.225	-0.151	-0.166		-0.428**	-0.390*	-0.386**
		(0.261)	(0.255)	(0.270)		(0.142)	(0.153)	(0.148)
College or trade school		0.042	0.031	0.025		0.165***	0.156***	0.147***
		(0.042)	(0.042)	(0.043)		(0.029)	(0.028)	(0.028)
≥ Bachelor's degree		0.397***	0.356***	0.323***		0.466***	0.429***	0.398***
		(0.041)	(0.043)	(0.045)		(0.032)	(0.032)	(0.034)
College/trade graduates with STEM		0.179***	0.174***	0.160***		0.027	0.007	0.001
		(0.035)	(0.034)	(0.034)		(0.049)	(0.049)	(0.049)
≥ Bachelor's degree with STEM		0.058	0.035	0.024		0.051	0.029	0.017
		(0.042)	(0.043)	(0.042)		(0.053)	(0.054)	(0.055)
Individuals with missing fields of study		0.128	0.106	0.134		0.299*	0.311*	0.319*
		(0.262)	(0.254)	(0.271)		(0.141)	(0.151)	(0.146)
Interaction								
< High school x foreign education		-0.376	-0.312	-0.368		-0.027	-0.015	-0.013
		(0.389)	(0.421)	(0.406)		(0.144)	(0.163)	(0.168)
High school x foreign education		-0.155*	-0.118	-0.111		-0.179*	-0.156*	-0.143
		(0.075)	(0.077)	(0.078)		(0.075)	(0.074)	(0.074)
College/trade x foreign education		0.043	0.073	0.065		-0.199*	-0.189*	-0.180*
		(0.098)	(0.098)	(0.102)		(0.088)	(0.085)	(0.087)
≥ Bachelor's degree x foreign education		-0.170**	-0.166**	-0.162*		-0.296***	-0.279***	-0.264***
		(0.064)	(0.063)	(0.063)		(0.071)	(0.071)	(0.070)
College or trade school x STEM x foreign education		-0.226	-0.249	-0.246		0.088	0.138	0.145
		(0.134)	(0.131)	(0.133)		(0.112)	(0.138)	(0.139)
≥ Bachelor's degree x STEM x foreign education		-0.009	0.027	0.018		0.035	0.045	0.049
		(0.088)	(0.088)	(0.086)		(0.089)	(0.088)	(0.088)
Missing field of study x foreign education		n/a	n/a	n/a		-0.086	n/a	n/a
		n/a	n/a	n/a		(0.394)	n/a	n/a

(continued)

Table 1.6. continued

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Other covariates:								
Provinces	N	Y	Y	Y	N	Y	Y	Y
Rural-urban indicators	N	Y	Y	Y	N	Y	Y	Y
Constant	1.383***	1.482***	1.472***	1.496***	1.319***	1.378***	1.383***	1.425***
	(0.174)	(0.164)	(0.162)	(0.163)	(0.170)	(0.145)	(0.146)	(0.147)
N	4434	4434	4434	4434	5109	5109	5109	5109
R^2	0.117	0.271	0.283	0.292	0.101	0.284	0.293	0.300
Adjusted R^2	0.116	0.266	0.277	0.286	0.099	0.279	0.288	0.295

Sources: Authors' calculations from PIAAC 2012.

Note: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores and positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). Income of the top 0.5% is set to be equal to C$112.98 per hour. The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table 1.7. Determinants of log hourly wage, including individuals with no basic ICT scores

	Dependent variable: Log(Hourly Wage)					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy			-0.005			0.027
			(0.025)			(0.024)
Numeracy			0.078***			0.043
			(0.022)			(0.024)
Reasons for not taking computer-based tests						
No computer experience	-0.263***	-0.182***	-0.160**	-0.194	-0.071	-0.078
	(0.053)	(0.053)	(0.053)	(0.102)	(0.106)	(0.106)
Failed ICT core tests	0.097*	0.052	0.032	0.003	-0.029	-0.052
	(0.047)	(0.044)	(0.042)	(0.049)	(0.046)	(0.044)
Refused taking computer-based tests	-0.010	0.026	-0.008	-0.034	-0.033	-0.078
	(0.046)	(0.040)	(0.046)	(0.044)	(0.039)	(0.042)
Levels of basic ICT test scores						
241 points to < 291 points	0.220***	0.159***	0.101***	0.174***	0.109***	0.054
	(0.028)	(0.027)	(0.030)	(0.031)	(0.027)	(0.031)
≥ 291 points	0.361***	0.219***	0.102**	0.365***	0.201***	0.090*
	(0.030)	(0.031)	(0.039)	(0.031)	(0.030)	(0.040)
Points-based immigrants	-0.003	-0.086	-0.079	0.005	-0.060	-0.056
	(0.031)	(0.046)	(0.046)	(0.039)	(0.052)	(0.052)
Refugee	-0.216***	-0.191**	-0.155*	-0.204*	-0.224***	-0.196**
	(0.065)	(0.068)	(0.068)	(0.091)	(0.066)	(0.071)
Other immigration program	-0.212	-0.247	-0.228	-0.070	-0.093	-0.083
	(0.151)	(0.176)	(0.172)	(0.051)	(0.064)	(0.066)
Family reunification	-0.190***	-0.182***	-0.144**	-0.094*	-0.116*	-0.094
	(0.040)	(0.053)	(0.053)	(0.039)	(0.051)	(0.052)
Temporary residents	-0.182*	-0.191	-0.159	-0.227***	-0.246**	-0.224**
	(0.083)	(0.104)	(0.105)	(0.063)	(0.089)	(0.086)
Young immigrants	0.096	0.060	0.081	0.081	0.012	0.020
	(0.057)	(0.063)	(0.061)	(0.049)	(0.047)	(0.047)
Canadians by birth born outside Canada	-0.072	-0.095	-0.094	-0.004	-0.050	-0.039
	(0.093)	(0.081)	(0.082)	(0.086)	(0.082)	(0.082)
Second-generation Canadians	0.003	-0.043	-0.036	0.074**	0.018	0.018
	(0.036)	(0.037)	(0.037)	(0.027)	(0.026)	(0.026)
Age	0.079***	0.072***	0.071***	0.073***	0.065***	0.065***
	(0.008)	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)
$Age^2/100$	-0.078***	-0.070***	-0.070***	-0.076***	-0.065***	-0.065***
	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)

(continued)

Table 1.7. continued

	Dependent variable: Log(Hourly Wage)					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Education						
< High school		-0.110	-0.129		-0.252	-0.257
		(0.211)	(0.211)		(0.202)	(0.192)
College or trade school		0.031	0.027		0.168***	0.158***
		(0.039)	(0.041)		(0.026)	(0.026)
≥ Bachelor's degree		0.356***	0.323***		0.443***	0.408***
		(0.040)	(0.042)		(0.031)	(0.031)
College/trade graduates with STEM		0.172***	0.156***		0.015	0.004
		(0.032)	(0.032)		(0.047)	(0.048)
≥ Bachelor's degree with STEM		0.058	0.039		0.032	0.018
		(0.040)	(0.040)		(0.053)	(0.054)
Individuals with missing fields of study		0.044	0.088		0.160	0.187
		(0.211)	(0.212)		(0.206)	(0.195)
Interaction						
< High school x foreign education		0.011	0.043		0.063	0.107
		(0.097)	(0.101)		(0.420)	(0.475)
High school x foreign education		-0.105	-0.081		-0.033	-0.017
		(0.061)	(0.062)		(0.068)	(0.071)
College/trade x foreign education		0.049	0.042		-0.164*	-0.153*
		(0.091)	(0.093)		(0.073)	(0.075)
≥ Bachelor's degree x foreign education		-0.213***	-0.210***		-0.289***	-0.273***
		(0.059)	(0.059)		(0.064)	(0.063)
College or trade school x STEM x foreign education		-0.248*	-0.238*		0.024	0.045
		(0.118)	(0.118)		(0.127)	(0.134)
≥ Bachelor's degree x STEM x foreign education		0.041	0.045		0.073	0.079
		(0.080)	(0.079)		(0.083)	(0.082)
Missing field of study x foreign education		n/a	n/a		-0.057	-0.068
					(0.401)	(0.457)

(continued)

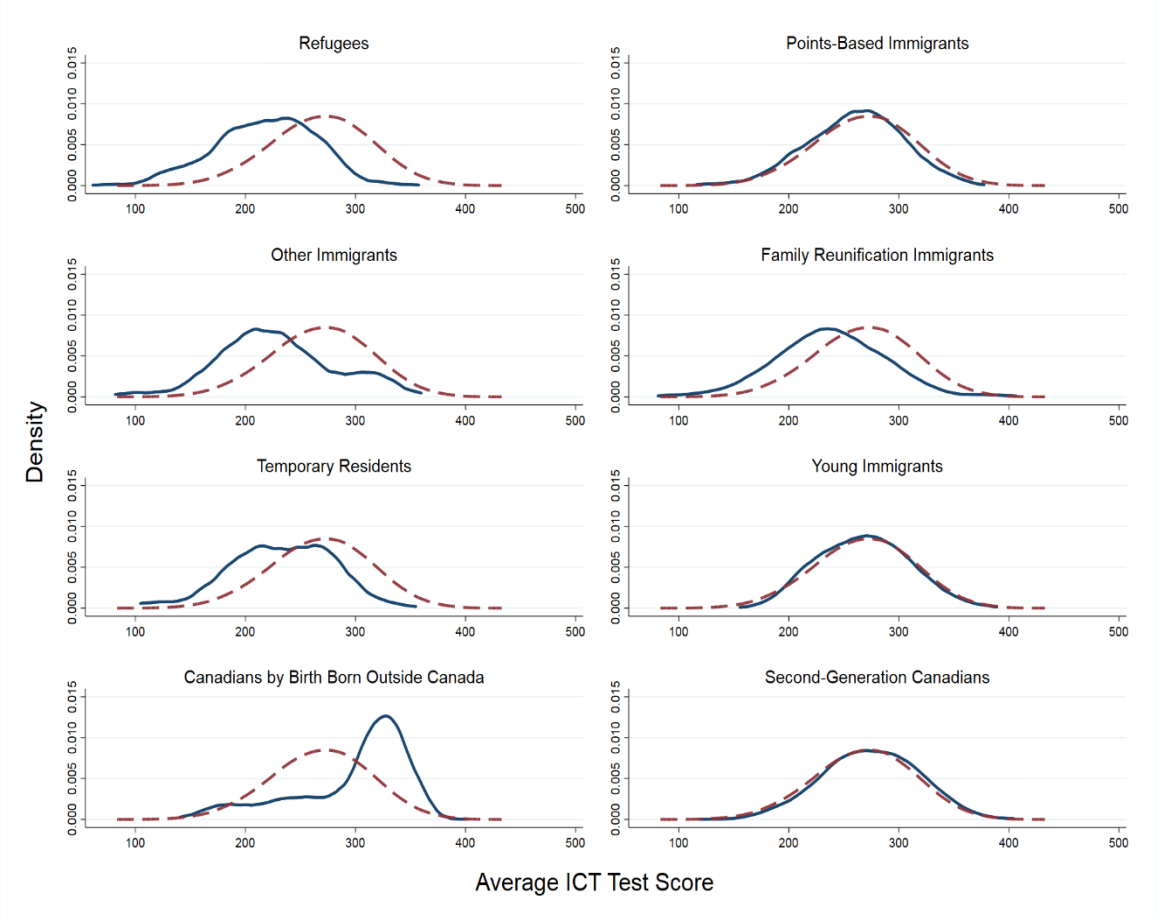
Table 1.7. continued

	Dependent variable: Log(Hourly Wage)					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Other covariates:						
Provinces	N	Y	Y	N	Y	Y
Rural-urban indicators	N	Y	Y	N	Y	Y
Constant	1.216***	1.350***	1.446***	1.235***	1.313***	1.418***
	(0.164)	(0.157)	(0.155)	(0.160)	(0.145)	(0.148)
N	5254	5254	5254	5816	5816	5816
R^2	0.193	0.294	0.305	0.180	0.305	0.313
Adjusted R^2	0.190	0.289	0.299	0.177	0.300	0.308

Sources: Authors' calculations from PIAAC 2012.

Note: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores and positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). Income of the top 0.5% is set to be equal to C$112.98 per hour. The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada and belong to the lowest group of ICT scores (<241 points). ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

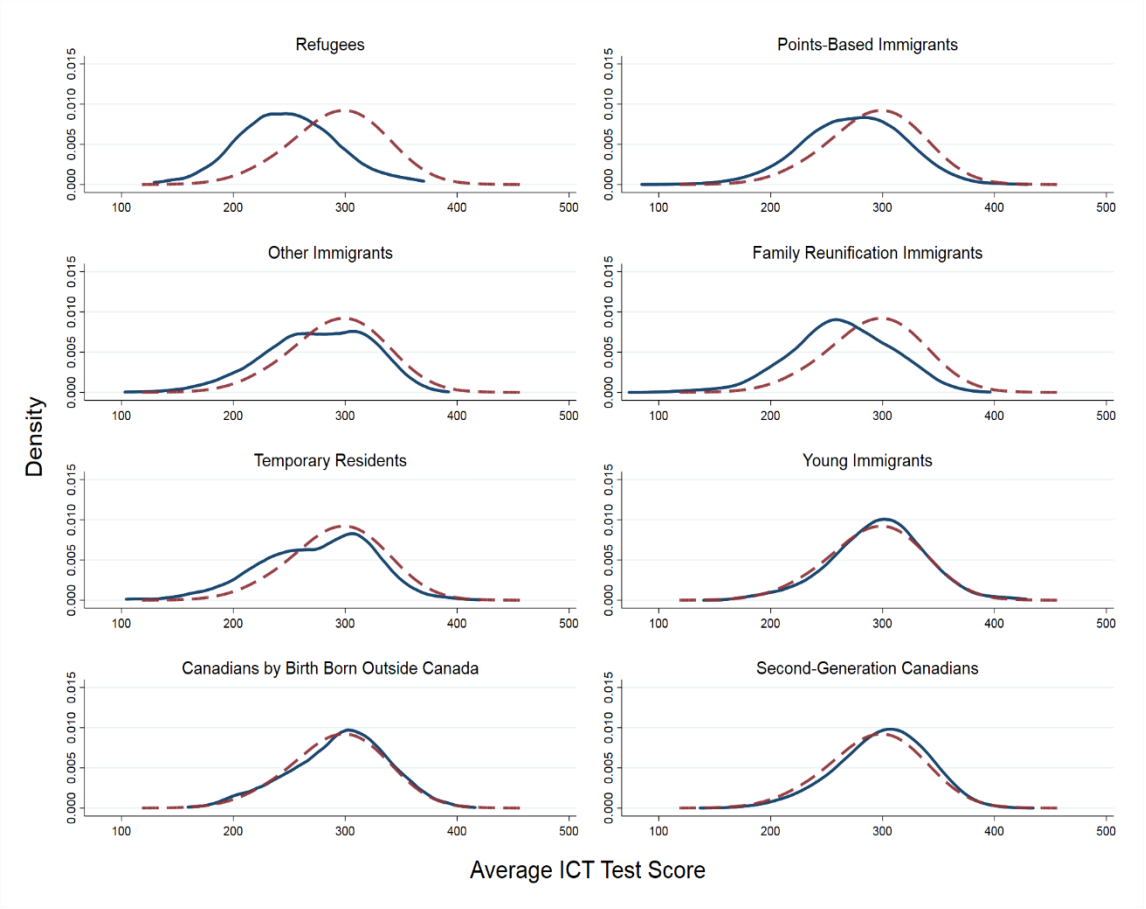
Figure 1.1. Density plots of basic ICT scores by subpopulation group, without post-secondary education



Source: PIAA 2012. Authors' calculations.

Notes: The dashed line represents the distribution of the test scores for the third generation. The solid line in each panel represents the distribution of test scores for the respective group. Each graph is generated using the Epanechnikov kernel with a bandwidth of 12.

Figure 1.2. Density plots of basic ICT scores by subpopulation group, with university education



Source: PIAAC 2012. Authors' calculations.

Notes: The dashed line represents the distribution of the test scores for the third generation. The solid line in each panel represents the distribution of test scores for the respective group. Each graph is generated using the Epanechnikov kernel with a bandwidth of 12.

APPENDIX

Table A.1.1. Correlation coefficients between test scores, by group and gender

	All			Men			Women		
	Literacy	Numeracy	PSL	Literacy	Numeracy	PSL	Literacy	Numeracy	PSL
All individuals in the sample									
Literacy	1.00			1.00			1.00		
Numeracy	0.87	1.00		0.88	1.00		0.87	1.00	
PSL	0.83	0.75	1.00	0.82	0.76	1.00	0.83	0.76	1.00
All individuals in the sample with valid earnings and available test scores									
Literacy	1.00			1.00			1.00		
Numeracy	0.84	1.00		0.85	1.00		0.85	1.00	
PSL	0.83	0.75	1.00	0.82	0.76	1.00	0.83	0.76	1.00
All Canadian born individuals in the sample									
Literacy	1.00			1.00			1.00		
Numeracy	0.86	1.00		0.87	1.00		0.86	1.00	
PSL	0.82	0.75	1.00	0.83	0.76	1.00	0.82	0.76	1.00
All Canadian born individuals in the sample with valid earnings and available test score									
Literacy	1.00			1.00			1.00		
Numeracy	0.84	1.00		0.85	1.00		0.85	1.00	
PSL	0.82	0.75	1.00	0.83	0.76	1.00	0.82	0.76	1.00
All immigrants in the sample									
Literacy	1.00			1.00			1.00		
Numeracy	0.87	1.00		0.88	1.00		0.87	1.00	
PSL	0.81	0.75	1.00	0.81	0.74	1.00	0.82	0.75	1.00
All immigrants in the sample with valid earnings and available test score									
Literacy	1.00			1.00			1.00		
Numeracy	0.83	1.00		0.84	1.00		0.84	1.00	
PSL	0.81	0.75	1.00	0.81	0.74	1.00	0.82	0.75	1.00

Source: Authors' calculations from PIAAC 2012.

Note: PSL = Problem solving in technology rich environments.

Table A.1.2. Core digital economy occupations defined by ICTC and ICT industries

Definition	Description
ICT Industries NAICS 2012	Following Murphy, Veall and Zhang (2016)
51	Information and cultural industries
54	Professional, scientific and technical services
ICT Occupations NOC 2011	15 digital economy occupations defined by ICTC (2016b)
0131	Telecommunication carrier managers
0213	Computer and information system managers
2133	Electrical and electronics engineers
2147	Computer engineers
2171	Information systems analysts and consultants
2172	Database analysts and data administrators
2173	Software engineers
2174	Computer programmers and interactive media developers
2175	Web designers and developers
2241	Electrical and electronics engineering technologists and technicians
2281	Computer network technicians
2282	User support technicians
2283	Systems testing technicians
5224	Broadcast technicians
5241	Graphic designers and illustrators

Source: ICTC (2016b); Murphy, Veall and Zhang (2016).

Notes: ICT = information and communication technology; ICTC = Information and Communication Technology Council; NAICS 2012 = North American Industry Classification System Canada 2012; NOC 2011 = National Occupational Classification 2011

Table A.1.3. Probability of using ICT at work for recently and currently employed individuals

	Probability of using					Probability of reporting ICT skills		
	Computer at Work[1]	Email[2]	Excel[3]	Word[4]	Programming[5]	Complex[6]	Sufficient[7]	Lacking[8]
Men								
Points-based immigrants	0.126***	0.052**	0.093***	0.134***	0.159***	0.133***	0.031*	0.115***
	(0.022)	(0.019)	(0.027)	(0.020)	(0.030)	(0.026)	(0.012)	(0.024)
Refugees or family reunification immigrants	-0.138***	-0.130***	-0.148***	-0.118**	0.024	0.030	-0.046	0.096**
	(0.033)	(0.037)	(0.042)	(0.038)	(0.033)	(0.029)	(0.030)	(0.031)
Other Immigrants or temporary residents	-0.048	-0.057	0.014	0.034	0.038	0.086	0.034**	0.059
	(0.059)	(0.048)	(0.050)	(0.043)	(0.044)	(0.047)	(0.011)	(0.032)
Young Immigrants	0.117**	0.018	0.076	0.096**	0.039	0.092*	0.011	-0.012
	(0.036)	(0.038)	(0.049)	(0.037)	(0.038)	(0.041)	(0.025)	(0.017)
Second Generation	0.067**	0.056**	0.039	0.062**	0.036	0.012	0.007	0.011
	(0.022)	(0.018)	(0.027)	(0.023)	(0.026)	(0.018)	(0.014)	(0.016)
Women								
Points-based immigrants	-0.058	-0.039	-0.116**	-0.081*	-0.155***	-0.148***	-0.049	0.026
	(0.030)	(0.030)	(0.040)	(0.034)	(0.037)	(0.031)	(0.026)	(0.042)
Refugees or family reunification immigrants	-0.003	0.094*	0.017	0.105*	-0.085*	-0.097**	0.039	0.060
	(0.046)	(0.044)	(0.051)	(0.052)	(0.042)	(0.036)	(0.029)	(0.043)
Other Immigrants or temporary residents	-0.009	-0.018	-0.265***	-0.176*	-0.103	-0.139**	-0.025	0.054
	(0.072)	(0.076)	(0.070)	(0.074)	(0.058)	(0.053)	(0.033)	(0.058)
Young Immigrants	0.021	0.049	-0.115	0.027	-0.131**	-0.134**	-0.016	0.075
	(0.042)	(0.048)	(0.064)	(0.054)	(0.044)	(0.046)	(0.032)	(0.043)

(continued)

Table A.1.3. continued

	Probability of using					Probability of reporting ICT skills		
	Computer at Work[1]	Email[2]	Excel[3]	Word[4]	Programming[5]	Complex[6]	Sufficient[7]	Lacking[8]
Second Generation	0.079***	0.002	-0.027	0.046*	-0.110***	-0.076***	0.011	0.008
	(0.022)	(0.020)	(0.037)	(0.023)	(0.029)	(0.021)	(0.017)	(0.021)
Third Generation	0.103***	0.018	-0.038*	0.046**	-0.091***	-0.059***	0.009	0.015
	(0.014)	(0.011)	(0.017)	(0.015)	(0.013)	(0.009)	(0.008)	(0.008)
Age - 40	0.032***	0.021***	0.037***	0.024***	0.009*	0.012***	0.001	0.007*
	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)	(0.003)	(0.002)	(0.003)
$(Age - 40)^2/100$	-0.039***	-0.025***	-0.046***	-0.029***	-0.015**	-0.017***	-0.005	-0.007
	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.004)	(0.003)	(0.004)
Constant	0.782***	0.890***	0.762***	0.779***	0.182***	0.123***	0.941***	0.064***
	(0.012)	(0.011)	(0.013)	(0.013)	(0.012)	(0.009)	(0.006)	(0.008)
N	14351	11016	11008	11015	11012	11009	11013	10992
R2	0.047	0.021	0.026	0.023	0.045	0.041	0.023	0.028
Adjusted R2	0.046	0.019	0.025	0.022	0.043	0.040	0.022	0.027

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The overall sample includes 16,379 individuals, aged 22-59. In each column, we control for standardized age and its quadratic form (Age-40 and $(Age-40)^2/100$). We only include individuals who are currently employed at the time of survey. However, we have dropped individuals who have missing information for each respective column. Ordinary least squares method was employed to calculate point estimates using all given plausible values of basic ICT scores in PIAAC 2012. Each column corresponds to each of the following survey questions:

1. "Do you use a computer in your current job?" (1 – Yes, and 0 – No)
2. "In your current job, how often do you usually use email?" (1 – some usage of email (from less than once a month to every day), and 0 – never used)
3. "In your current job, how often do you usually use spreadsheets software, for example, Excel?" (1 – some usage of Excel (from less than once a month to every day), and 0 – never used)
4. "In your current job, how often do you usually use a word processor, for example, Word?" (1 – some usage of Word (from less than once a month to every day), and 0 – never used)
5. "In your current job, how often do you usually use a programming language to program or write computer code?" (1 – some usage of programming language (from less than once a month to every day), and 0 – never used)
6. "What level of computer use was needed to perform your current job?" (1 – for individuals who answered "complex, and 0 – for everyone else (straightforward and moderate))
7. "Do you think you have the computer skills you need to perform your current job well?" (1 – Yes, and 0 – everyone else)
8. "Has a lack of computer skills affected your chances of being hired for a job or getting a promotion or a pay raise?" (1 – Yes, and 0 – everyone else)

Table A.1.4. Probability of being employed in the ICT industries, defined by NAICS industries 51 and 54

	Dependent variable: Prob(Employed in NAICS industries 51 and 54 =1)				
	Age-adjusted	Full control	Full control	Full control	Full control
Men					
Basic ICT			0.035***		
			(0.009)		
Literacy				0.028**	
				(0.009)	
Numeracy					0.020*
					(0.009)
Point-based immigrants	0.119***	0.075	0.090*	0.089	0.083
	(0.030)	(0.046)	(0.045)	(0.046)	(0.046)
Refugee	-0.023	-0.023	0.003	0.000	-0.008
	(0.030)	(0.039)	(0.040)	(0.039)	(0.039)
Other immigration programs	0.193*	0.159*	0.168*	0.167*	0.166*
	(0.083)	(0.080)	(0.079)	(0.081)	(0.080)
Family reunification	0.028	0.025	0.046	0.046	0.040
	(0.034)	(0.045)	(0.046)	(0.046)	(0.046)
Temporary Residents	0.088	0.093	0.105	0.108	0.103
	(0.077)	(0.081)	(0.080)	(0.080)	(0.081)
Young immigrants	0.050	0.021	0.025	0.027	0.027
	(0.042)	(0.045)	(0.045)	(0.045)	(0.045)
Canadians by birth born outside Canada	0.001	-0.018	-0.019	-0.016	-0.020
	(0.082)	(0.080)	(0.080)	(0.080)	(0.081)
Second-generation Canadians	0.026	0.009	0.009	0.010	0.012
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Constant	0.238*	0.246*	0.241*	0.258**	0.250*
	(0.100)	(0.099)	(0.099)	(0.099)	(0.099)
N	4434	4434	4434	4434	4434
R^2	0.017	0.067	0.076	0.072	0.070
Adjusted R^2	0.015	0.059	0.068	0.065	0.062
Women					
Basic ICT			0.023**		
			(0.008)		
Literacy				0.018*	
				(0.009)	
Numeracy					0.021*
					(0.009)
Point-based immigrants	0.053	0.042	0.055	0.051	0.048
	(0.028)	(0.037)	(0.037)	(0.037)	(0.037)
Refugee	-0.046	-0.058	-0.030	-0.038	-0.039
	(0.026)	(0.032)	(0.031)	(0.031)	(0.031)

(continued)

Table A.1.4. continued

	Dependent variable: Prob(Employed in NAICS industries 51 and 54 =1)				
	Age adjusted	Full control	Full control	Full control	Full control
Other immigration programs	-0.024	-0.022	-0.011	-0.014	-0.014
	(0.021)	(0.034)	(0.034)	(0.033)	(0.033)
Family reunification	0.019	0.011	0.030	0.025	0.024
	(0.031)	(0.042)	(0.043)	(0.042)	(0.043)
Temporary Residents	-0.046	-0.045	-0.023	-0.030	-0.031
	(0.042)	(0.052)	(0.053)	(0.053)	(0.053)
Young immigrants	0.006	-0.014	-0.010	-0.010	-0.010
	(0.034)	(0.035)	(0.035)	(0.035)	(0.035)
Canadians by birth born outside Canada	0.122	0.112	0.112	0.112	0.111
	(0.093)	(0.089)	(0.089)	(0.090)	(0.089)
Second-generation Canadians	-0.008	-0.022	-0.023	-0.023	-0.022
	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)
Constant	0.035	0.044	0.046	0.053	0.058
	(0.104)	(0.108)	(0.110)	(0.110)	(0.111)
N	5109	5109	5109	5109	5109
R^2	0.008	0.026	0.031	0.029	0.030
Adjusted R^2	0.006	0.020	0.024	0.022	0.023

Source: Authors' calculations from PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The analysis was done separately for men and women. The ordinary least squares method was employed to calculate point estimates using all given plausible values of PSTRE (i.e., problem-solving in technology-rich environments test scores), literacy, and numeracy in PIAAC 2012. Only men and women with valid PSTRE scores were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The sample includes individuals, aged 22-59, who self-reported positive earnings. These individuals include young immigrants, who migrated before the age of 13, and second- and third-generation Canadians whose highest educational attainment was a bachelor's degree. The omitted group is individuals who live in large urban population centers in Ontario. We only controlled for age and its squared in the "Age adjusted" column. In the "Full control" columns, we include covariates, such as the highest educational attainment, an indicator of whether an individual obtained a STEM degree at the bachelor's level or above or a diploma at the college/trade level, rural-urban indicators, and province dummy variables. NAICS = North American Industry Classification System Canada.

Table A.1.5. Probability of being employed in ICT occupations defined by ICTC

	Dependent variable: Prob(Employed in ICT occupations =1)				
	Age-adjusted	Full control	Full control	Full control	Full control
Men					
Basic ICT			0.040***		
			(0.008)		
Literacy				0.030***	
				(0.008)	
Numeracy					0.028***
					(0.008)
Point-based immigrants	0.139***	0.105**	0.122**	0.119**	0.115**
	(0.027)	(0.038)	(0.038)	(0.038)	(0.038)
Refugee	0.047	0.055	0.086	0.080	0.077
	(0.075)	(0.082)	(0.081)	(0.081)	(0.081)
Other immigration programs	0.087	0.066	0.076	0.074	0.077
	(0.090)	(0.095)	(0.095)	(0.095)	(0.096)
Family reunification	0.032	0.038	0.062	0.060	0.059
	(0.037)	(0.046)	(0.045)	(0.046)	(0.046)
Temporary Residents	0.076	0.103	0.118	0.119	0.118
	(0.065)	(0.067)	(0.067)	(0.068)	(0.068)
Young immigrants	0.117**	0.091*	0.096*	0.097*	0.099*
	(0.043)	(0.041)	(0.041)	(0.041)	(0.041)
Canadians by birth born outside Canada	0.022	0.009	0.008	0.011	0.007
	(0.062)	(0.064)	(0.063)	(0.063)	(0.062)
Second-generation Canadians	-0.012	-0.023	-0.024	-0.022	-0.020
	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
Constant	-0.256***	-0.251***	-0.256***	-0.238**	-0.246**
	(0.075)	(0.075)	(0.077)	(0.076)	(0.077)
N	4434	4434	4434	4434	4434
R^2	0.035	0.120	0.135	0.128	0.127
Adjusted R^2	0.033	0.113	0.128	0.121	0.120
Women					
Basic ICT			0.009*		
			(0.004)		
Literacy				0.006	
				(0.004)	
Numeracy					0.005
					(0.004)
Point-based immigrants	0.036	0.007	0.012	0.010	0.009
	(0.020)	(0.017)	(0.018)	(0.018)	(0.018)
Refugee	0.018	0.003	0.013	0.009	0.008
	(0.031)	(0.031)	(0.032)	(0.032)	(0.032)

(continued)

Table A.1.5. continued

	Dependent variable: Prob(Employed in ICT occupations =1)				
	Age-adjusted	Full control	Full control	Full control	Full control
Other immigration programs	-0.017	-0.034*	-0.029	-0.031	-0.032
	(0.011)	(0.016)	(0.017)	(0.017)	(0.016)
Family reunification	-0.008	-0.028	-0.021	-0.023	-0.025
	(0.011)	(0.015)	(0.015)	(0.015)	(0.015)
Temporary Residents	0.033	-0.001	0.006	0.003	0.002
	(0.061)	(0.053)	(0.052)	(0.052)	(0.052)
Young immigrants	0.006	-0.005	-0.003	-0.004	-0.004
	(0.017)	(0.019)	(0.019)	(0.019)	(0.019)
Canadians by birth born outside Canada	0.037	0.028	0.028	0.028	0.028
	(0.041)	(0.043)	(0.043)	(0.043)	(0.043)
Second-generation Canadians	-0.001	-0.002	-0.003	-0.003	-0.002
	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)
Constant	-0.106**	-0.088*	-0.087*	-0.085	-0.085
	(0.041)	(0.044)	(0.044)	(0.044)	(0.044)
N	5109	5109	5109	5109	5109
R^2	0.008	0.061	0.063	0.062	0.062
Adjusted R^2	0.006	0.055	0.056	0.055	0.055

Source: Authors' calculations from PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The analysis was done separately for men and women. The ordinary least squares method was employed to calculate point estimates using all given plausible values of PSTRE (i.e., problem-solving in technology-rich environments test scores), literacy, and numeracy in PIAAC 2012. Only men and women with valid PSTRE scores were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The sample includes individuals, aged 22-59, who self-reported positive earnings. These individuals include young immigrants, who migrated before the age of 13, and second- and third-generation Canadians whose highest educational attainment was a bachelor's degree. The omitted group is individuals who live in large urban population centers in Ontario. We only controlled for age and its square in the "Age-adjusted" column. In the "Full control" columns, we include covariates, such as the highest educational attainment, an indicator of whether an individual obtained a STEM degree at the Bachelor's level or above or a diploma at the college/trade level, rural-urban indicators, and province dummy variables. ICTC = Information and Communication Technology Canada.

Table A.1.6. Determinants of basic ICT scores for individuals who use a computer at work

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy				0.608***				0.584***
				(0.033)				(0.027)
Numeracy				0.218***				0.244***
				(0.034)				(0.030)
Points-based immigrants	-0.261***	-0.524***	-0.416***	-0.003	-0.452***	-0.609***	-0.537***	-0.211*
	(0.074)	(0.076)	(0.116)	(0.081)	(0.080)	(0.077)	(0.110)	(0.090)
Refugee	-0.664*	-0.733**	-0.702*	-0.062	-1.335***	-1.382***	-1.320**	-0.381
	(0.293)	(0.269)	(0.294)	(0.154)	(0.390)	(0.413)	(0.461)	(0.249)
Other immigration program	-0.225	-0.347	-0.255	-0.072	-0.473**	-0.563***	-0.421*	-0.064
	(0.216)	(0.193)	(0.163)	(0.136)	(0.163)	(0.161)	(0.174)	(0.157)
Family reunification	-0.498***	-0.596***	-0.580***	0.064	-0.623***	-0.712***	-0.658***	-0.174
	(0.136)	(0.128)	(0.137)	(0.091)	(0.111)	(0.111)	(0.121)	(0.100)
Temporary residents	-0.178	-0.376*	-0.249	0.095	-0.823**	-0.862***	-0.727**	-0.321
	(0.185)	(0.186)	(0.204)	(0.155)	(0.260)	(0.257)	(0.265)	(0.175)
Young immigrants	0.053	-0.018	-0.075	0.110	-0.078	-0.157	-0.211	-0.022
	(0.121)	(0.121)	(0.123)	(0.090)	(0.113)	(0.112)	(0.117)	(0.101)
Canadians by birth born outside Canada	0.122	0.066	0.024	0.111	0.259	0.204	0.173	0.127
	(0.186)	(0.203)	(0.200)	(0.142)	(0.185)	(0.184)	(0.183)	(0.166)
Second-generation Canadians	0.088	0.049	-0.006	0.059	0.142*	0.102	0.043	-0.002
	(0.061)	(0.059)	(0.060)	(0.037)	(0.058)	(0.056)	(0.057)	(0.044)
Age	0.002	-0.012	-0.004	-0.012	0.046*	0.027	0.028	0.010
	(0.020)	(0.019)	(0.019)	(0.014)	(0.018)	(0.017)	(0.017)	(0.016)
$Age^2/100$	-0.028	-0.011	-0.020	-0.001	-0.084***	-0.058**	-0.059**	-0.029
	(0.025)	(0.024)	(0.023)	(0.017)	(0.022)	(0.021)	(0.022)	(0.019)

(continued)

Table A.1.6. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education								
< High school		-0.643***	-1.188*	-0.556		-0.718***	-0.450	-0.130
		(0.137)	(0.604)	(0.589)		(0.140)	(0.333)	(0.384)
College or trade school		0.217***	0.181*	-0.006		0.088	0.080	-0.062
		(0.066)	(0.090)	(0.057)		(0.055)	(0.060)	(0.049)
≥ Bachelor's degree		0.624***	0.487***	-0.117		0.446***	0.417***	-0.172**
		(0.070)	(0.082)	(0.072)		(0.053)	(0.059)	(0.056)
College/trade graduates with STEM			0.034	0.010			0.249*	0.104
			(0.084)	(0.050)			(0.100)	(0.080)
≥ Bachelor's degree with STEM			0.289**	0.125			0.335***	0.066
			(0.094)	(0.074)			(0.095)	(0.066)
Individuals with missing fields of study			0.586	0.429			-0.247	0.021
			(0.585)	(0.583)			(0.329)	(0.374)
Interaction								
< High school x foreign education			-1.247	-0.847			-1.259	-0.664
			(1.020)	(1.106)			(0.961)	(0.810)
High school x foreign education			-0.531*	-0.233			-0.272	-0.013
			(0.246)	(0.171)			(0.224)	(0.165)
College/trade x foreign education			-0.398	0.026			-0.286	-0.053
			(0.220)	(0.179)			(0.187)	(0.146)
≥ Bachelor's degree x foreign education			-0.041	0.033			-0.278*	0.042
			(0.135)	(0.089)			(0.117)	(0.082)
College or trade school x STEM x foreign education			0.240	-0.055			-0.011	0.142
			(0.267)	(0.211)			(0.772)	(0.434)
≥ Bachelor's degree x STEM x foreign education			-0.435**	-0.219			-0.081	-0.000
			(0.157)	(0.116)			(0.161)	(0.130)
Missing field of study x foreign education			n/a	n/a			0.799	0.445
			n/a	n/a			(0.652)	(0.694)

(continued)

Table A.1.6. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Other covariates:								
Provinces	N	Y	Y	Y	N	Y	Y	Y
Rural-urban indicators	N	Y	Y	Y	N	Y	Y	Y
Constant	0.632	0.643	0.615	0.557*	-0.227	-0.093	-0.016	0.292
	(0.385)	(0.370)	(0.359)	(0.267)	(0.354)	(0.332)	(0.344)	(0.295)
N	4608	4608	4608	4608	5441	5441	5441	5441
R^2	0.083	0.177	0.202	0.689	0.132	0.201	0.228	0.694
Adjusted R^2	0.081	0.175	0.196	0.687	0.130	0.199	0.223	0.691

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores, self-reported use a computer at work, and positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table A.1.7. Determinants of basic ICT scores for individuals who use programming and complex skills at work

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy				0.583***				0.560***
				(0.069)				(0.088)
Numeracy				0.197**				0.227**
				(0.073)				(0.080)
Points-based immigrants	-0.334*	-0.550***	-0.554**	-0.071	-0.317	-0.471*	-0.388	-0.249
	(0.131)	(0.136)	(0.191)	(0.154)	(0.200)	(0.208)	(0.259)	(0.183)
Refugee	-0.764	-0.836	-0.828	-0.154	-0.798*	-0.713	-0.880	-0.568
	(0.495)	(0.546)	(0.527)	(0.323)	(0.389)	(0.399)	(0.479)	(0.486)
Other immigration program	-0.005	-0.101	-0.272	0.007	-1.092**	-1.276***	-0.918*	-0.401
	(0.237)	(0.228)	(0.260)	(0.209)	(0.350)	(0.371)	(0.408)	(0.340)
Family reunification	-0.263	-0.362	-0.455	0.044	-0.731**	-0.775**	-0.630*	-0.276
	(0.238)	(0.232)	(0.237)	(0.184)	(0.248)	(0.277)	(0.275)	(0.232)
Temporary residents	-0.200	-0.363	-0.408	-0.053	0.306	0.258	0.234	-0.170
	(0.281)	(0.310)	(0.332)	(0.241)	(0.787)	(0.902)	(0.823)	(0.571)
Young immigrants	0.144	0.127	0.060	0.178	-0.154	-0.233	-0.413	-0.101
	(0.229)	(0.222)	(0.221)	(0.165)	(0.304)	(0.302)	(0.308)	(0.237)
Canadians by birth born outside Canada	-0.197	-0.183	-0.282	0.028	0.357	0.144	0.129	0.202
	(0.534)	(0.635)	(0.605)	(0.375)	(0.689)	(0.728)	(0.866)	(0.565)
Second generation Canadians	0.102	0.131	0.102	0.167*	0.290	0.239	0.126	-0.009
	(0.140)	(0.118)	(0.122)	(0.082)	(0.181)	(0.179)	(0.182)	(0.148)
Age	0.017	0.008	0.016	-0.028	0.092	0.061	0.044	0.012
	(0.043)	(0.040)	(0.039)	(0.027)	(0.050)	(0.048)	(0.052)	(0.037)
$Age^2/100$	-0.045	-0.035	-0.044	0.018	-0.151*	-0.106	-0.085	-0.028
	(0.053)	(0.049)	(0.049)	(0.033)	(0.063)	(0.062)	(0.066)	(0.046)

(continued)

Table A.1.7. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education								
< High school		-0.695	-0.426	-0.914		-1.035	-0.728	-0.333
		(0.394)	(0.676)	(0.831)		(0.566)	(0.790)	(0.548)
College or trade school		0.362*	0.271	0.120		0.111	0.071	0.006
		(0.164)	(0.220)	(0.156)		(0.220)	(0.255)	(0.176)
≥ Bachelor's degree		0.699***	0.518**	-0.144		0.427*	0.373	-0.113
		(0.156)	(0.195)	(0.141)		(0.206)	(0.239)	(0.173)
College/trade graduates with STEM			0.083	-0.091			0.219	-0.006
			(0.192)	(0.134)			(0.229)	(0.169)
≥ Bachelor's degree with STEM			0.242	0.155			0.298	0.024
			(0.158)	(0.120)			(0.186)	(0.141)
Individuals with missing fields of study			n/a	n/a			n/a	n/a
			n/a	n/a			n/a	n/a
Interaction								
< High school x foreign education			n/a	n/a			n/a	n/a
			n/a	n/a			n/a	n/a
High school x foreign education			-0.766	-0.373			0.317	-0.169
			(0.762)	(0.518)			(0.643)	(0.534)
College/trade x foreign education			-0.284	0.303			-0.229	0.269
			(0.577)	(0.519)			(0.639)	(0.467)
≥ Bachelor's degree x foreign education			0.337	0.164			-0.584	0.000
			(0.293)	(0.224)			(0.315)	(0.251)
College or trade school x STEM x foreign education			0.654	-0.255			n/a	n/a
			(0.643)	(0.530)			n/a	n/a
≥ Bachelor's degree x STEM x foreign education			-0.587	-0.227			0.204	0.111
			(0.329)	(0.220)			(0.386)	(0.319)
Missing field of study x foreign education			n/a	n/a			n/a	n/a
			n/a	n/a			n/a	n/a

(continued)

Table A.1.7. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Other covariates:								
Provinces	N	Y	Y	Y	N	Y	Y	Y
Rural-urban indicators	N	Y	Y	Y	N	Y	Y	Y
Constant	0.615	0.377	0.287	0.899	-0.754	-0.472	0.032	0.259
	(0.835)	(0.777)	(0.775)	(0.533)	(0.919)	(0.894)	(0.950)	(0.654)
N	986	986	986	986	565	565	565	565
R^2	0.090	0.192	0.230	0.672	0.196	0.242	0.326	0.726
Adjusted R^2	0.081	0.182	0.202	0.659	0.181	0.224	0.282	0.708

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores and positive self-reported earnings were included. The sample includes individuals who self-reported the use of programming and complex ICT skills at work. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table A.1.8. Determinants of basic ICT scores, including controls for groups of countries in which the highest level of education was obtained

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy				0.613***				0.588***
				(0.033)				(0.028)
Numeracy				0.229***				0.229***
				(0.037)				(0.029)
Points-based immigrants		-0.288*	-0.339**	-0.032		-0.444***	-0.503***	-0.226*
		(0.117)	(0.119)	(0.095)		(0.126)	(0.125)	(0.096)
Refugee		-0.750**	-0.771**	-0.080		-1.198***	-1.223***	-0.407*
		(0.265)	(0.270)	(0.166)		(0.352)	(0.357)	(0.205)
Other immigration programs		-0.197	-0.236	0.006		-0.388*	-0.426*	-0.131
		(0.192)	(0.185)	(0.149)		(0.169)	(0.181)	(0.161)
Family reunification		-0.507***	-0.501***	0.046		-0.735***	-0.726***	-0.219*
		(0.134)	(0.139)	(0.090)		(0.117)	(0.117)	(0.101)
Temporary residents		-0.342	-0.363	0.102		-0.749**	-0.834***	-0.291
		(0.198)	(0.203)	(0.149)		(0.248)	(0.253)	(0.179)
Young immigrants		-0.115	-0.116	0.078		-0.196	-0.204	-0.006
		(0.142)	(0.141)	(0.105)		(0.118)	(0.121)	(0.102)
Canadians by birth born outside Canada		0.058	0.061	0.069		0.004	-0.010	0.004
		(0.228)	(0.228)	(0.156)		(0.181)	(0.186)	(0.175)
Second generation Canadians		0.002	0.007	0.058		0.031	0.030	0.007
		(0.071)	(0.071)	(0.044)		(0.063)	(0.063)	(0.043)
Age	0.038*	0.018	0.019	-0.006	0.054**	0.028	0.028	0.004
	(0.018)	(0.017)	(0.017)	(0.013)	(0.019)	(0.018)	(0.018)	(0.016)
$Age^2/100$	-0.070**	-0.046*	-0.047*	-0.008	-0.094***	-0.057*	-0.057*	-0.021
	(0.023)	(0.021)	(0.021)	(0.016)	(0.023)	(0.022)	(0.022)	(0.019)

(continued)

Table A.1.8. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Groups of countries where the highest level of education was obtained								
English-speaking countries (ESC)	0.342**	0.080			-0.036	-0.044		
	(0.122)	(0.137)			(0.156)	(0.145)		
European	-0.398**	-0.408**			-0.771***	-0.353		
	(0.131)	(0.149)			(0.187)	(0.189)		
East-Southeast Asia	-0.797***	-0.792***			-0.919***	-0.612***		
	(0.134)	(0.146)			(0.130)	(0.174)		
Rest of Asia	-0.457***	-0.561**			-0.901***	-0.522**		
	(0.137)	(0.181)			(0.168)	(0.166)		
Rest of the World	-0.350*	-0.215			-0.595***	-0.053		
	(0.147)	(0.168)			(0.136)	(0.166)		
Education								
< High school		-0.728***	-1.033*	-0.406		-0.689***	-0.533	-0.174
		(0.110)	(0.462)	(0.425)		(0.119)	(0.335)	(0.375)
College or trade school		0.202**	0.134	-0.032		0.160**	0.132*	-0.053
		(0.068)	(0.097)	(0.056)		(0.058)	(0.064)	(0.054)
≥ Bachelor's degree		0.688***	0.600***	-0.112		0.554***	0.513***	-0.137*
		(0.073)	(0.085)	(0.072)		(0.059)	(0.060)	(0.059)
College/trade graduates with STEM			0.103	0.009			0.200	0.079
			(0.085)	(0.052)			(0.114)	(0.075)
≥ Bachelor's degree with STEM			0.237**	0.081			0.255**	0.058
			(0.084)	(0.062)			(0.090)	(0.064)
Individuals with missing fields of study			0.311	0.282			-0.165	0.040
			(0.439)	(0.414)			(0.336)	(0.379)
Interaction								
English-speaking countries x < high school			0.615	-0.415			1.075*	0.580
			(0.569)	(0.393)			(0.514)	(0.894)

(continued)

Table A.1.8. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
English-speaking countries x high school			-1.022	0.354			-0.541	-0.527
			(0.669)	(0.490)			(0.721)	(0.943)
English-speaking countries x college or trade school			-0.444	0.522			-1.184	-0.544
			(0.731)	(0.466)			(0.608)	(0.941)
English-speaking countries x ≥ bachelor's degree			-0.488	0.423			-1.147*	-0.539
			(0.553)	(0.400)			(0.546)	(0.901)
European x < high school			0.434	-0.235			-1.376	-0.880
			(1.344)	(0.621)			(1.057)	(0.675)
European x high school			-0.698	0.033			0.116	0.593
			(1.430)	(0.698)			(1.131)	(0.728)
European x college or trade school			-0.844	-0.157			0.882	0.618
			(1.365)	(0.629)			(1.121)	(0.693)
European x ≥ bachelor's degree			-0.913	0.034			1.357	0.950
			(1.352)	(0.602)			(1.083)	(0.671)
East-Southeast Asia x < high school			-2.445	-1.613			-0.806	-0.078
			(2.491)	(1.730)			(0.632)	(0.494)
East-Southeast Asia x high school			1.506	1.504			0.341	0.005
			(2.510)	(1.752)			(0.748)	(0.561)
East-Southeast Asia x college or trade school			1.877	1.707			0.262	0.065
			(2.507)	(1.761)			(0.709)	(0.535)
East-Southeast Asia x ≥ bachelor's degree			1.629	1.422			0.155	0.074
			(2.496)	(1.735)			(0.599)	(0.477)
Rest of Asia x < high school			0.031	0.247			-0.649	-0.052
			(0.558)	(0.806)			(1.396)	(0.386)
Rest of Asia x high school			-0.483	-0.384			0.196	0.057
			(0.700)	(0.863)			(1.458)	(0.433)

(continued)

Table A.1.8. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rest of Asia x college or trade school			-0.424	-0.287			0.213	0.161
			(0.595)	(0.813)			(1.447)	(0.438)
Rest of Asia x ≥ bachelor's degree			-0.645	-0.441			0.096	0.183
			(0.583)	(0.813)			(1.403)	(0.402)
Rest of the World x < high school			-1.983	-0.666			0.195	0.085
			(1.962)	(0.981)			(0.754)	(0.426)
Rest of the World x high school			1.629	0.504			-0.198	0.163
			(1.987)	(0.996)			(0.809)	(0.457)
Rest of the World x college or trade school			1.833	0.574			-0.014	0.218
			(1.968)	(0.966)			(0.746)	(0.430)
Rest of the World x ≥ bachelor's degree			n/a	n/a			-0.438	0.018
			n/a	n/a			(0.802)	(0.439)
Other covariates								
Provinces	N	Y	Y	Y	N	Y	Y	Y
Rural-urban indicators	N	Y	Y	Y	N	Y	Y	Y
Constant	-0.207	0.096	0.079	0.437	-0.463	-0.152	-0.141	0.351
	(0.344)	(0.316)	(0.314)	(0.247)	(0.374)	(0.365)	(0.363)	(0.299)
N	4434	4434	4434	4434	5109	5109	5109	5109
R^2	0.077	0.238	0.248	0.727	0.130	0.268	0.282	0.722
Adjusted R^2	0.076	0.233	0.239	0.724	0.129	0.263	0.275	0.719

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores and positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table A.1.9. Determinants of log hourly wage

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy				0.001				0.026
				(0.033)				(0.029)
Numeracy				0.082***				0.050*
				(0.024)				(0.025)
Basic ICT			0.072***	0.013			0.073***	0.018
			(0.013)	(0.022)			(0.012)	(0.025)
Points-based immigrants	-0.008	-0.111*	-0.106*	-0.100	-0.065	-0.110*	-0.024	-0.028
	(0.032)	(0.047)	(0.054)	(0.054)	(0.040)	(0.051)	(0.054)	(0.055)
Refugee	-0.331***	-0.246***	-0.137	-0.118	-0.360***	-0.309***	-0.172	-0.164
	(0.077)	(0.073)	(0.099)	(0.094)	(0.083)	(0.059)	(0.097)	(0.102)
Other immigration program	-0.214	-0.258	-0.293	-0.276	-0.145**	-0.135*	-0.072	-0.066
	(0.138)	(0.173)	(0.184)	(0.180)	(0.054)	(0.064)	(0.060)	(0.061)
Family reunification	-0.294***	-0.230***	-0.132*	-0.106	-0.247***	-0.192***	-0.095	-0.089
	(0.042)	(0.053)	(0.059)	(0.057)	(0.043)	(0.053)	(0.058)	(0.058)
Temporary residents	-0.207*	-0.201	-0.199	-0.175	-0.360***	-0.313***	-0.175	-0.170
	(0.090)	(0.105)	(0.115)	(0.113)	(0.068)	(0.093)	(0.103)	(0.101)
Young immigrants	0.131*	0.064	0.068	0.086	0.068	-0.007	0.031	0.037
	(0.058)	(0.065)	(0.067)	(0.065)	(0.048)	(0.046)	(0.052)	(0.051)
Canadians by birth born outside Canada	-0.039	-0.082	-0.070	-0.073	0.015	-0.047	-0.012	-0.014
	(0.104)	(0.086)	(0.088)	(0.088)	(0.090)	(0.083)	(0.088)	(0.090)
Second generation Canadians	0.037	-0.037	-0.051	-0.042	0.106***	0.024	0.018	0.018
	(0.036)	(0.037)	(0.040)	(0.039)	(0.028)	(0.026)	(0.026)	(0.026)
Age	0.083***	0.073***	0.073***	0.072***	0.082***	0.068***	0.068***	0.068***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.007)	(0.007)	(0.007)

(continued)

Table A.1.9. continued

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Age^2/100$	-0.087***	-0.074***	-0.071***	-0.071***	-0.093***	-0.070***	-0.069***	-0.069***
	(0.010)	(0.009)	(0.010)	(0.010)	(0.011)	(0.009)	(0.009)	(0.009)
Education								
< High school		-0.208	-0.151	-0.166		-0.298	-0.390*	-0.386**
		(0.220)	(0.255)	(0.270)		(0.211)	(0.153)	(0.148)
College or trade school		0.052	0.031	0.025		0.178***	0.156***	0.147***
		(0.040)	(0.042)	(0.043)		(0.027)	(0.028)	(0.028)
≥ Bachelor's degree		0.413***	0.356***	0.323***		0.485***	0.429***	0.398***
		(0.038)	(0.043)	(0.045)		(0.031)	(0.032)	(0.034)
College/trade graduates with STEM		0.176***	0.174***	0.160***		0.029	0.007	0.001
		(0.034)	(0.034)	(0.034)		(0.047)	(0.049)	(0.049)
≥ Bachelor's degree with STEM		0.063	0.035	0.024		0.054	0.029	0.017
		(0.042)	(0.043)	(0.042)		(0.052)	(0.054)	(0.055)
Individuals with missing fields of study		0.080	0.106	0.134		0.142	0.311*	0.319*
		(0.219)	(0.254)	(0.271)		(0.216)	(0.151)	(0.146)
Interaction								
< High school x foreign education		-0.032	-0.312	-0.368		0.099	-0.015	-0.013
		(0.102)	(0.421)	(0.406)		(0.416)	(0.163)	(0.168)
High school x foreign education		-0.163*	-0.118	-0.111		-0.077	-0.156*	-0.143
		(0.066)	(0.077)	(0.078)		(0.071)	(0.074)	(0.074)
College/trade x foreign education		0.010	0.073	0.065		-0.171*	-0.189*	-0.180*
		(0.091)	(0.098)	(0.102)		(0.076)	(0.085)	(0.087)
≥ Bachelor's degree x foreign education		-0.229***	-0.166**	-0.162*		-0.317***	-0.279***	-0.264***
		(0.061)	(0.063)	(0.063)		(0.065)	(0.071)	(0.070)
College or trade school x STEM x foreign education		-0.223	-0.249	-0.246		-0.012	0.138	0.145
		(0.121)	(0.131)	(0.133)		(0.129)	(0.138)	(0.139)
≥ Bachelor's degree x STEM x foreign education		0.035	0.027	0.018		0.072	0.045	0.049
		(0.082)	(0.088)	(0.086)		(0.084)	(0.088)	(0.088)

(continued)

Table A.1.9. continued

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Missing field of study x foreign education		n/a	n/a	n/a		-0.086	n/a	n/a
		n/a	n/a	n/a		(0.394)	n/a	n/a
Other covariates:								
- Provinces	N	Y	Y	Y	N	Y	Y	Y
- Rural/urban indicators	N	Y	Y	Y	N	Y	Y	Y
Constant	1.439***	1.513***	1.472***	1.496***	1.382***	1.428***	1.383***	1.425***
	(0.167)	(0.155)	(0.162)	(0.163)	(0.167)	(0.144)	(0.146)	(0.147)
N	5254	5254	4434	4434	5816	5816	5109	5109
R^2	0.117	0.271	0.283	0.292	0.101	0.284	0.293	0.300
Adjusted R^2	0.116	0.266	0.277	0.286	0.099	0.279	0.288	0.295

Sources: Authors' calculations from PIAAC 2012.

Note: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores were included in columns 3, 4, 7, 8. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The sample includes individuals aged 22-59 who self-reported that they are currently employed at the time of survey. Income of the top 0.5% is set to be equal to C$112.98 per hour. The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table A.1.10. Determinants of log hourly wage for the sample of individuals with a bachelor's degree only

	Age-adjusted	Full control	Age-adjusted	Full control	Age-adjusted	Full control
Male						
Basic ICT	0.057*	0.047				
	(0.029)	(0.030)				
Literacy			0.067*	0.056		
			(0.033)	(0.035)		
Numeracy					0.096***	0.085**
					(0.028)	(0.030)
Constant	0.905*	0.909*	0.915**	0.910*	0.914*	0.920*
	(0.357)	(0.360)	(0.353)	(0.357)	(0.359)	(0.365)
N	980	980	980	980	980	980
R^2	0.199	0.237	0.202	0.239	0.215	0.25
Adjusted R^2	0.197	0.221	0.199	0.224	0.213	0.234
Female						
Basic ICT	0.069**	0.051				
	(0.025)	(0.027)				
Literacy			0.065**	0.047		
			(0.025)	(0.026)		
Numeracy					0.081**	0.064*
					(0.025)	(0.025)
Constant	0.904**	0.930***	0.899**	0.925***	0.890**	0.922***
	(0.280)	(0.277)	(0.279)	(0.275)	(0.279)	(0.275)
N	1462	1462	1462	1462	1462	1462
R^2	0.186	0.234	0.185	0.234	0.192	0.239
Adjusted R^2	0.184	0.224	0.183	0.223	0.190	0.228

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for men and women. The ordinary least squares method was employed to calculate point estimates using all given plausible values of PSTRE, literacy, and numeracy in PIAAC 2012. Only men and women with valid PSTRE test scores and positive earnings were included. All replicate weights were used to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). These individuals include young immigrants, who migrated before the age of 13, and were second- and third-generation Canadians whose highest educational attainment is a bachelor's degree. The omitted group is individuals who live in large urban population centers in Ontario. We only controlled for age, and its square in the "Age-adjusted" columns. In the "Full control" columns, we include the following covariates: age and age squared, an indicator for whether individuals obtained a STEM degree, rural-urban indicators, the province of residence, and an indicator for individuals obtained an education abroad. ICT = information and communication technology.

Table A.1.11. Selective functional forms of literacy and numeracy test scores

	Dependent Variable: Log(hourly wage)					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy		0.006	-0.003		0.041	0.030
		(0.032)	(0.025)		(0.028)	(0.024)
Literacy^2		-0.003	0.001		-0.007	-0.004
		(0.014)	(0.012)		(0.011)	(0.011)
Literacy^3		-0.002			-0.003	
		(0.004)			(0.004)	
Numeracy		0.087**	0.078***		0.052	0.054*
		(0.029)	(0.022)		(0.027)	(0.025)
Numeracy^2		0.003	0.005		0.019	0.019
		(0.011)	(0.010)		(0.013)	(0.011)
Numeracy^3		-0.002			0.001	
		(0.004)			(0.005)	
Levels of literacy test scores						
241 points to < 291 points	0.000			0.059		
	(0.048)			(0.034)		
≥ 291 points	0.034			0.143***		
	(0.060)			(0.043)		
Levels of numeracy test scores						
241 points to < 291 points	0.080			0.015		
	(0.043)			(0.028)		
≥ 291 points	0.159**			0.082*		
	(0.050)			(0.037)		
Reasons for not taking computer-based tests						
No computer experience	-0.190***	-0.183***	-0.169**	-0.093	-0.092	-0.089
	(0.053)	(0.051)	(0.053)	(0.106)	(0.107)	(0.105)
Failed ICT core tests	0.008	0.017	0.029	-0.070	-0.064	-0.058
	(0.042)	(0.043)	(0.042)	(0.044)	(0.045)	(0.045)
Refused taking computer-based tests	-0.023	-0.017	-0.008	-0.096*	-0.084	-0.078
	(0.045)	(0.047)	(0.046)	(0.044)	(0.043)	(0.042)
Levels of basic ICT test scores						
241 points to < 291 points	0.098**	0.092**	0.105***	0.050	0.057	0.063*
	(0.037)	(0.033)	(0.030)	(0.034)	(0.033)	(0.031)
≥ 291 points	0.086*	0.080	0.099**	0.053	0.078	0.088*
	(0.039)	(0.042)	(0.038)	(0.040)	(0.042)	(0.040)
Points-based immigrants	-0.075	-0.077	-0.078	-0.050	-0.054	-0.054
	(0.046)	(0.047)	(0.047)	(0.051)	(0.051)	(0.051)

(continued)

Table A.1.11. continued

	Dependent Variable: Log(hourly wage)					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Refugee	-0.151*	-0.152*	-0.157*	-0.194**	-0.197**	-0.198**
	(0.068)	(0.067)	(0.067)	(0.071)	(0.071)	(0.070)
Other immigration program	-0.228	-0.222	-0.225	-0.083	-0.082	-0.083
	(0.178)	(0.173)	(0.172)	(0.066)	(0.065)	(0.065)
Family reunification	-0.147**	-0.145**	-0.146**	-0.092	-0.098	-0.098
	(0.055)	(0.054)	(0.054)	(0.053)	(0.052)	(0.052)
Temporary residents	-0.154	-0.156	-0.159	-0.229**	-0.234**	-0.232**
	(0.107)	(0.105)	(0.105)	(0.086)	(0.087)	(0.087)
Young immigrants	0.081	0.083	0.081	0.018	0.021	0.021
	(0.062)	(0.061)	(0.061)	(0.047)	(0.046)	(0.046)
Canadians by birth born outside Canada	-0.094	-0.095	-0.093	-0.043	-0.040	-0.039
	(0.083)	(0.082)	(0.083)	(0.082)	(0.082)	(0.082)
Second-generation Canadians	-0.040	-0.037	-0.036	0.017	0.017	0.017
	(0.037)	(0.037)	(0.037)	(0.025)	(0.026)	(0.026)
Other covariates:						
Provinces	Y	Y	Y	Y	Y	Y
Rural-urban indicators	Y	Y	Y	Y	Y	Y
Constant	1.363***	1.467***	1.443***	1.322***	1.411***	1.401***
	(0.158)	(0.155)	(0.155)	(0.148)	(0.151)	(0.149)
N	5254	5254	5254	5816	5816	5816
R^2	0.302	0.306	0.305	0.315	0.315	0.315
Adjusted R^2	0.296	0.300	0.300	0.310	0.310	0.310

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. All covariates in columns 4 and 8 in Table 1.6., and columns 3 and 6 in Table 1.7. were included. The analysis was done separately for men and women. The ordinary least squares method was employed to calculate point estimates using all given plausible values of PSTRE in PIAAC 2012. Only men and women with positive self-reported earnings were included. All replicate weights were used to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians who live in large urban population centers in Ontario, obtained a HS diploma as the highest educational attainment in Canada, and belong to the lowest group of ICT scores (< 241 points). ICT = information and communication technology; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table A.1.12. Determinants of log hourly wage, no income Winsorizing at the top 5%

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy				0.001				0.026
				(0.033)				(0.029)
Numeracy				0.082***				0.050*
				(0.024)				(0.025)
Basic ICT			0.072***	0.013			0.073***	0.018
			(0.013)	(0.022)			(0.012)	(0.025)
Points-based immigrants	-0.035	-0.134*	-0.104	-0.098	-0.043	-0.065	-0.026	-0.030
	(0.034)	(0.056)	(0.055)	(0.056)	(0.043)	(0.055)	(0.054)	(0.055)
Refugee	-0.198	-0.191	-0.137	-0.118	-0.301**	-0.262**	-0.174	-0.166
	(0.106)	(0.102)	(0.099)	(0.094)	(0.114)	(0.088)	(0.097)	(0.102)
Other immigration program	-0.240	-0.312	-0.295	-0.278	-0.120**	-0.111	-0.075	-0.069
	(0.153)	(0.182)	(0.184)	(0.180)	(0.045)	(0.060)	(0.060)	(0.061)
Family reunification	-0.184***	-0.176**	-0.134*	-0.107	-0.201***	-0.159**	-0.099	-0.092
	(0.052)	(0.057)	(0.059)	(0.057)	(0.050)	(0.060)	(0.058)	(0.058)
Temporary residents	-0.211*	-0.225	-0.200	-0.175	-0.300***	-0.245*	-0.178	-0.174
	(0.100)	(0.116)	(0.115)	(0.114)	(0.080)	(0.111)	(0.104)	(0.102)
Young immigrants	0.115	0.064	0.072	0.091	0.091	0.014	0.028	0.034
	(0.066)	(0.074)	(0.072)	(0.070)	(0.054)	(0.051)	(0.053)	(0.051)
Canadians by birth born outside Canada	-0.011	-0.070	-0.072	-0.075	0.059	-0.014	-0.016	-0.018
	(0.103)	(0.091)	(0.088)	(0.088)	(0.091)	(0.088)	(0.088)	(0.090)
Second-generation Canadians	0.006	-0.051	-0.051	-0.041	0.092**	0.019	0.016	0.016
	(0.039)	(0.040)	(0.040)	(0.039)	(0.029)	(0.027)	(0.027)	(0.027)
Age	0.085***	0.074***	0.073***	0.072***	0.083***	0.069***	0.067***	0.067***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.010)	(0.008)	(0.008)	(0.008)

(continued)

Table A.1.12. continued

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age^2/100	-0.087***	-0.074***	-0.071***	-0.071***	-0.092***	-0.071***	-0.067***	-0.067***
	(0.011)	(0.010)	(0.010)	(0.010)	(0.012)	(0.010)	(0.010)	(0.010)
Education								
< High school		-0.225	-0.151	-0.167		-0.426**	-0.387*	-0.383*
		(0.262)	(0.256)	(0.272)		(0.146)	(0.157)	(0.151)
College or trade school		0.041	0.030	0.024		0.160***	0.150***	0.141***
		(0.042)	(0.042)	(0.044)		(0.031)	(0.030)	(0.030)
≥ Bachelor's degree		0.397***	0.355***	0.323***		0.462***	0.425***	0.394***
		(0.041)	(0.043)	(0.046)		(0.034)	(0.035)	(0.037)
College/trade graduates with STEM		0.179***	0.173***	0.159***		0.027	0.007	0.002
		(0.036)	(0.035)	(0.035)		(0.049)	(0.049)	(0.049)
≥ Bachelor's degree with STEM		0.058	0.035	0.024		0.053	0.031	0.019
		(0.043)	(0.043)	(0.042)		(0.052)	(0.053)	(0.053)
Individuals with missing fields of study		0.125	0.103	0.132		0.289	0.302	0.310*
		(0.263)	(0.256)	(0.272)		(0.149)	(0.159)	(0.153)
Interaction								
< High school x foreign education		-0.379	-0.316	-0.372		-0.027	-0.014	-0.013
		(0.389)	(0.419)	(0.405)		(0.142)	(0.161)	(0.167)
High school x foreign education		-0.159*	-0.122	-0.115		-0.183*	-0.160*	-0.147*
		(0.075)	(0.077)	(0.078)		(0.075)	(0.074)	(0.075)
College/trade x foreign education		0.039	0.069	0.061		-0.198*	-0.188*	-0.180*
		(0.099)	(0.099)	(0.103)		(0.089)	(0.086)	(0.087)
≥ Bachelor's degree x foreign education		-0.172**	-0.168**	-0.165**		-0.297***	-0.279***	-0.264***
		(0.064)	(0.063)	(0.064)		(0.071)	(0.071)	(0.070)
College or trade school x STEM x foreign education		-0.225	-0.248	-0.245		0.089	0.140	0.146
		(0.135)	(0.132)	(0.133)		(0.112)	(0.138)	(0.139)

(continued)

Table A.1.12. continued

	Dependent variable: Log(Hourly Wage)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
≥ Bachelor's degree x STEM x foreign education		-0.010	0.026	0.017		0.035	0.045	0.049
		(0.089)	(0.088)	(0.086)		(0.089)	(0.088)	(0.087)
Missing field of study x foreign education		n/a	n/a	n/a		n/a	n/a	n/a
		n/a	n/a	n/a		n/a	n/a	n/a
Other covariates:								
Provinces	N	Y	Y	Y	N	Y	Y	Y
Rural-urban indicators	N	Y	Y	Y	N	Y	Y	Y
Constant	1.390***	1.489***	1.479***	1.503***	1.353***	1.413***	1.418***	1.460***
	(0.178)	(0.169)	(0.167)	(0.168)	(0.186)	(0.166)	(0.167)	(0.168)
N	4434	4434	4434	4434	5109	5109	5109	5109
R^2	0.128	0.262	0.276	0.285	0.099	0.266	0.280	0.287
Adjusted R^2	0.126	0.257	0.270	0.279	0.097	0.261	0.275	0.281

Sources: Authors' calculations from PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores and positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table A.1.13. Determinants of log hourly wage, no income Winsorizing at the top 0.5%, including individuals who do not have valid PSTRE scores

	Dependent variable: Log(Hourly Wage)					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy			-0.005			0.027
			(0.025)			(0.024)
Numeracy			0.078***			0.043
			(0.022)			(0.024)
Reasons for not taking computer-based tests						
No computer experience	-0.265***	-0.181***	-0.158**	-0.194	-0.071	-0.077
	(0.053)	(0.053)	(0.054)	(0.102)	(0.105)	(0.106)
Failed ICT core tests	0.105*	0.058	0.040	0.003	-0.029	-0.052
	(0.048)	(0.045)	(0.043)	(0.049)	(0.046)	(0.044)
Refused taking computer-based tests	0.004	0.042	0.009	-0.034	-0.032	-0.077
	(0.051)	(0.047)	(0.053)	(0.044)	(0.039)	(0.042)
Levels of basic ICT test scores						
241 points to < 291 points	0.223***	0.160***	0.103***	0.174***	0.109***	0.054
	(0.028)	(0.028)	(0.030)	(0.031)	(0.027)	(0.031)
≥ 291 points	0.362***	0.218***	0.101**	0.368***	0.203***	0.093*
	(0.030)	(0.031)	(0.039)	(0.031)	(0.031)	(0.041)
Points-based immigrants	-0.001	-0.086	-0.079	0.004	-0.061	-0.058
	(0.032)	(0.047)	(0.047)	(0.039)	(0.052)	(0.052)
Refugee	-0.220***	-0.197**	-0.161*	-0.205*	-0.225***	-0.197**
	(0.065)	(0.067)	(0.067)	(0.091)	(0.066)	(0.071)
Other immigration program	-0.216	-0.251	-0.232	-0.071	-0.097	-0.087
	(0.151)	(0.176)	(0.172)	(0.051)	(0.064)	(0.066)
Family reunification	-0.196***	-0.189***	-0.151**	-0.096*	-0.119*	-0.096
	(0.042)	(0.054)	(0.054)	(0.039)	(0.051)	(0.052)
Temporary residents	-0.183*	-0.192	-0.161	-0.228***	-0.248**	-0.226**
	(0.084)	(0.105)	(0.105)	(0.064)	(0.089)	(0.086)
Young immigrants	0.099	0.060	0.082	0.079	0.009	0.017
	(0.061)	(0.068)	(0.066)	(0.049)	(0.048)	(0.047)
Canadians by birth born outside Canada	-0.075	-0.099	-0.098	-0.007	-0.054	-0.043
	(0.093)	(0.082)	(0.083)	(0.086)	(0.082)	(0.082)
Second-generation Canadians	0.002	-0.045	-0.039	0.073**	0.016	0.016
	(0.036)	(0.038)	(0.038)	(0.028)	(0.026)	(0.026)

(continued)

Table A.1.13. continued

	Dependent variable: Log(Hourly Wage)					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Age	0.079***	0.072***	0.071***	0.072***	0.064***	0.063***
	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)
$Age^2/100$	-0.077***	-0.070***	-0.070***	-0.075***	-0.064***	-0.063***
	(0.010)	(0.009)	(0.009)	(0.011)	(0.010)	(0.010)
Education						
< High school		-0.108	-0.128		-0.249	-0.255
		(0.213)	(0.213)		(0.202)	(0.192)
College or trade school		0.036	0.032		0.163***	0.152***
		(0.041)	(0.042)		(0.028)	(0.028)
≥ Bachelor's degree		0.357***	0.325***		0.439***	0.404***
		(0.041)	(0.042)		(0.033)	(0.034)
College/trade graduates with STEM		0.167***	0.151***		0.015	0.005
		(0.035)	(0.035)		(0.047)	(0.048)
≥ Bachelor's degree with STEM		0.058	0.038		0.034	0.019
		(0.041)	(0.041)		(0.052)	(0.053)
Individuals with missing fields of study		0.040	0.084		0.153	0.180
		(0.213)	(0.214)		(0.207)	(0.196)
Interaction						
< High school x foreign education		0.006	0.037		0.064	0.108
		(0.098)	(0.102)		(0.414)	(0.468)
High school x foreign education		-0.109	-0.086		-0.037	-0.021
		(0.061)	(0.062)		(0.068)	(0.071)
College/trade x foreign education		0.040	0.033		-0.163*	-0.152*
		(0.093)	(0.095)		(0.073)	(0.075)
≥ Bachelor's degree x foreign education		-0.211***	-0.208***		-0.289***	-0.273***
		(0.059)	(0.060)		(0.064)	(0.063)
College or trade school x STEM x foreign education		-0.244*	-0.234*		0.025	0.047
		(0.118)	(0.118)		(0.128)	(0.135)
≥ Bachelor's degree x STEM x foreign education		0.034	0.038		0.073	0.079
		(0.081)	(0.080)		(0.083)	(0.081)

(continued)

Table A.1.13. continued

	Dependent variable: Log(Hourly Wage)					
	Men			Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Missing field of study x foreign education		n/a	n/a		-0.056	-0.067
		n/a	n/a		(0.395)	(0.450)
Other covariates:						
Provinces	N	Y	Y	N	Y	Y
Rural-urban indicators	N	Y	Y	N	Y	Y
Constant	1.218***	1.354***	1.448***	1.266***	1.345***	1.448***
	(0.168)	(0.162)	(0.160)	(0.175)	(0.163)	(0.165)
N	5254	5254	5254	5816	5816	5816
R^2	0.185	0.284	0.294	0.173	0.294	0.301
Adjusted R^2	0.183	0.279	0.289	0.171	0.289	0.296

Sources: Authors' calculations from PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada and belong to the lowest group of ICT scores (<241 points). ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table A.1.14. Determinants of basic ICT scores, including interaction terms of STEM and subpopulation groups

	Dependent variable: Basic ICT scores			
	Men		Women	
	(1)	(2)	(3)	(4)
Literacy		0.612***		0.589***
		(0.032)		(0.028)
Numeracy		0.230***		0.229***
		(0.036)		(0.030)
Points-based immigrants	-0.376**	-0.083	-0.542***	-0.213*
	(0.140)	(0.097)	(0.139)	(0.099)
Refugee	-0.854**	-0.096	-1.314***	-0.375
	(0.310)	(0.175)	(0.385)	(0.221)
Other immigration program	-0.499	-0.124	-0.553**	-0.154
	(0.289)	(0.154)	(0.204)	(0.167)
Family reunification	-0.556**	-0.008	-0.817***	-0.260*
	(0.178)	(0.118)	(0.126)	(0.107)
Temporary residents	-0.732**	-0.065	-1.025***	-0.361
	(0.223)	(0.176)	(0.288)	(0.197)
Young immigrants	-0.188	0.067	-0.187	-0.012
	(0.170)	(0.114)	(0.137)	(0.119)
Canadians by birth born outside Canada	0.083	0.029	0.078	0.040
	(0.351)	(0.233)	(0.201)	(0.192)
Second-generation Canadians	0.047	0.058	0.044	0.013
	(0.096)	(0.057)	(0.064)	(0.044)
Age	0.015	-0.006	0.025	0.003
	(0.017)	(0.013)	(0.018)	(0.016)
$Age^2/100$	-0.042*	-0.008	-0.053*	-0.020
	(0.020)	(0.016)	(0.022)	(0.019)
Education				
< High school	-1.025*	-0.409	-0.527	-0.172
	(0.462)	(0.424)	(0.337)	(0.377)
College or trade school	0.149	-0.024	0.126	-0.055
	(0.101)	(0.058)	(0.065)	(0.054)
≥ Bachelor's degree	0.571***	-0.131	0.511***	-0.138*
	(0.090)	(0.076)	(0.060)	(0.060)
College/trade graduates with STEM	0.058	-0.023	0.254*	0.095
	(0.100)	(0.063)	(0.107)	(0.081)
≥ Bachelor's degree with STEM	0.388***	0.133	0.365**	0.076
	(0.111)	(0.088)	(0.118)	(0.073)
Individuals with missing fields of study	0.294	0.280	-0.172	0.039
	(0.438)	(0.413)	(0.337)	(0.380)

(continued)

Table A.1.14. continued

	Dependent variable: Basic ICT scores			
	Men		Women	
	(1)	(2)	(3)	(4)
Interaction				
< High school x foreign education	-0.858	-0.620	-0.116	-0.011
	(1.101)	(0.668)	(0.497)	(0.255)
High school x foreign education	-0.442	-0.066	-0.289	0.061
	(0.254)	(0.198)	(0.210)	(0.161)
College/trade x foreign education	-0.351	-0.143	-0.112	0.042
	(0.212)	(0.158)	(0.172)	(0.131)
≥ Bachelor's degree x foreign education	-0.033	0.078	-0.216	0.076
	(0.154)	(0.098)	(0.123)	(0.086)
College or trade school x STEM x foreign education	0.046	-0.008	-0.446	-0.116
	(0.343)	(0.236)	(0.757)	(0.513)
≥ Bachelor's degree x STEM x foreign education	-0.285	-0.295	-0.125	-0.055
	(0.235)	(0.180)	(0.268)	(0.204)
Missing field of study x foreign education	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a
STEM interaction terms				
STEM at college or trade x Points-based immigrants	0.085	0.183	-0.405	-0.020
	(0.361)	(0.208)	(0.651)	(0.439)
STEM at college or trade x Refugee	0.388	0.120	0.652	0.044
	(0.458)	(0.373)	(0.603)	(0.403)
STEM at college or trade x Other immigration programs	0.755	0.624	0.812	-0.117
	(0.441)	(0.403)	(0.679)	(0.509)
STEM at college or trade x Family reunification	0.117	0.097	-0.603	-0.161
	(0.300)	(0.190)	(0.771)	(0.412)
STEM at college or trade x Temporary residents	0.929	0.379	1.622	0.537
	(0.498)	(0.389)	(1.347)	(0.597)
STEM at college or trade x Young immigrants	0.230	0.062	0.199	0.086
	(0.296)	(0.187)	(0.506)	(0.395)
STEM at college or trade x Canadians by birth born outside Canada	0.050	0.111	-0.245	0.141
	(0.445)	(0.366)	(1.183)	(0.672)
STEM at college or trade x Second-generation Canadians	-0.094	-0.011	0.014	-0.029
	(0.155)	(0.098)	(0.389)	(0.287)
STEM at ≥ bachelor's degree x Points-based immigrants	-0.342	0.047	-0.022	0.001
	(0.221)	(0.166)	(0.327)	(0.232)
STEM at ≥ bachelor's degree x Refugee	-0.428	-0.090	0.534	-0.071
	(0.664)	(0.396)	(0.981)	(0.547)

(continued)

Table A.1.14. continued

	Dependent variable: Basic ICT scores			
	Men		Women	
	(1)	(2)	(3)	(4)
STEM at ≥ bachelor's degree x Other immigration programs	0.347	0.127	0.007	0.078
	(0.445)	(0.304)	(0.503)	(0.387)
STEM at ≥ bachelor's degree x Family reunification	-0.575	-0.063	-0.046	0.142
	(0.327)	(0.211)	(0.313)	(0.223)
STEM at ≥ bachelor's degree x Temporary residents	0.351	0.225	-0.069	0.145
	(0.394)	(0.289)	(0.588)	(0.359)
STEM at ≥ bachelor's degree x Young immigrants	0.010	-0.079	-0.107	0.023
	(0.366)	(0.274)	(0.307)	(0.249)
STEM at ≥ bachelor's degree x Canadians by birth born outside Canada	-0.923	-0.085	-0.803	-0.379
	(0.857)	(0.402)	(1.380)	(0.490)
STEM at ≥ bachelor's degree x Second-generation Canadians	-0.120	0.059	-0.205	-0.125
	(0.202)	(0.154)	(0.277)	(0.214)
Other covariates				
Provinces	Y	Y	Y	Y
Rural-urban indicators	Y	Y	Y	Y
Constant	0.134	0.432	-0.078	0.371
	(0.312)	(0.248)	(0.360)	(0.293)
N	4434	4434	5109	5109
R^2	0.244	0.727	0.275	0.720
Adjusted R^2	0.235	0.724	0.267	0.717

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores and positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians, who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

Table A.1.15. Determinants of basic ICT scores for all individuals with valid basic ICT scores

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy				0.609***				0.598***
				(0.027)				(0.027)
Numeracy				0.227***				0.236***
				(0.030)				(0.030)
Points-based immigrants	-0.179*	-0.526***	-0.384***	0.009	-0.391***	-0.565***	-0.431***	-0.151
	(0.076)	(0.080)	(0.107)	(0.083)	(0.071)	(0.070)	(0.100)	(0.087)
Refugee	-0.708**	-0.808***	-0.726**	-0.073	-1.172***	-1.234***	-1.103***	-0.312*
	(0.233)	(0.214)	(0.242)	(0.134)	(0.199)	(0.210)	(0.253)	(0.151)
Other immigration program	-0.291	-0.450*	-0.283	-0.059	-0.463**	-0.582***	-0.432**	-0.114
	(0.212)	(0.185)	(0.158)	(0.120)	(0.141)	(0.138)	(0.150)	(0.121)
Family reunification	-0.515***	-0.627***	-0.551***	0.069	-0.718***	-0.777***	-0.667***	-0.150
	(0.114)	(0.107)	(0.121)	(0.084)	(0.090)	(0.083)	(0.097)	(0.082)
Temporary residents	-0.424*	-0.582***	-0.371*	0.117	-0.900***	-0.908***	-0.736***	-0.160
	(0.166)	(0.163)	(0.169)	(0.133)	(0.185)	(0.165)	(0.180)	(0.132)
Young immigrants	0.101	-0.003	-0.070	0.102	0.019	-0.090	-0.153	-0.015
	(0.111)	(0.110)	(0.113)	(0.083)	(0.109)	(0.108)	(0.108)	(0.093)
Canadians by birth born outside Canada	0.229	0.120	0.066	0.092	0.109	0.085	0.066	0.042
	(0.168)	(0.194)	(0.187)	(0.127)	(0.202)	(0.185)	(0.181)	(0.143)
Second-generation Canadians	0.137**	0.085	0.011	0.063	0.160**	0.096	0.031	0.026
	(0.052)	(0.049)	(0.053)	(0.034)	(0.057)	(0.054)	(0.055)	(0.041)
Age	0.018	-0.007	0.003	-0.011	0.047**	0.021	0.024	0.008
	(0.017)	(0.016)	(0.016)	(0.011)	(0.015)	(0.015)	(0.015)	(0.013)
$Age^2/100$	-0.046*	-0.016	-0.027	-0.002	-0.086***	-0.050**	-0.054**	-0.026
	(0.021)	(0.020)	(0.019)	(0.014)	(0.019)	(0.018)	(0.018)	(0.015)

(continued)

Table A.1.15. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education								
< High school		-0.754***	-0.995*	-0.406		-0.787***	-0.553	-0.137
		(0.088)	(0.401)	(0.371)		(0.097)	(0.287)	(0.325)
College or trade school		0.202***	0.166*	-0.007		0.132**	0.123*	-0.050
		(0.055)	(0.079)	(0.048)		(0.046)	(0.052)	(0.044)
≥ Bachelor's degree		0.693***	0.568***	-0.093		0.520***	0.504***	-0.143**
		(0.060)	(0.071)	(0.068)		(0.047)	(0.053)	(0.051)
College/trade graduates with STEM			0.045	0.002			0.287***	0.137*
			(0.076)	(0.045)			(0.085)	(0.065)
≥ Bachelor's degree with STEM			0.315***	0.136			0.370***	0.082
			(0.088)	(0.071)			(0.083)	(0.061)
Individuals with missing fields of study			0.310	0.293			-0.206	0.046
			(0.391)	(0.358)			(0.288)	(0.330)
Interaction								
< High school x foreign education			-1.054*	-0.602			-1.030	-0.560
			(0.415)	(0.393)			(0.678)	(0.675)
High school x foreign education			-0.454**	-0.143			-0.202	0.010
			(0.173)	(0.142)			(0.151)	(0.104)
College/trade x foreign education			-0.429*	-0.094			-0.295*	-0.018
			(0.176)	(0.145)			(0.148)	(0.112)
≥ Bachelor's degree x foreign education			-0.148	0.011			-0.357***	0.032
			(0.127)	(0.085)			(0.103)	(0.073)
College or trade school x STEM x foreign education			0.280	0.066			-0.425	-0.120
			(0.233)	(0.166)			(0.559)	(0.301)
≥ Bachelor's degree x STEM x foreign education			-0.439**	-0.255*			-0.155	-0.033
			(0.155)	(0.113)			(0.152)	(0.109)

(continued)

Table A.1.15. continued

	Dependent variable: Basic ICT scores							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Missing field of study x foreign education			n/a	n/a			0.823	0.425
			n/a	n/a			(0.604)	(0.656)
Other covariates:								
Provinces	N	Y	Y	Y	N	Y	Y	Y
Rural-urban indicators	N	Y	Y	Y	N	Y	Y	Y
Constant	0.144	0.445	0.384	0.501*	-0.364	-0.073	-0.067	0.276
	(0.326)	(0.302)	(0.291)	(0.217)	(0.299)	(0.286)	(0.287)	(0.239)
N	6151	6151	6151	6151	7396	7396	7396	7396
R^2	0.079	0.215	0.244	0.722	0.137	0.239	0.266	0.728
Adjusted R^2	0.078	0.213	0.240	0.721	0.136	0.238	0.263	0.726

Source: PIAAC 2012. Authors' calculations.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. Empty cells indicate that the respective independent variable was not included in the regression analysis. The analysis was done separately for each gender. Included are 13,447 individuals with valid basic ICT scores. The ordinary least squares method was used to calculate point estimates using all given plausible values of basic ICT test scores in PIAAC 2012. Only men and women with valid basic ICT test scores and positive self-reported earnings were included. All replicate weights were employed to derive standard errors following the delete-one jackknife method outlined in OECD (2013a). The omitted group is third-generation Canadians who live in large urban population centers in Ontario and obtained a HS diploma as the highest educational attainment in Canada. ICT = information and communication technology; N = variable was not included in the regression analysis; n/a = not applicable; STEM = science, technology, engineering, and mathematics; Y = variable was controlled for in the regression analysis.

CHAPTER 2 – WAGE, LITERACY, NUMERACY SKILLS INEQUALITY: THE ROLE OF IMMIGRATION ADMISSION CATEGORIES

2.1. INTRODUCTION

Canada is a major immigrant-receiving nation with individuals arriving from different countries, economic backgrounds, and under various admission categories. There are numerous studies focused on the labour market performance of immigrants compared to the Canadian born (e.g., Aydemir and Skuterud 2005; Sweetman and Warman 2013; Warman, Webb, and Worswick 2019). However, there is little research studying differences in basic skills (e.g., literacy and numeracy) and labour market remuneration between immigrant and Canadian-born population subgroups. This paper utilizes Statistics Canada's 2012 Survey of Adult Skills, part of the OECD's Programme for the International Assessment of Adult Competencies (PIAAC), to compare immigrants' performance on basic literacy and numeracy tests by admission category to those of second- and third-generation Canadians. We also examine the impact of literacy and numeracy on earnings and rates of return to education among these subgroups of the population, controlling for key variables affecting labour market outcomes.

While immigrants' characteristics (e.g., countries of origin, language skills, and other socioeconomic variables) and the programs underlying admission categories have changed over the past 50 years, the three broad immigrant admission categories – economic

class, family reunification, and refugee – have remained intact. Although there have been appreciable changes to the economic class over the period relevant for our sample, it has consistently comprised a mix of sub-categories with the goal of selecting principal applicants who are expected to be successful in the labour market and/or fill a labour market niche, along with their spouses and dependents. The family reunification category allows current Canadian citizens and permanent residents to sponsor family members to immigrate to Canada. Refugees, who could be privately sponsored or sponsored by the government, are admitted on humanitarian grounds. In this paper, the refugee category cannot be separated into different subgroups, and it excludes those who were refugee claimants at the time of the survey since it had not been determined if they would qualify. In 2015, the economic class (which includes principal applicants, and their dependents) accounted for 62.7 percent of all permanent immigrants, up from about 35 percent in 1980. Between 1980 and 2015, approximately 12 percent of the annual immigrant flow were refugees (Sweetman 2017; Sweetman and Truong 2018; IRCC multiple dates).

Economic immigrants (at least the principal applicants) are expected to perform well in the Canadian labour market because they are assessed on essential determinants of labour market success such as education and employment history.[20] In this paper, we define economic immigration to include points-based immigrants, investors, entrepreneurs, and

[20] A subclass of economics class immigrants are investors, entrepreneurs and self-employed individuals who are assessed on their ability to establish businesses and otherwise invest in the Canadian economy. They are a small percentage of total immigration, comprising approximately two percent of the flow in 2015 (IRCC 2016). However, we are not able to separate subcategories such as points-based immigrants, business investors, or live-in caregivers using our data. Furthermore, there are newer immigration subcategories under the economic class – such as the provincial/territorial nominee program introduced in the late 1990s and the Canadian experience class in 2009 – which we are also not able to separate out using our data.

self-employment stream immigrants using self-reports in the PIAAC 2012. In 2010 Citizenship and Immigration Canada (CIC), the predecessor to the current Immigration, Refugees, and Citizenship Canada (IRCC) introduced mandatory language testing for points-based immigrants.[21] The admission of immigrants from the other two major classes (i.e., family reunification and refugees) is not based on employability factors, and thus they are likely to have lower basic literacy and numeracy skills compared to those of economic immigrants.

Despite coming from various socioeconomic backgrounds and having different motives for migrating, immigrants are treated as one homogenous group in many studies due to the paucity of data on immigration categories. There are a few studies considering immigrants by specific category, particularly those focusing on refugees. Some studies do identify refugees based on their year of arrival and specific refugee events provided in the survey of interest (e.g., the Mariel Boatlift Cuban refugees in the U.S. in Card (1990) and Borjas and Monras (2017); Vietnamese refugees in Canada in Hou (2017)). Furthermore, studies that compare the education and labour market performance of immigrants in various admission categories to those of the native-born mostly use data from Canada and Australia.[22] For Canada, Sweetman and Warman (2013) find that immigrants who arrived in Canada in the economic class have long-term earnings advantages compared to those in

[21] Under the most recent skilled-based system, mandatory language testing is required for all individuals applying through the Express Entry program. Unfortunately, our data do not capture the changes in the immigration program that were implemented from 2011 onward.

[22] Refer to Bauer, Lofstrom, and Zimmermann (2001) for an overview of the overall differences in the immigration policies of Canada and Australia, and Mahboubi (2017) for differences specifically in the points-based systems in Canada and Australia. For studies examining the labour market performance of different immigration classes in Australia, see Miller (1999), Cobb-Clark (2000), Hugo (2002), Chiswick, Lee, and Miller (2006) as examples.

other categories. Their results also suggest that in the short run privately sponsored refugees have relatively good labour market outcomes compared to economic immigrants and that economic immigrants have earnings advantages compared to other categories in the longer-term, defined as approximately four years after landing. Aydemir (2011) finds that even though economic immigrants are selected for their high skills and education, on average, they do not have superior earnings and labour force participation rates compared to other immigration categories in the short term, around two years after landing.

Truong and Sweetman (2018) document that refugees have lower educational attainment compared to other immigrant classes as well as those born in Canada. Hou and Bonikowski (2016) use the 2011 National Household Survey linked with the Immigrant Landing File to assess the labour market performance of childhood immigrants who arrived at age 17 or younger. They find that children whose parents arrived in the economic class have the highest earnings while those whose parents arrived as refugees have the lowest and that these outcomes are transmitted in part through differences in education and the official language abilities of parents. Warman, Webb, and Worswick (2019) use the Longitudinal Immigration Database (IMDB), which links administrative immigration and income tax data files, and find that economic immigrants have higher earnings, compared to those who arrived under the family or refugee classes, and that this advantage also extends to their children.

Beyond immigration, we extend the growing literature showing the importance of basic skills for earnings. Green and Riddell (2003), using the 1994 International Adult Literacy Survey (IALS), find that literacy has a large positive impact on earnings and

reduces the schooling coefficient by about 30 percent. Green and Riddell (2013) combine the IALS with the 2003 International Adult Literacy and Life Skills Survey (IALSS) to examine the impacts of ageing on literacy skills across birth cohorts for Canada, the U.S., and Norway. They find a weak negative relationship between age and literacy skills in the cross-sectional analysis, with the age effect less evident in the bottom of this skills distribution but stronger at the top. In an international comparison, Hanushek et al. (2015) employ the PIAAC to study the return to numeracy skills in 23 countries for workers between 35 to 54 years of age who work at least 30 hours per week. They find that a one-standard-deviation increase in numeracy skills is on average associated with approximately an 18 percent increase in earnings, and different labour and product market regulations (e.g., unionization) play a role in determining differences in returns to skill.

In term of studies on socioeconomic outcomes of immigrants in Canada, Ferrer, Green, and Riddell (2006) also use the IALS along with the 1998 Ontario Immigrant Literacy Survey (OILS) and show that differences in measured literacy scores explain about two-thirds of the earnings gap between university-educated immigrants and those born in Canada. Furthermore, in a simple policy-oriented think tank report Mahboubi (2017) employs the immigration variable in PIAAC 2012 and finds that immigrants on average score below all Canadian-born individuals. She also provides policy recommendations emphasizing more robust official language testing, international students as a source of immigrants, and high-quality language programs for immigrants after arrival.

Other literature also points to the importance of language skills on labour market outcomes (e.g., Chiswick and Miller 1995, 2002, 2005; Bleakley and Chin 2004, 2010; de

Coulon and Wolff 2007; Dustmann and van Soest 2001, 2002). Warman, Sweetman, and Goldmann (2015) note that host-country language proficiency is highly rewarded in the Canadian labour market. Similarly, Sweetman and Warman (2010) cite poor language ability as a deficiency that makes immigrant human capital less productive. Warman, Webb, and Worswick (2019) find that the wage premium in Canada for immigrants with either French or English as a mother tongue is substantial, even after controlling for knowledge of one or both official languages (a self-reported yes/no with no measure of actual skills) at the time of arrival. Also of relevance is the literature studying the earning differences among immigration generations (surveyed by Sweetman and van Ours 2014) and the impacts of age at arrival on the earnings of immigrants.

This research contributes to the literature in two ways. First, we contrast literacy and numeracy proficiency between immigrants and Canadian-born individuals. Secondly, we extend the current literature studying the labour market outcomes of immigrants in the host country to gain a deeper understanding of how basic literacy and numeracy skills are valued across different population subgroups. To do so, survey respondents are first grouped into adult immigrant, young immigrants, and the Canadian-born. We then disaggregate the sample into nine population subgroups: adult economic immigrants, adult refugees, adult family reunification, other adult immigrants, adult temporary residents, young refugees, young non-refugee immigrants, and second- and third-generation Canadians. Subgroups of immigrants are based on self-reported immigration status, place of birth, and age at arrival. The generation status of the Canadian-born is based on the place of birth of their parents. We exclude the Indigenous population, Canadians at birth who

were born abroad, and individuals whose immigration admission categories cannot be defined.

We also explore differences in foundational skills among population subgroups using subsamples of individuals with and without university education to attempt to account for the heterogeneity in skills among immigrants and the Canadian-born. Literacy and numeracy score gaps are examined along the distribution of each test category using the unconditional quantile method proposed by Firpo, Fortin, and Lemieux (2009). In regards to earnings, we examine the influence of literacy/numeracy scores across the earnings distribution again using the unconditional quantile method.

We observe that both adult and young (i.e., those who arrived in Canada at age 13 years or younger) immigrants have, on average, lower literacy, and numeracy scores than those born in Canada, although the average young immigrant has higher test scores than their adult counterpart. Similar results are found for hourly wages. As the tests are conducted in English or French, domestic language fluency plays a moderating role. Another finding is that those admitted under the economic class tend to have the highest test scores and hourly wages among immigration categories, with refugees having the lowest. In unconditional quantile regressions, test score differences between population groups are quantitatively unchanged across the distribution of skills for classes of immigrants who are highly educated, while classes of immigrants with lower levels of educational attainment experience a decreasing trend in absolute magnitude of test score differences across quantiles. A one-standard-deviation increase in each test score is associated with an eight to 13 percent increase in hourly wages. Also, controlling for test

scores (separately or jointly) reduces the differences in earnings between different groups of immigrants and the Canadian-born. Furthermore, these test scores, when included in earnings regressions, reduce the returns to university education from 17 to 24 percent for both men and women. Finally, our results show that the Canadian labour market rewards all immigrants, regardless of immigration category, and Canadian-born individuals similarly for their literacy and numeracy proficiency.

Section 2.2 discusses the PIACC data set used in the subsequent empirical models which are explained in Section 2.3. Section 2.4 presents the results of the empirical estimation. The final section concludes.

2.2. DATA DESCRIPTION AND SUMMARY STATISTICS

We employ Statistics Canada's Survey of Adult Skills, a component of the OECD's 2012 Programme for the International Assessment of Adult Competencies (PIAAC). Our sample includes all individuals aged 25 to 65 years, excluding members of Canada's Indigenous population, those with unknown population subgroup or immigration information, and Canadians at birth who are born outside of Canada.[23] One disadvantage of PIAAC 2012 in relation to immigrants is that it does not allow us to identify principal applicants, spouses or dependents.

We separate young immigrants – defined as those who arrived in Canada at age 13 years or younger – into two groups, young refugees and young non-refugees. The rationale

[23] These individuals are born outside of Canada to at least one Canadian born parent. In the conventional definition of immigrants based on place of birth, they would have been included in the immigrant group. Even though it is interesting to study these individuals, they are excluded due to insufficient sample size and to obtain more homogenous groupings. Truong and Sweetman (2018) explicitly look at this group of individuals.

for this is following Schaafsma and Sweetman (2001) who show that age-at-arrival has important implications for educational attainment and earnings. Adult immigrants are grouped into five different categories: economic immigrants (those admitted under the points system, including a small number of investors, entrepreneurs, and self-employed persons), refugees, family reunification class, temporary residents and the "other" immigration classes (not clearly defined by Statistics Canada). Unfortunately, we are not able to identify the provincial/territorial nominee programs (which began in 1999 in some provinces) and Canadian Experience Class immigrants (which began in 2009), so there might be a few of each in our 2012 data.[24] In this paper, these few individuals are possibly included in the economic class or the "other" category. Canadian-born individuals are categorized by their parents' place of birth, with the second generation having at least one foreign-born parent, and the third (or higher) generation being those with both parents Canadian-born.

Besides providing demographic and labour market information, PIAAC 2012 evaluates individuals on three cognitive skills: literacy, numeracy, and problem-solving in technology-rich environments. In this paper, we focus on literacy and numeracy proficiency and their impacts on the labour market performance of different immigrant and Canadian-born groups. These cognitive skills are described as "foundational" or "key information-processing competencies" that are used to build other complex skills. Literacy and numeracy scores range from zero to 500 (OECD 2013, 25). Each observation has ten

[24] In a recent change, immigrants in the provincial/territorial nominee programs and the Canadian Experience Class started to be assessed under the Comprehensive Ranking System (a points system separate from the Skilled Worker point system) as part of the Express Entry. However, this was launched after the PIAAC 2012 survey.

plausible values for each test, which are calculated using multiple item response theory.[25] To account for the sample stratification characteristics, 80 replicated weights are provided by Statistics Canada to compute variance estimates using the delete-one jackknife method.

The final sample contains 17,891 individuals, 3,944 of whom fall into one of the immigrant categories and the remaining 13,947 are classified as second- or third-generation Canadians. Table 2.1 presents summary statistics for the sample, classified into two groups – immigrants and Canadian-born individuals. For both men and women who were born in Canada, 80 percent were born to two Canadian-born parents. Within the immigrant group, 38 percent of male immigrants are economic immigrants (including spouses and dependents), and 34 percent are family reunification class. Other categories make up the remainder. On the other hand, family reunification accounts for 41 percent of all female immigrants, with economic immigrants accounting for 31 percent. The proportion of male refugees is almost double that of their female counterparts.

Regarding numeracy and literacy, immigrants are likely to have lower scores, and higher variances compared to those born in Canada. For both groups, men have higher average numeracy scores than women, and immigrant men have higher average literacy scores than their female counterparts. Male Canadian-born workers have higher average hourly wages (for the subsample with positive self-reported earnings) than both Canadian and immigrant women. Hourly wages are similar for Canadian and immigrant men but are higher for women born in Canada compared to immigrant women. The hourly wage

[25] For this reason, these test scores do not represent each individual proficiency level in literacy and numeracy, but a spectrum of proficiency levels for the population of interest.

variance for Canadian-born men is the highest of all four groups, with both groups of men having markedly higher wage variances than the female groups. Regarding education, both male and female immigrants are more likely than the Canadian born to hold at least a bachelor's degree. Conversely, a higher proportion of Canadians hold college or trade credentials (i.e., post-secondary non-university education) than their immigrant counterparts.

Table 2.2 presents the average characteristics of seven population subgroups; we do not distinguish between young refugee and non-refugee immigrant groups in this table. This is to show that there is great heterogeneity among immigration categories. It is not surprising that economic immigrants generally have the highest average literacy and numeracy scores among all immigrant groups; the exception is women in the other immigration classes who have marginally higher scores in both categories. Refugees have the lowest average scores, and second-generation Canadians have higher scores for both tests than the third-generation. Test score variances tend to be higher for the immigrant groups.[26]

Since economic immigrants are admitted based on their favourable labour market characteristics, it is unsurprising that their average hourly wages are the highest among all immigrants and are similar to those of third-generation Canadians. Second-generation Canadians have the highest hourly wages among all individuals in the sample. Our analysis below examines whether this relationship holds when controlling for other demographic

[26] This pattern of literacy scores by immigration category is similar to results of Mahboubi (2017) who also uses the PIAAC data.

characteristics and test scores. Refugees of both genders have the lowest average hourly wages among all immigrant categories. This wage pattern is comparable to the annual earnings pattern in Hou and Bonikowski (2016). The average ages of immigrants and the Canadian-born are similar, between 43 and 48, except temporary residents at 38.5. Economic immigrants arrived in Canada at older ages with relatively few arriving under the age of 14. For refugees, the average age at entry is 25, with about 20 percent coming before age 14.

The percentages of economic immigrants, other immigrants, and temporary residents holding a bachelor's degree exceed those in the refugee and family reunification categories as well as in both Canadian-born groups. However, among immigrant categories, the refugees have the highest rates of post-secondary educational attainment below a university degree, at about 40 percent, a figure comparable to both second and third-generation Canadians. The pattern of individuals holding a university degree is similar to the university completion rate pattern in Hou and Bonikowski (2016). Fewer refugees obtained their highest level of education outside of Canada compared to economic immigrants; that is not surprising given that they were younger on average at the time of arrival.

2.3. EMPIRICAL FRAMEWORKS

Using regression analysis, we explore the mean differences in literacy and numeracy scores, first among the three broad categories – adult and young immigrants, and the Canadian-born – and then among the nine population subgroups. To address the heterogeneous relationships with the independent variables, we also study the differences

across subsamples of individuals with and without a university degree and across the quantiles of the distributions of dependent variables. We then examine average differences in earnings among these groups using a Mincer-type human capital model and seek to understand how these differences change when we control for literacy or numeracy scores (whether separately or jointly in the earnings regressions).

In the initial regression analysis, we estimate the following model for each gender using ordinary least squares (OLS):

$$Score_i = \alpha_1 + \mathbf{Category_i}\alpha_2 + X_i\alpha_3 + \epsilon_i, \quad (2.1)$$

where $Score_i$ is our measure of individual i's literacy or numeracy. These scores have been standardized to have a mean of zero and a standard deviation of one.[27] X_i is a vector of covariates which changes across specifications; included are a cubic polynomial in age, years in Canada,[28] highest level of educational attainment (i.e., below high school, high school graduates – the reference group, post-secondary education below university, and bachelor's degree and above), a dummy variable if the education was obtained abroad,[29] a rural/urban indicator (e.g., rural, small urban, medium urban, and large urban – the reference group),[30] and an indicator for province of residence (i.e., Ontario - the reference

[27] The full-sample standard deviation of the literacy score is 51.2, and that of the numeracy score is 56 points on the scale of 500. A one standard deviation in literacy is equivalent to 1.2 times the unconditional difference in literacy between a high school graduate and individuals who did not complete any secondary education. Also, a one standard deviation in numeracy score can be interpreted as 1.3 times the unconditional difference in numeracy between these individuals.

[28] Years in Canada = survey year (2012) – the year of arrival in Canada + 1. In so doing, we can code 0 years in Canada for all Canadian-born individuals. This variable captures the number of years an immigrant stays in Canada since arrival. Individuals could arrive in Canada before or after they have become a landed immigrant.

[29] We dropped second- and third-generation Canadians who obtained their education abroad in order to obtain a clearer effect on foreign education on literacy and numeracy proficiency.

[30] A small urban population centre has 1,000 to 29,999 inhabitants, a medium urban area has 30,000 to 99,999 inhabitants, and a large urban population center has 100,000 inhabitants or greater.

group, Alberta, British Columbia, the Prairies, the Atlantic provinces, Quebec, and the Territories). We do not mean-deviate age and year-in-Canada variables and we assume that immigrants and the Canadian-born share similar age profiles of literacy and numeracy scores. We also assume that all immigrants would have similar gains in literacy and numeracy scores for each additional year spent in Canada. Thus, the estimated coefficient, α_2, for each immigrant category can be interpreted as the standard deviation difference in test scores in the year of arrival in Canada; the differences change as immigrants spend more time in Canada. Thus, immigrant groups have its own differences in test scores compared to the Canadian-born, but all would have similar gains in literacy/numeracy proficiency for each additional year they live in Canada.[31]

Category is a vector which includes three broad population subgroups (adult immigrants, young immigrants, and the Canadian-born), and subsequently the nine immigration categories: refugees, economic immigrants, family reunification, other immigrants, temporary residents, young refugees, young non-refugee immigrants (young immigrants who arrived under other categories), and second-generation Canadians (third-generation Canadians are the reference category). Including the young immigrant groups

[31] In the regression where we grouped immigrants into nine categories, we first interact the years-in-Canada variable with the economic-immigrant category and assume that other immigrants would experience similar gain in literacy and numeracy for each additional year they live in Canada since arrival. The null hypothesis, that the effects of an additional year in Canada for would be the same for economic immigrants and immigrants arrived under other categories (or the coefficient on this interaction term is equal to zero), cannot be rejected, for both men and women, with p-value of 0.584 for men and 0.405 for women. We also interact the year-in-Canada variable with each of the immigrant categories, and an F-test cannot reject the null hypothesis that the gain in literacy and numeracy proficiency for each additional year they live in Canada since arrival is equal for each immigrant group. The results for these tests could be caused by (1) small sample sizes of some immigrant categories (thus, low power of test), and (2) the inability to distinguish between principal and dependent applicants influence the test results (at least for the economic-immigrant category, the only immigrant group where this distinction is made).

allows us to indirectly control for age at arrival. In the regressions where nine immigration categories were included, the inability to distinguish between principal and dependent applicants may (1) potentially dampen the coefficient on the economic-immigrant category, and (2) have unknown effects on coefficients for other immigration categories. Finally, ϵ_i is a possibly heteoskedastic error term.

In the second stage of the regression analysis, we estimate a Mincer-type model using OLS to understand the earnings gaps among these population/immigrant subgroups by estimating:

$$\log(hourlywage_i) = \beta_1 + \mathbf{Category_i}\beta_2 + X_i\beta_3 + \theta Score_i + \mu_i, \qquad (2.2)$$

where $\log(hourlywage_i)$ is the natural logarithm of the hourly wage rate for individual i, $Score_i$ is the standardized literacy or numeracy score for each individual.[32] These variables are added separately or jointly into the earnings equation. The error term μ_i is possibly heteroskedastic. We control for age and years in Canada, both in its quadratic functional form. We also make assumptions that immigrants and the Canadian-born share a similar age-profile for earnings, and that all immigrants have similar returns to an extra year spent in Canada.[33] The estimated coefficient of β_2 for each immigration category can be interpreted as the average percentage difference in earnings between those in that category in their first year in Canada and third generation Canadians. This difference is assumed to

[32] Self-employed respondents and individuals with missing hourly wage information are excluded in the earnings regressions.

[33] Similarly, we have also interacted the year-in-Canada variable with the economic-immigrant variable in earnings regression where nine population subgroups were included. The null hypothesis that the economic immigrant and other immigration categories have similar returns to an additional year spent in Canada since arrival cannot be rejected for both genders, with p-values of 0.329 and 0.939 for men and women, respectively.

decrease at a decreasing rate with each additional year in Canada. As suggested by both the OECD and Statistics Canada, all plausible values and replicated weights are used to calculate point estimates and compute jackknife standard errors.[34]

Let γ_t denote the coefficient of interest from either regression and $\widehat{\gamma_t}$ be the OLS estimate of γ_t. Indexing plausible values by t, $\hat{\gamma}$ is the equally weighted average of all $\widehat{\gamma_t}$. Also, for each replicate k, $\widehat{\gamma_k}$ is the estimate of γ using observations included in the kth replicate. When plausible values are employed in regression analysis, the variance is the sum of the equally weighted average of sampling variance and the imputation variance, which is imputed as follows:

$$Var(\hat{\gamma}) = \sum_{t=1}^{10} \frac{Var_{sampling}(\widehat{\gamma_t})}{10} + \left[1 + \frac{1}{10}\right] \times \sum_{t=1}^{10} \frac{(\widehat{\gamma_t} - \hat{\gamma})^2}{9} , \qquad (2.3)$$

where $Var_{sampling}(\widehat{\gamma_t})$ is the delete-one jackknife variance, $\frac{79 \sum_{k=1}^{80} (\widehat{\gamma_k} - \hat{\gamma})^2}{80}$. When plausible values are not employed in the regressions, the variance of $\hat{\gamma}$ is the sampling variance. That is, $Var(\hat{\gamma}) = Var_{sampling}(\hat{\gamma})$.

To carry out the sensitivity tests, we explore how differences in test scores change between subsamples of university and non-university graduates and across quantiles of each test scores. We also examine how earnings gaps change across quantiles of log hourly wages. We employ the unconditional quantile method proposed in Firpo, Fortin, and Lemieux (2009) to look at changes in coefficients for the immigrant and Canadian-born

[34] Other methods are sometimes used to deal with plausible values, such as Hanushek et al. (2015) who use only the first plausible value of numeracy scores (of all ten plausible values), and Green and Riddell (2003, 2013) who take a log of an equally weighted average of all five plausible values in IALS 1994 and IALSS 2003. However, these approaches do not take the design of the survey fully into account and inference may be affected.

categories at the 25th, 50th, and 75th quantiles of literacy scores, numeracy scores, and log hourly wages. We examine how immigrants and the Canadian-born differ along the distribution of dependent variables of interest. The standard errors are calculated using the method mentioned above to account for both sampling and imputation (of plausible values) errors. We also seek to understand how economic returns to literacy and numeracy change across the distribution of the earnings and how their presence influences the return to education.

The unconditional quantile regression method is chosen over the conditional quantile regression – proposed by Koenker and Bassett (1978, 2001) – because the latter method cannot be used to estimate the impact of a change in an explanatory variable on the quantile of the unconditional distribution of the outcome variable Firpo, Fortin, and Lemieux (2009). The re-centered influence function (RIF) for the τ^{th} quantile is:

$$RIF(Y, q_\tau) = q_\tau + \frac{\tau - I\{Y \leq q_\tau\}}{f_Y(q_\tau)}, \quad (2.4)$$

where Y is the output of interest, such as literacy, numeracy, and log hourly wages. I is an indicator function of whether the outcome falls below the threshold of q_τ, and $f_Y(q_\tau)$ is the marginal density function of each above-mentioned outcome. However, $RIF(Y, q_\tau)$ is unobserved in practice because it relies on an unobservable true unconditional quantile q_τ. Thus, Firpo, Fortin, and Lemieux (2009) propose the following:

$$\widehat{RIF}(Y, \widehat{q_\tau}) = \widehat{q_\tau} + \frac{\tau + I\{Y \leq \widehat{q_\tau}\}}{\widehat{f_Y}(\widehat{q_\tau})}, \quad (2.5)$$

Equation (2.5) is estimated using the OLS regression, with the assumption that the re-entered influence function is linear in independent variables. We estimate:

$$\widehat{RIF}(Y, \widehat{q_\tau}) = \mathbf{Category_i}\delta_1 + \mathrm{X_i}\delta_2 + \mathrm{e_i}\,, \qquad (2.6)$$

where $\widehat{RIF}(Y, \widehat{q_\tau})$ is the recentered influence function of the τ^{th} quantile. The coefficient δ_1 can be interpreted, similar to the OLS regression coefficient, as the standard deviation difference in test scores (in the case of test scores as the dependent variables) and percentage differences in wages (in the case of log hourly wages as the dependent variable) between the immigration and Canadian-born categories when these immigrants first arrive in Canada, but at the τ^{th} quantile of the respective dependent variables conditional on X_i. In the case where log hourly wage is the dependent variable, standardized literacy and numeracy scores are introduced sequentially as explanatory variables.

2.4. RESULTS

2.4.1. Literacy and numeracy score gaps

Table 2.3 shows, separately for men and women, regression results using OLS with literacy scores as the dependent variable and the three broad population categories. Estimated coefficients are interpreted as the number of standard deviations away from the average score of the non-immigrant group – the reference group – when they first arrive in Canada, which change linearly with each additional year spent in Canada

Columns 1 and 5 of Table 2.3 show that controlling for age, its polynomial and years in Canada, male and female adult immigrants have literacy scores that are on average about 0.66 and 1.07 standard deviations less than their counterparts who are born in Canada. Adding controls for the highest level of educational attainment (columns 2 and 6) results in a larger negative coefficient for immigrants: -1.04 for men and -1.20 for women. Accounting for whether individuals obtained their education in countries other than Canada

(columns 4 and 8) helps explain some of the differences in test scores and reduces the coefficients to -0.90 and -0.87 for men and women, respectively.[35]

Coming to Canada at a young age allows immigrants to participate in the Canadian education system and have better knowledge, compared to their parents, of one or both official languages in Canada. However, both male and female young immigrants do face statistically significant literacy scores gaps compared to the non-immigrant group. In the full specification model, columns 4 and 8, the differences in literacy proficiency are lower by 0.71 for men and 0.64 for women. For these individuals who were born abroad, not all of whom would have learned English or French before coming to Canada, the results suggest that the disadvantages are due to young immigrants being less likely to speak English or French at a young age when language skills are developed.[36,37]

It is not surprising that those with higher levels of education (above high school) tend to have higher literacy scores. However, individuals who obtained their education abroad do worse on literacy tests than those who received their highest level of education in Canada. The coefficients are statistically significant and negative for male adult immigrants with non-postsecondary education. Interestingly, education abroad has a more detrimental effect on literacy scores at lower levels of education than at higher levels,

[35] For example, a male adult immigrant who has been in Canada for 10 years would have scores (-0.899+0.011 x 10 =) -0.789 standard deviations lower in literacy compared to the non-immigrant in Canada, assuming all else equal.

[36] We test the hypothesis that coefficients on adult immigrants and young immigrants are jointly equal to zero. The F-test rejects the null hypothesis that immigrants and young immigrants would have the similar differences in test scores compared to the non-immigrant group, for both genders (p-value=0.000).

[37] For male young immigrants who have been in Canada for 20 years and all else equal, the estimate for these individuals would be -0.712 + 20 x 0.011 = -0.492. That is, the test scores gap for young immigrants who have been in Canada for at least 20 years is 0.49 standard deviations less compared to those who are born in Canada.

especially for men. The result also suggests that there are no statistical differences in test scores by urban size, except for men who live in rural areas (column 4). Nor does region of residence matter, except for those who live in Atlantic Canada and Quebec where average literacy scores are lower than for those who live in Ontario.

As mentioned above, immigrants arrived in Canada under various categories and with different circumstances. Table 2.1 shows considerable heterogeneity in test scores, educational, and other observable characteristics. Recall that we assume immigrants and the Canadian-born have similar age-profiles for literacy proficiency and that all immigrants have similar gains for each additional year spent in Canada. To test this assumption, we repeated the analysis with immigrants and the Canadian disaggregated into nine population subgroups in Table 2.4. Columns 1 and 5 show that both male and female second-generation Canadians outscore their third-generation counterparts. However, these differences are related to differences in educational attainment (columns 2 and 6). All adult immigrant groups have literacy scores that are statistically below those of third-generation Canadians (the reference category), especially once the education variables are included. Refugees tend to have the lowest literacy scores for both men and women: more than one standard deviation less than third-generation Canadians in all specifications.

Across all specifications and for both genders, the estimates for all immigration categories are relatively constant, except for male adult economic immigrants. The coefficients estimated for this group increase in absolute magnitude as we go from left to right. Recall from Table 2.2 that 68 percent of male adult immigrants obtained at least a bachelor's degree, as compared to less than 30 percent of the Canadian-born, and that many

of them obtained their degrees abroad. These proportions are the highest in all immigration categories. Given their admission category, these individuals might be expected to have literacy skills that would allow them to compete in the labour market. The results in Table 2.4 suggest otherwise, especially when controlling for education and whether it was obtained abroad.[38] Controlling for foreign education helps alleviate some of these differences in test scores between immigration categories compared to the third generation. As mentioned in the previous section, the estimated coefficient on the economic-immigrant categories could be dampened due to our inability to distinguish principal applicants from their dependents.

Young immigrants are separated into two groups in Table 2.4, young refugee and non-refugee immigrants; the statistically significant differences in literacy scores as compared to the third generation found for all young immigrants in Table 2.3 remain. These individuals come to Canada at young ages and thus mostly receive a Canadian education. However, the results in Tables 2.3 and 2.4 seem to suggest that disadvantages in language proficiency could be due to not learning English or French at the young age and that their foreign-born parents use other languages in the home more frequently. An F-test rejects the null hypothesis at these coefficients would have similar differences in literacy scores compared to the third generation ($p = 0.0001$ for men and $p = 0.0004$ for women). Moreover, an extra year spent in Canada has only a small positive effect of 0.01 standard deviations on the literacy scores of both men and women.

[38] The F-test rejects the null hypothesis that coefficients on these various immigration categories (with or without including the temporary residents and/or young immigrant categories) are jointly equal to zero (p-value=0.000).

The above exercises are repeated in Tables 2.5 and 2.6 for numeracy scores. The results are similar. That is not surprising since, as shown in Appendix Table A.2.1, literacy and numeracy scores are highly correlated, with correlation coefficients around 0.87. However, the magnitudes are smaller. In columns 4 and 8 of Table 2.5, adult immigrants average 0.78 and 0.67 standard deviations lower in numeracy scores compared to their Canadian-born counterparts. That compares with differences of 0.90 and 0.87 standard deviations for literacy scores (Table 2.4).

When nine population subgroups are identified in Table 2.6, the estimate for second-generation men in column 1 suggests a numeracy score advantage over the third generation. However, that advantage is mitigated when the highest educational attainments are accounted for in the full specification regressions. Adult refugees have the lowest numeracy scores, and they are joined by both genders in the family reunification class and women who are temporary residents in all specifications. This result is not surprising for the former two groups of immigrants as they have lower proportions of individuals who obtain at least a bachelor's degree. All coefficients on adult refugee immigrants are negative and statistically significant. Estimated coefficients are higher for female adult economic immigrants and adult temporary residents than those for the same male categories. While higher levels of education are associated with higher numeracy scores, obtaining a foreign education can reduce this benefit.

The coefficients on all immigrant groups remain quantitatively unchanged across specifications, except for both male and female adult economic immigrants. Test scores gaps for these groups in their first year of arrival increase when controlling for education

in columns 2 and 6, and are slightly reduced in the full specification model. It is important to note that controlling for education levels and whether the degree obtained abroad does not matter very much in explaining differences in literacy and numeracy scores between low educated groups of immigrants and the third-generation, as evidenced by only small changes in coefficients when moving from left to right in the table.

In sum, for both men and women, immigrants have test scores disadvantages in literacy and numeracy scores compared to their Canadian-born counterparts. The results hold even when we classify immigrants and Canadian-born individuals into nine subpopulation groups.

2.4.2. Differences in test scores in various subsamples and across different quantiles

By gender, we further examine differences in literacy and numeracy scores between immigrants and the Canadian-born by separating individuals into different subsamples with and without a university education. Differences in test scores are evaluated between these groups of individuals at the 25^{th}, 50^{th}, and 75^{th} quantiles of literacy and numeracy scores, respectively.[39] The top panel in Table 2.7 shows differences in literacy test scores and the bottom panel shows differences in numeracy test scores across the three broad categories. Within each panel, estimated coefficients are obtained by using OLS for subsamples separated by their educational attainment, and by applying the above-mentioned unconditional quantile regression.

[39] In the Appendix Table A.2.2, we show the results for unconditional quantile regressions at the 10^{th} and 90^{th} percentiles.

Moving between the two groups with and without a university education, test scores gaps between adult immigrants and the Canadian born are not quantitatively different. However, these differences are, on average, more pronounced within each subsample than compared to those estimated coefficients on adult and young immigrants in columns 4 and 8 in Tables 2.3 and 2.5, for men and women respectively. As compared with the Canadian born, both male and female young immigrants with university degrees have marginally higher literacy score gaps than those without. Adult immigrant men with at least a bachelor's degree have lower numeracy score gaps relative to than those less than a bachelor's degree, both relative to their Canadian-born.

Male adult immigrants have higher literacy and numeracy disadvantages than their female counterparts, even though these differences are not quantitatively different across quantiles for both genders. Literacy scores gaps are not statistically different from zero at the 25^{th} quantile for male young immigrants, and at the 75^{th} quantile for female young immigrants, both compared to the Canadian born. Numeracy scores gaps are not statistically significant across all quantiles for female young immigrants but are for all other groups. That could be due to the small sample sizes of these groups. Otherwise, test scores gaps are not quantitatively different across quantiles of literacy and numeracy for both male and female young immigrants.

Moving from the 25^{th} to the 75^{th} quantile, it is worth noting that men and women who did not complete a high school diploma have lower test scores those with a high school diploma, and the test scores gap between individuals with and without high school diploma decreases in magnitude values. For both genders, individuals with a non-university post-

secondary education have better literacy and numeracy scores than those with a high school diploma, but these differences are similar across the quantiles for each test score. Coefficients on university graduates increase from the 25th to the 50th quantile and remain quantitatively unchanged in the 75th quantile (or in the 90th quantile as shown in Appendix Table A.2.2).

On the other hand, men and women, who studied abroad but did not complete a high school diploma, have higher literacy scores at the 75th quantile compared to those who did not complete secondary education in Canada. Obtaining a high school diploma abroad is associated with much lower test scores than those in Canada, at the 25th quantile. For individuals with a university degree, foreign education is at a greater disadvantage at the upper percentiles of the distribution. The negative effects of obtaining a university degree abroad have a significant impact on literacy and numeracy scores at the median and the 75th quantile for women, but only on literacy at the 75th quantile for men.

We repeat the exercise with the nine population subgroups in Table 2.8. We observe that the impacts of educational attainments are like those seen in Table 2.7. In various subsamples and across different quantiles of test scores, the second generation seems to perform as well as the third generation on both literacy and numeracy. Moving between the two subsamples with and without a university education, gaps in literacy and numeracy scores between immigration categories and the third generation are not statistically different. In general, the variations in test scores between groups are higher from within each subsample than compared to those in columns 4 and 8 in Tables 2.4 and 2.6, for men and women respectively.

The unconditional quantile regression results show more of a pattern as the coefficients on the immigrant variables decrease in absolute value as we move up in the distribution of each test score. Groups of more highly educated immigrants (e.g., adult economic immigrants) experience small changes in magnitudes of coefficients moving from the 25th to 75th quantiles of literacy and numeracy scores. In contrast, groups of immigrants with lower levels of education encounter more substantial changes in absolute magnitudes of coefficients across quantiles. In other words, literacy and numeracy score gaps for both men and women by different immigration categories compared to third-generation Canadians decrease moving right in the skills distribution.

2.4.3. The earnings gap

In this section, we examine the effects of literacy and numeracy scores on earnings differences between immigration categories and on the returns to education. Estimated coefficients are derived using Equation 2.2 for three broad categories and the nine population subgroups. Literacy and numeracy scores are introduced linearly (separately or jointly) to the model to examine their effects on earnings gaps among these groups of individuals, with separate models estimated for men and women.[40] Table 2.9 shows the results for the three broad categories, while Table 2.10 repeats the exercise with the nine population subgroups. The estimated coefficients on immigration categories approximate the average percentage gap in the hourly wage of the respective immigration category

[40] Test scores are specified linearly and could miss an important non-linearity. However, we have experimented with various specifications and find that being specified linearly is a compact approach that does not affect coefficients of interest markedly. The results from other specifications can be found from Appendix Tables A.2.3 to A.2.8.

compared to the Canadian-born, in their first year of arrival in Canada, *ceteris paribus*. The coefficients on literacy or numeracy scores can be interpreted as the approximate percentage change in hourly wages as literacy or numeracy scores increase by one standard deviation.

In Table 2.9, columns 1 and 6 show that the earnings penalty for adult immigrants is lower for men (-0.33 log points) than for women (-0.39 log points) when controlling for age, years in Canada, and their quadratic functional forms. The earnings gap for male adult immigrants does not change quantitatively when all covariates and different test scores are introduced into the model – coefficients remain at around -0.33 log points. In contrast, the earnings gap for female immigrants reduces as we control for other characteristics and test scores, ranging from -0.29 to -0.39 log points. Coefficients on young immigrants follow a similar trend as those for adult immigrants. When controlling for numeracy score or both test scores jointly, the earnings gap for male young immigrants compared to Canadian-born individuals is negative, but not statistically different from zero.

On the other hand, young female immigrants earn less, on average, than the Canadian born, regardless of model specification. The result for young female immigrants is rather surprising as these individuals are educated mostly in the Canadian education system and would be familiar with the Canadian labour market. Also, they could have a network that could potentially be helpful to gain employment. It could be that there are intergenerational disadvantages for immigrants who arrived in Canada at young ages.[41]

[41] The top panel of Appendix Table A.2.9 shows the results when we interact each test score with these groups of immigrants. Even though individual coefficients are not statistically significant, the F-test cannot reject the null hypothesis that adult and young immigrants would have similar returns to literacy and numeracy scores as the Canadian-born (in the case of men: p =0.161 for literacy and p=0.187 for numeracy; and, in the case

Controlling for each test score separately or jointly has little impact on the estimated coefficients on adult immigrants for both genders, even though the returns to each test score are different in the Canadian labour market. Compared to the results in columns 2 and 7, the immigrant earnings gap decreases when introducing literacy, numeracy, or both into the earnings regressions. A one-standard-deviation increase in literacy is associated with eight percent increase in earnings for men, and nine percent for women.

Meanwhile, the economic returns to a one-standard-deviation increase in numeracy are around ten percent for men and nine percent for women. When these test scores are introduced jointly in the earnings regression, being proficient in numeracy seems to have an independent effect on earnings (despite both test scores being highly and positively correlated as shown in Appendix Table A.2.1). The stand-alone remuneration rate of a one-standard-deviation increase in numeracy is 11 percent for men and 6.5 percent for women. This result aligns with the findings in both Mueller, Truong and Smoke (2018) and Truong and Sweetman (2018).

Controlling for literacy and numeracy scores (whether separately or jointly) helps explain some of the earnings advantages of those with a university degree over those with a high school diploma,[42] 17 to 24 percent for men and women, respectively. It is striking, though perhaps unsurprising that a bachelor's degree earned abroad on average is less

of women: p=0.825 for literacy and p=0.999 for numeracy). When the test is done separately for the interaction of each test score and the adult immigrant category, the null hypothesis, that male adult immigrants would have similar returns to literacy and numeracy scores as the Canadian-born, is rejected at 10 percent level (p=0.058 for literacy and p=0.071 for numeracy). For female adult immigrants, the null hypothesis test cannot be rejected (p=0.550 for literacy and p=0.972 for numeracy).

[42] For example, the coefficient on "bachelor's degree and above" in column 2 is 0.46, and that in column 3 is 0.38. Thus, the change is equivalent to $\left|\frac{0.38-0,.46}{0.46}\right| x100\% \approx 17\%$.

advantageous than one earned in Canada: immigrants face earnings gaps of around 13 or 14 percent for men and 25 to 30 percent for women. However, individuals who obtained less than a bachelor's degree abroad do not experience earnings penalties in the fully specified models (columns 5 and 10). Furthermore, conditioning on basic skills measurements also reduces the earnings gap for women (but not men) who obtain a university degree abroad.

Table 2.10 extends the analysis in Table 2.9 to examine differences in earnings for the nine population subgroups. Female second-generation Canadians have an earnings advantage of almost 10 percent compared to female third-generation Canadians, as shown in column 6. However, this advantage is accounted for when controlling for differences in education levels and location of residence (column 7) and test scores in subsequent columns.[43] For both genders, immigrants in all immigration categories, including those who arrived at a young age, experience earnings deficits compared to the third generation. It is important to note that except for male adult economic immigrants these earnings gaps become smaller when education levels, geographical variables, and test scores are introduced in the earnings regressions. With respect to the column 1, the earnings gap for male economic immigrants increases almost 45 percent in column 2. As shown in Table 2.2, this result is rather surprising as more male economic immigrants obtained a university degree compared to any other immigrant and Canadian-born groups. The negative

[43] We have done a t-test on the interaction between the second-generation variable and literacy/numeracy scores to examine if they would have the similar return to each test as compared to the third-generation. The t-test cannot reject the null hypothesis that both second- and third-generation Canadians would be rewarded equally for their literacy or numeracy in the Canadian labour market. For men, the p-values are 0.725 for literacy and 0.845 for numeracy. For women, these values are 0.661 for literacy and 0.860 for numeracy.

coefficient in the male economic-immigrant category could be overestimated due to our inability to distinguish principal applicants from their dependents in PIAAC 2012. Most of them also completed their degree abroad. This result suggests that education obtained abroad is not valued in the Canadian labour market. [44]

2.4.4. The earnings gap across quantiles of earnings

We examine the earnings gap between immigrants and the Canadian-born across the 25th, 50th, and 75th quantiles of log hourly wages.[45] Table 2.11 shows the earnings gap between adult and young immigrants compared to all Canadian-born counterparts. Literacy and numeracy skills have significant impacts on earnings along the distribution of log hourly wages.[46] This result suggests that both basic literacy and numeracy skills are

[44] In the bottom panel of the Appendix Table A.2.9, we separately interact the literacy and numeracy scores with each immigration and Canadian-born category. This exercise is done to answer the question of whether there are differential effects of literacy and numeracy on the wages of immigrant groups versus the Canadian born. The hypothesis that coefficients on interaction terms (except for those of young refugees and non-refugees) are jointly equal to zero cannot be rejected. For these tests, p-values are 0.517 for interaction terms with literacy, and 0.504 for those with numeracy. Coefficients for women are 0.408 and 0.475 for literacy and numeracy interaction terms respectively. We also find no statistically significant results in any of the model specifications estimated. The impacts of literacy and numeracy proficiency on wages are similar for both Canadian-born individuals and immigrants if they score at the same level on these tests.

We also did separate tests for interaction terms of immigration categories (except young immigrant groups and temporary residents) with each test score. As shown in Table 2.1, a sizeable proportion of temporary residents are educated in Canada. Thus, we should exclude them to examine if Canadian labour market reward literacy and numeracy equally between immigration categories, other than temporary residents, and the third generation. The null hypothesis cannot be rejected. For men, p-values are 0.497 for the literacy and 0.569 for the numeracy interaction terms. For women, these values are 0.366 and 0.430, respectively. Thus, we are comfortable to say that the Canadian labour market rewards literacy and numeracy equally between the Canadian born and immigrants.

As a part of sensitivity tests, we have also indirectly controlled for literacy and numeracy by disaggregating the whole sample into three subsamples: individuals with similar literacy and numeracy scores, with literacy scores higher than numeracy scores, and with numeracy scores higher than literacy scores. Unfortunately, the small sample sizes render most coefficients to be insignificant. The results and description can be found in Appendix Table A.2.10.

[45] Appendix Table A.2.11 shows results for the 10th and 90th quantiles.

[46] Appendix Table A.2.11 shows that at the 90th percentile, a one-standard-deviation increase in literacy does not have any effect on earnings. On the other hand, the remuneration rate of a one-standard-deviation increase in numeracy is statistically significant at eight percent.

important in the Canadian labour market, although (as seen above) both are positively correlated, and numeracy scores have a larger impact on wages when both are included in regressions models (Table 2.10). Moving from the lower to upper quantiles of log hourly wages, the economic returns to a one-standard increase in literacy range from eight percent to approximately 11 percent. The rates or return to an increase in numeracy by one standard deviation ranges from ten to 13 percent.

The rates of return to obtaining at least a bachelor's degree increase when moving from the bottom 25^{th} quantile to the 75^{th} quantile for both men and women. There are heterogeneous effects of literacy or numeracy on the returns to university education. On the other hand, the coefficients on non-university post-secondary education levels remain relatively constant across quantiles for men, except for the returns to college/trade degree at the 50^{th} quantile. For women, these coefficients experience a decreasing trend from the lower to the upper 25^{th} quantile. We also observe that the returns to obtaining a university degree abroad are statistically significantly lower than those obtained in Canada at the 75^{th} quantile for men, and at both median and the 75^{th} quantile for women. As shown in Appendix Table A.2.11, these coefficients are more negative at the top end of the distribution of log hourly wages, suggesting that obtaining university education abroad can be detrimental to immigrants' earnings in the Canadian labour market, particularly at the higher quantiles of log hourly wages. That is perhaps due to the lack of foreign credentials recognition in the Canadian labour market, as suggested by Goldman et al. (2015).

Across all quantiles of log hourly wages, accounting for literacy or numeracy scores helps reduce the earnings disadvantage of adult immigrants, for both genders. Immigrants

who arrive in Canada at young ages experience a similar reduction in earnings disadvantage compared to the Canadian-born. For female young immigrants, the differences in earnings are not statistically significant from the 50th quantile and above.

We examine the earnings gap at different quantiles for the nine population subgroups in Table 2.12. The trends in the returns to literacy, numeracy, and education levels are like those seen in Table 2.11. Including literacy or numeracy scores accounts for some of the earnings gaps between immigration categories and the third generation. Across quantiles of earnings, the second-generation experiences no earnings gaps compared to the third generation of either gender.

For both genders, adult refugees encounter earnings deficits, but these tend to become smaller as compared to the third generation at higher quantiles of earnings. In contrast, adult male economic immigrants experience around 38 percent earnings gap in the 25th quantile, 43 percent in the 50th, and 31 percent in the 75th. The result is interesting since they are the most educated of all immigrant categories. This trend suggests that the earnings gap for the adult male economic immigrants observed in Tables 2.9 and 2.10 could be driven by the variation at the median earnings levels and that the results for other immigration categories could be driven by the variation in the quantile below the median earnings level. Furthermore, we can only observe the earnings gap for female adult economic immigrants at the lower 25th quantile.

2.5. CONCLUSION

The objective of this research is to investigate differences in basic skills (as measured by literacy and numeracy scores in PIAAC 2012) between the three broad

categories of immigrants, nine population subgroups of adult and young immigrants and the Canadian-born. We also examine how these skills are valued in the Canadian labour market and the extent to which skill differences explain earnings gaps among subpopulation groups and the returns to different education levels.

We find that adult and young immigrants of both genders score lower on both literacy and numeracy assessments than the Canadian-born even after controlling for factors such as age, education, and years in Canada. The result for young immigrants may seem surprising since most of their education took place mostly in Canada. A possible (but untested) explanation for the gaps in their literacy and numeracy scores could be the lack of English/French learning and usage at young ages when language skills are being developed. The test score differences across the nine subpopulation groups highlight the heterogeneity in the abilities of those arriving in Canada in the various immigration classes. Among the three major or broad immigration entry classes, the gaps can be as high as one standard deviation once all factors are controlled for with refugees having the most substantial deficits and economic immigrants the least. Having a higher level of education is positively correlated with test scores, but the effect for immigrants tends to be lower than for the Canadian born, and in some cases even reversed, if that education was obtained outside of Canada.

In sensitivity tests, we carry out analyses using various subsamples of university and non-university education levels, and across quantiles of literacy and numeracy separately. Groups of immigrants with higher proportions of university educated (e.g., adult economic immigrants) have similar coefficients moving for across all quantiles of literacy

and numeracy scores. In contrast, groups of immigrants with lower proportions of university educated individuals show relatively large differences in absolute magnitudes of coefficients across quantiles of the test scores. These results show that differences in test scores between immigrants and the Canadian-born should not be analyzed using mean regressions, but rather across the quantiles of test scores in order to better capture the differences.

When considered separately, a one-standard-deviation increase in literacy is associated with an eight percent increase in earnings for men and nine percent for women while the same increase in numeracy yields ten percent for men and nine percent for women. When these two test scores are introduced jointly in the earnings regression, being proficient in numeracy seems to have an independent effect on earnings, and the stand-alone rate of return to a one-standard-deviation increase in numeracy is 11 percent for men and seven percent for women.

Whether examining the earnings gap for the three broad categories or the nine population subgroups, the gaps are reduced when education levels, geographical variables, and test scores are included in the earnings regressions, except for male adult economic immigrants. This result is surprising, and important since this is the group with the highest proportion of university degrees. The result suggests that advanced education obtained outside Canada is not valued as highly in the Canadian labour market as those obtained in Canada. Controlling for literacy and numeracy scores reduces the rate of return to university degree by 17 to 24 percent compared to those with a high school diploma.

The analysis suggests that policymakers should consider applying a more rigorous method to assess how skills obtained via foreign education can be transferred and applied to the Canadian labour market. In particular, a more rigorous assessment of foreign education programs and training may be appropriate. Furthermore, there should be programs in place to help current immigrants to update their skills and to improve their language skills to help them integrate economically in Canada. Lastly, the government may consider rewarding more points in the permanent resident application of international students since they have received a Canadian education.

Numeracy scores can be independently rewarded in the Canadian labour market when both test scores are jointly accounted for in the earnings regression. Once we include these scores in the hourly wage model, the coefficients on immigration category variables decrease suggesting that these skills are necessary to perform well in the Canadian labour market. As we move across the distribution of earnings, the returns to literacy or numeracy scores are statistically significant for both genders. It is important for immigrants to improve their literacy and/or numeracy skills to help transfer their knowledge learned in a foreign-education system since these foreign skills appear to be penalized in the Canadian labour market, so that they would be at no disadvantages in earnings compared to those of the third generation. Furthermore, the Canadian labour market does not reward immigrants and the Canadian born differently when they have similar literacy and numeracy scores.

Overall, the results presented here underline the importance of immigration class as well as immigrating to Canada at a young age in the examination of earnings gaps between immigrants and the Canadian-born. While no immigrant group does as well on the two tests

or has hourly wages as the Canadian-born, there are still differences between immigrant admission categories that are worthy of note, namely that those admitted under the points system tend to perform better in Canada, regardless of which metric we use. Mahboubi (2017) recently wrote that Canada should toughen the language requirements for new immigrants – much the way that Australia has done – by allowing fewer points for poor language skills. Our results support this suggestion and further suggest that numeracy skills might be the better indicator of labour market success, along with immigration class and whether higher education is obtained in Canada or abroad.

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Table 2.1. Sample characteristics – Immigrants vs. the Canadian-born

	Immigrant		Canadian-born	
	Men	Women	Men	Women
Weighted proportion of				
Third-generation Canadians	--	--	0.81	0.80
Second-generation Canadians	--	--	0.20	0.20
Refugees	0.11	0.06	--	--
Economic immigrants	0.38	0.31	--	--
Family reunification category	0.34	0.41	--	--
Other immigration programs	0.11	0.13	--	--
Temporary residents	0.07	0.09	--	--
Average literacy	257.67	250.01	281.24	280.62
s.d.	56.84	55.87	48.31	45.58
s.e.	(2.06)	(1.97)	(1.14)	(1.02)
Average numeracy	258.84	236.88	278.50	265.69
s.d.	63.13	60.86	53.20	49.09
s.e.	(2.48)	(2.06)	(1.08)	(1.17)
Average age	45.22	44.43	44.93	45.31
Average age at immigration	25.30	24.60	--	--
Proportion of young immigrants (arrived at <14 years old)	0.20	0.20	--	--
Average hourly wage	$29.46	$22.75	$31.90	$25.85
s.d.	21.52	13.16	23.82	16.91
s.e.	(0.91)	(0.52)	(0.63)	(0.32)
Education characteristics				
< High school	0.10	0.12	0.13	0.10
High school	0.16	0.18	0.22	0.21
College or trade	0.30	0.29	0.41	0.41
≥ Bachelor's degree	0.45	0.42	0.24	0.27

(continued)

Table 2.1. continued

	Immigrant		Canadian-born	
	Men	Women	Men	Women
Proportion with foreign education	0.61	0.63	0.02	0.01
Sample size (N)	1,816	2,128	6,485	7,462

Source: PIAAC 2012. Authors' calculations.

Notes: The sample includes 17,891 individuals, aged 25 to 65. Estimates are weighted using the final sample weight. Average literacy and numeracy scores are calculated using all plausible test scores and replicate weights in the survey. Average hourly wages including bonuses are calculated for individuals with positive self-reported wages. s.e. = standard errors; s.d. = standard deviations

Table 2.2. Sample characteristics of immigrants – by immigration category, and second-and third-generation Canadians

	Refugee		Economic Immigrants		Family Reunification		Other Immig. Program		Temp. Res.		2nd Generation		3rd Generation	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Average test scores														
Literacy	235.87	232.40	272.33	259.62	243.28	240.86	273.02	271.92	258.18	238.73	288.98	288.41	279.36	278.70
s.d.	59.60	48.29	49.13	52.62	58.63	55.70	51.07	50.31	62.04	63.95	43.82	45.58	49.15	45.37
s.e.	(6.89)	(6.01)	(2.72)	(2.95)	(4.07)	(3.49)	(5.62)	(5.99)	(11.42)	(8.64)	(2.24)	(2.62)	(1.17)	(1.02)
Numeracy	233.30	222.68	282.00	252.12	237.79	223.94	269.60	254.53	257.77	227.25	284.91	270.17	276.95	264.59
s.d.	61.77	53.12	53.64	56.70	63.09	60.97	58.19	53.76	70.60	69.77	48.88	51.42	54.08	48.43
s.e.	(6.87)	(6.50)	(3.29)	(3.31)	(4.09)	(3.70)	(6.69)	(5.80)	(13.42)	(9.35)	(2.65)	(2.97)	(1.14)	(1.08)
Average age	46.27	43.03	45.81	44.55	45.18	44.48	46.19	48.48	38.56	38.71	43.13	43.65	45.37	45.72
Average age at immigration	24.69	25.69	30.58	28.83	21.08	22.81	18.39	19.38	28.36	24.82	--	--	--	--
Share of young immigrants (arrived at <14 years old)	0.20	0.21	0.10	0.09	0.27	0.21	0.42	0.40	0.12	0.22	--	--	--	--
Average hourly wage	$24.47	$19.49	$32.24	$24.51	$27.87	$22.02	$30.63	$24.17	$27.76	$19.72	$32.65	$28.11	$31.72	$25.31
s.d.	17.66	17.08	24.75	12.96	20.08	12.82	13.19	11.43	20.03	13.54	21.63	17.11	24.32	16.82
s.e.	(2.09)	(3.06)	(1.32)	(1.00)	(1.85)	(0.86)	(2.17)	(1.12)	(2.99)	(1.89)	(1.28)	(0.96)	(0.72	(0.34)
Education characteristics														
< High school	0.13	0.10	0.02	0.06	0.18	0.18	0.12	0.07	0.08	0.14	0.09	0.06	0.14	0.11
High school	0.26	0.24	0.08	0.10	0.19	0.24	0.17	0.15	0.25	0.16	0.18	0.21	0.23	0.21
College or trade	0.41	0.40	0.22	0.29	0.35	0.26	0.34	0.34	0.21	0.27	0.44	0.40	0.41	0.42
≥ Bachelor's degree	0.20	0.27	0.68	0.56	0.29	0.32	0.38	0.44	0.46	0.42	0.29	0.34	0.22	0.26
Proportion with foreign education	0.52	0.57	0.71	0.70	0.53	0.63	0.43	0.46	0.82	0.73	0.02	0.03	0.02	0.01
Proportion living in urban areas	0.91	0.95	0.93	0.88	0.92	0.93	0.78	0.78	0.90	0.86	0.64	0.67	0.46	0.49

Source: PIAAC 2012. Authors' calculations.

Notes: The sample includes 17,891 individuals, aged 25 to 65. Estimates are weighted using the final sample weight. Average literacy and numeracy scores are calculated using all plausible test scores, and replicate weights in the survey. Average hourly wages including bonuses are calculated for individuals with positive self-reported wages. s.e. = standard errors; s.d. = standard deviations; Immig. = Immigration; Temp. Res. = Temporary Residents.

Table 2.3. Regression analysis – literacy scores gaps across the three broad categories

	Dependent variable: standardized literacy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Adult immigrants	-0.658***	-1.042***	-1.091***	-0.899***	-1.067***	-1.199***	-1.240***	-0.871***
	(0.088)	(0.082)	(0.083)	(0.104)	(0.073)	(0.067)	(0.070)	(0.122)
Young immigrants (migrated at <14 years)	-0.258	-0.707***	-0.735***	-0.712***	-0.482**	-0.756***	-0.789***	-0.637***
	(0.208)	(0.190)	(0.190)	(0.188)	(0.175)	(0.169)	(0.170)	(0.178)
Education (Reference group: HS graduates)								
< high school		-0.835***	-0.806***	-0.786***		-0.850***	-0.819***	-0.814***
		(0.069)	(0.070)	(0.070)		(0.081)	(0.081)	(0.075)
College or trade school		0.256***	0.260***	0.217***		0.230***	0.243***	0.221***
		(0.050)	(0.050)	(0.054)		(0.049)	(0.049)	(0.048)
≥ bachelor's degree		0.994***	0.982***	0.919***		0.849***	0.855***	0.841***
		(0.050)	(0.050)	(0.055)		(0.051)	(0.052)	(0.054)
Foreign education x < high school				-0.550**				-0.438*
				(0.194)				(0.183)
Foreign education x high school				-0.472**				-0.432**
				(0.179)				(0.151)
Foreign education x college or trade school				-0.174				-0.406***
				(0.158)				(0.119)
Foreign education x ≥ bachelor's degree				-0.136				-0.400***
				(0.098)				(0.112)
Rural/urban and provinces (Reference group: Large urban in Ontario)								
Rural			-0.103	-0.114*			0.023	0.026
			(0.057)	(0.057)			(0.046)	(0.045)

(continued)

Table 2.3. continued

	Dependent variable: standardized literacy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Small urban			-0.101	-0.107			-0.044	-0.046
			(0.062)	(0.061)			(0.051)	(0.051)
Medium urban			0.057	0.050			-0.025	-0.028
			(0.062)	(0.062)			(0.051)	(0.050)
Alberta			0.014	0.015			0.003	-0.003
			(0.071)	(0.070)			(0.055)	(0.054)
British Columbia			-0.014	-0.004			0.030	0.033
			(0.083)	(0.083)			(0.060)	(0.061)
Prairie provinces			-0.062	-0.063			-0.007	-0.011
			(0.057)	(0.057)			(0.054)	(0.054)
Atlantic provinces			-0.161**	-0.163**			-0.171***	-0.176***
			(0.053)	(0.053)			(0.045)	(0.045)
Territories			0.083	0.088			0.103	0.116
			(0.142)	(0.144)			(0.171)	(0.176)
Quebec			-0.180***	-0.185***			-0.250***	-0.256***
			(0.046)	(0.046)			(0.040)	(0.039)
Age	0.217*	0.143	0.172*	0.183*	0.202*	0.086	0.083	0.075
	(0.094)	(0.080)	(0.080)	(0.080)	(0.092)	(0.084)	(0.086)	(0.085)
$Age^2/100$	-0.520*	-0.361*	-0.425*	-0.449*	-0.488*	-0.220	-0.215	-0.196
	(0.217)	(0.183)	(0.183)	(0.183)	(0.209)	(0.193)	(0.196)	(0.193)
$Age^3/10000$	0.370*	0.266*	0.313*	0.331*	0.338*	0.154	0.151	0.138
	(0.161)	(0.134)	(0.134)	(0.134)	(0.154)	(0.142)	(0.144)	(0.142)
Years in Canada	0.003	0.012**	0.011**	0.011**	0.012**	0.016***	0.015***	0.012***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)

(continued)

Table 2.3. continued

	Dependent variable: standardized literacy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	-2.570*	-1.786	-2.097	-2.220*	-2.277	-1.052	-0.935	-0.824
	(1.302)	(1.126)	(1.129)	(1.121)	(1.289)	(1.179)	(1.195)	(1.183)
N	8210	8210	8210	8210	9518	9518	9518	9518
R^2	0.079	0.317	0.325	0.330	0.152	0.348	0.358	0.365
Adjusted R^2	0.079	0.316	0.323	0.328	0.152	0.348	0.357	0.363

Source: Authors' calculation. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate point estimates using all 10 plausible values for literacy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women.

Table 2.4. Regression analysis – literacy scores gaps across the nine population subgroups

	Dependent variable: standardized literacy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Second-generation Canadians	0.171***	0.065	0.003	0.005	0.153**	0.075	0.006	0.007
	(0.049)	(0.046)	(0.048)	(0.048)	(0.058)	(0.050)	(0.049)	(0.049)
Adult refugees	-1.282***	-1.375***	-1.446***	-1.223***	-1.344***	-1.462***	-1.502***	-1.148***
	(0.211)	(0.188)	(0.190)	(0.191)	(0.170)	(0.163)	(0.168)	(0.214)
Adult economic immigrants	-0.304***	-0.891***	-0.956***	-0.753***	-0.698***	-1.001***	-1.061***	-0.695***
	(0.080)	(0.077)	(0.078)	(0.115)	(0.078)	(0.077)	(0.081)	(0.132)
Adult family reunification immigrants	-1.219***	-1.299***	-1.380***	-1.133***	-1.265***	-1.267***	-1.336***	-0.961***
	(0.124)	(0.121)	(0.122)	(0.135)	(0.096)	(0.085)	(0.084)	(0.138)
Adult other categories	-0.532***	-0.799***	-0.841***	-0.623***	-0.641***	-0.941***	-0.983***	-0.602***
	(0.152)	(0.130)	(0.127)	(0.145)	(0.146)	(0.142)	(0.143)	(0.170)
Adult temporary residents	-0.818**	-1.032***	-1.097***	-0.832***	-1.429***	-1.439***	-1.497***	-1.102***
	(0.257)	(0.225)	(0.225)	(0.213)	(0.192)	(0.174)	(0.177)	(0.190)
Young refugee immigrants	-0.709*	-0.844**	-0.879**	-0.832*	-1.054**	-0.967***	-0.996***	-0.893**
	(0.349)	(0.325)	(0.328)	(0.330)	(0.330)	(0.282)	(0.280)	(0.278)
Young non-refugee immigrants	-0.478*	-0.808***	-0.861***	-0.790***	-0.380*	-0.687***	-0.745***	-0.568**
	(0.208)	(0.200)	(0.200)	(0.198)	(0.183)	(0.178)	(0.178)	(0.187)
Education (Reference group: HS graduates)								
< high school		-0.824***	-0.795***	-0.784***		-0.837***	-0.808***	-0.812***
		(0.067)	(0.067)	(0.069)		(0.081)	(0.081)	(0.076)

(continued)

Table 2.4. continued

	Dependent variable: standardized literacy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
College or trade school		0.247***	0.253***	0.220***		0.215***	0.228***	0.215***
		(0.052)	(0.052)	(0.054)		(0.049)	(0.050)	(0.048)
≥ bachelor's degree		0.948***	0.938***	0.904***		0.821***	0.827***	0.827***
		(0.052)	(0.052)	(0.055)		(0.051)	(0.053)	(0.054)
Foreign education x < high school				-0.452*				-0.366*
				(0.196)				(0.184)
Foreign education x high school				-0.421*				-0.384*
				(0.171)				(0.149)
Foreign education x college or trade school				-0.194				-0.423***
				(0.154)				(0.122)
Foreign education x ≥ bachelor's degree				-0.211*				-0.420***
				(0.104)				(0.113)
Rural/urban and provinces (Reference group: Large urban in Ontario)								
Rural			-0.111	-0.117*			0.015	0.019
			(0.057)	(0.057)			(0.046)	(0.045)
Small urban			-0.108	-0.109			-0.051	-0.051
			(0.062)	(0.061)			(0.052)	(0.052)
Medium urban			0.050	0.048			-0.033	-0.034
			(0.063)	(0.063)			(0.052)	(0.051)
Alberta			0.006	0.006			-0.007	-0.013
			(0.070)	(0.069)			(0.055)	(0.054)
British Columbia			-0.029	-0.020			0.018	0.023
			(0.082)	(0.082)			(0.061)	(0.062)

(continued)

Table 2.4. continued

	Dependent variable: standardized literacy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Prairie provinces			-0.073	-0.073			-0.011	-0.016
			(0.057)	(0.057)			(0.053)	(0.053)
Atlantic provinces			-0.170**	-0.172**			-0.176***	-0.180***
			(0.054)	(0.054)			(0.045)	(0.045)
Territories			0.063	0.066			0.090	0.102
			(0.142)	(0.143)			(0.160)	(0.164)
Quebec			-0.191***	-0.194***			-0.254***	-0.260***
			(0.047)	(0.047)			(0.038)	(0.038)
Age	0.173	0.123	0.151	0.166*	0.174	0.076	0.075	0.069
	(0.092)	(0.081)	(0.080)	(0.080)	(0.090)	(0.084)	(0.085)	(0.084)
$Age^2/100$	-0.420*	-0.312	-0.376*	-0.407*	-0.429*	-0.200	-0.198	-0.184
	(0.212)	(0.184)	(0.183)	(0.182)	(0.205)	(0.192)	(0.195)	(0.193)
$Age^3/10000$	0.295	0.228	0.274*	0.297*	0.298*	0.141	0.140	0.130
	(0.156)	(0.135)	(0.134)	(0.134)	(0.151)	(0.141)	(0.143)	(0.142)
Years in Canada	0.010**	0.015***	0.014***	0.013***	0.011**	0.015***	0.015***	0.011**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)
Constant	-1.983	-1.501	-1.798	-1.988	-1.860	-0.884	-0.768	-0.695
	(1.277)	(1.133)	(1.133)	(1.120)	(1.265)	(1.174)	(1.191)	(1.182)
N	8210	8210	8210	8210	9518	9518	9518	9518
R^2	0.113	0.325	0.332	0.336	0.173	0.355	0.364	0.370
Adjusted R^2	0.111	0.323	0.330	0.334	0.172	0.354	0.363	0.368

Source: Authors' calculation. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate point estimates using all 10 plausible values for literacy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women.

Table 2.5. Regression analysis – Numeracy scores gaps across the three broad categories

	Dependent variable: standardized numeracy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Adult immigrants	-0.484***	-0.879***	-0.913***	-0.784***	-0.902***	-1.041***	-1.055***	-0.665***
	(0.094)	(0.085)	(0.084)	(0.100)	(0.073)	(0.062)	(0.065)	(0.115)
Young immigrants (migrated at <14 years)	-0.213	-0.683***	-0.703***	-0.716***	-0.422**	-0.703***	-0.714***	-0.549***
	(0.206)	(0.186)	(0.187)	(0.180)	(0.156)	(0.147)	(0.149)	(0.162)
Education (Reference group: HS graduates)								
< high school		-0.805***	-0.785***	-0.792***		-0.837***	-0.823***	-0.839***
		(0.080)	(0.080)	(0.082)		(0.081)	(0.081)	(0.077)
College or trade school		0.364***	0.366***	0.300***		0.242***	0.245***	0.215***
		(0.053)	(0.053)	(0.057)		(0.052)	(0.052)	(0.050)
≥ bachelor's degree		1.089***	1.081***	0.989***		0.883***	0.886***	0.865***
		(0.053)	(0.052)	(0.057)		(0.048)	(0.049)	(0.046)
Foreign education x < high school				-0.454*				-0.398*
				(0.196)				(0.185)
Foreign education x high school				-0.565**				-0.489**
				(0.198)				(0.154)
Foreign education x college or trade school				-0.066				-0.425***
				(0.157)				(0.125)
Foreign education x ≥ bachelor's degree				-0.041				-0.421***
				(0.097)				(0.118)
Rural/urban and provinces (Reference group: Large urban in Ontario)								
Rural			-0.059	-0.072			0.076	0.079
			(0.057)	(0.057)			(0.046)	(0.046)

(continued)

Table 2.5. continued

	Dependent variable: standardized numeracy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Small urban			-0.072	-0.079			-0.030	-0.032
			(0.062)	(0.061)			(0.050)	(0.050)
Medium urban			0.076	0.066			-0.026	-0.029
			(0.063)	(0.063)			(0.056)	(0.055)
Alberta			0.029	0.031			0.018	0.012
			(0.075)	(0.074)			(0.068)	(0.067)
British Columbia			-0.017	-0.006			0.041	0.046
			(0.077)	(0.076)			(0.061)	(0.061)
Prairie provinces			-0.050	-0.049			0.035	0.031
			(0.060)	(0.060)			(0.056)	(0.056)
Atlantic provinces			-0.216***	-0.217***			-0.194***	-0.198***
			(0.057)	(0.056)			(0.043)	(0.044)
Territories			-0.027	-0.019			0.051	0.066
			(0.126)	(0.129)			(0.165)	(0.172)
Quebec			-0.105*	-0.109*			-0.071*	-0.077*
			(0.047)	(0.046)			(0.036)	(0.036)
Age	0.248*	0.175	0.195*	0.203*	0.153	0.033	0.040	0.032
	(0.105)	(0.090)	(0.091)	(0.092)	(0.092)	(0.083)	(0.083)	(0.082)
$Age^2/100$	-0.574*	-0.417*	-0.463*	-0.480*	-0.354	-0.079	-0.094	-0.076
	(0.238)	(0.201)	(0.202)	(0.205)	(0.209)	(0.188)	(0.189)	(0.186)
$Age^3/10000$	0.400*	0.298*	0.332*	0.344*	0.229	0.040	0.051	0.039
	(0.173)	(0.145)	(0.146)	(0.148)	(0.152)	(0.137)	(0.138)	(0.136)
Years in Canada	0.002	0.010**	0.010**	0.011**	0.009**	0.014***	0.013***	0.010**
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)

(continued)

Table 2.5. continued

	Dependent variable: standardized numeracy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	-3.085*	-2.365	-2.601*	-2.650*	-1.940	-0.695	-0.757	-0.644
	(1.479)	(1.291)	(1.305)	(1.321)	(1.304)	(1.161)	(1.169)	(1.151)
N	8210	8210	8210	8210	9518	9518	9518	9518
R^2	0.054	0.306	0.311	0.317	0.120	0.326	0.330	0.336
Adjusted R^2	0.053	0.305	0.309	0.315	0.119	0.325	0.328	0.335

Source: Authors' calculation. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate point estimates using all 10 plausible values for literacy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women.

Table 2.6. Regression analysis – Numeracy scores gaps across nine subpopulation groups

	Dependent variable: standardized numeracy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Second-generation Canadians	0.119*	0.007	-0.039	-0.036	0.058	-0.022	-0.055	-0.055
	(0.058)	(0.055)	(0.057)	(0.057)	(0.058)	(0.050)	(0.050)	(0.050)
Adult refugees	-1.146***	-1.239***	-1.295***	-1.113***	-1.176***	-1.298***	-1.317***	-0.948***
	(0.203)	(0.176)	(0.175)	(0.172)	(0.161)	(0.144)	(0.149)	(0.198)
Adult economic immigrants	-0.048	-0.646***	-0.697***	-0.543***	-0.496***	-0.810***	-0.838***	-0.457***
	(0.088)	(0.082)	(0.083)	(0.111)	(0.082)	(0.077)	(0.079)	(0.124)
Adult family reunification immigrants	-1.215***	-1.295***	-1.358***	-1.162***	-1.210***	-1.216***	-1.249***	-0.861***
	(0.124)	(0.113)	(0.115)	(0.128)	(0.096)	(0.085)	(0.085)	(0.133)
Adult other categories	-0.508**	-0.783***	-0.815***	-0.647***	-0.620***	-0.928***	-0.951***	-0.551**
	(0.158)	(0.131)	(0.130)	(0.132)	(0.148)	(0.144)	(0.144)	(0.171)
Adult temporary residents	-0.741**	-0.947***	-0.993***	-0.766***	-1.259***	-1.272***	-1.300***	-0.895***
	(0.280)	(0.238)	(0.238)	(0.222)	(0.197)	(0.183)	(0.184)	(0.202)
Young refugee immigrants	-0.972*	-1.118**	-1.149**	-1.112**	-0.786*	-0.696*	-0.704*	-0.593
	(0.407)	(0.401)	(0.403)	(0.402)	(0.367)	(0.325)	(0.329)	(0.328)
Young non-refugee immigrants	-0.485*	-0.829***	-0.870***	-0.815***	-0.414*	-0.730***	-0.757***	-0.566***
	(0.202)	(0.188)	(0.189)	(0.183)	(0.163)	(0.156)	(0.158)	(0.171)
Education (Reference group: HS graduates)								
< high school		-0.787***	-0.765***	-0.787***		-0.826***	-0.811***	-0.837***
		(0.077)	(0.078)	(0.082)		(0.080)	(0.079)	(0.078)
College or trade school		0.355***	0.359***	0.307***		0.224***	0.227***	0.211***
		(0.054)	(0.053)	(0.057)		(0.051)	(0.051)	(0.050)
≥ bachelor's degree		1.025***	1.017***	0.970***		0.853***	0.855***	0.852***
		(0.053)	(0.052)	(0.056)		(0.048)	(0.049)	(0.046)
Foreign education x < high school				-0.291				-0.307
				(0.203)				(0.184)
Foreign education x high school				-0.481*				-0.418**
				(0.193)				(0.151)

(continued)

Table 2.6. continued

	Dependent variable: standardized numeracy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Foreign education x college or trade school				-0.091				-0.440***
				(0.149)				(0.128)
Foreign education x ≥ bachelor's degree				-0.159				-0.437***
				(0.099)				(0.119)
Rural/urban and provinces (Reference group: Large urban in Ontario)								
Rural			-0.075	-0.079			0.063	0.068
			(0.057)	(0.057)			(0.046)	(0.045)
Small urban			-0.085	-0.085			-0.043	-0.042
			(0.061)	(0.061)			(0.050)	(0.050)
Medium urban			0.061	0.059			-0.038	-0.039
			(0.065)	(0.065)			(0.056)	(0.054)
Alberta			0.018	0.019			0.004	-0.001
			(0.074)	(0.074)			(0.067)	(0.067)
British Columbia			-0.031	-0.023			0.032	0.037
			(0.075)	(0.074)			(0.062)	(0.062)
Prairie provinces			-0.063	-0.062			0.028	0.023
			(0.059)	(0.059)			(0.056)	(0.055)
Atlantic provinces			-0.229***	-0.231***			-0.209***	-0.212***
			(0.057)	(0.057)			(0.045)	(0.045)
Territories			-0.044	-0.040			0.038	0.051
			(0.127)	(0.129)			(0.155)	(0.161)
Quebec			-0.123**	-0.126**			-0.085*	-0.090*
			(0.047)	(0.047)			(0.035)	(0.035)
Age	0.200	0.151	0.174	0.185*	0.124	0.024	0.030	0.025
	(0.102)	(0.089)	(0.090)	(0.090)	(0.092)	(0.083)	(0.084)	(0.083)
$Age^2/100$	-0.465*	-0.363	-0.413*	-0.438*	-0.296	-0.061	-0.077	-0.064
	(0.231)	(0.199)	(0.200)	(0.201)	(0.208)	(0.189)	(0.191)	(0.188)

(continued)

Table 2.6. continued

	Dependent variable: standardized numeracy scores (with mean of 0 and variance of 1)							
	Men				Women			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Age^3/10000$	0.318	0.257	0.293*	0.311*	0.190	0.028	0.040	0.031
	(0.168)	(0.144)	(0.144)	(0.145)	(0.152)	(0.138)	(0.140)	(0.137)
Years in Canada	0.011*	0.015***	0.015***	0.014***	0.010**	0.014***	0.014***	0.010**
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	-2.407	-2.013	-2.249	-2.390	-1.498	-0.509	-0.557	-0.491
	(1.448)	(1.281)	(1.291)	(1.301)	(1.292)	(1.166)	(1.175)	(1.161)
N	8210	8210	8210	8210	9518	9518	9518	9518
R^2	0.100	0.320	0.325	0.328	0.143	0.334	0.338	0.344
Adjusted R^2	0.099	0.318	0.323	0.326	0.142	0.333	0.336	0.342

Source: Authors' calculation. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate point estimates using all 10 plausible values for literacy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women.

Table 2.7. Differences in basic skills proficiency across various subsamples of educational attainments and quantiles

	Men					Women				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< Bachelor's	≥ Bachelor's	25th	50th	75th	< Bachelor's	≥ Bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
	Dependent variable: Standardized Literacy Score (with mean of 0 and variance of 1)									
Adult Immigrants	-1.187***	-1.100***	-0.919***	-0.963***	-0.761***	-1.161***	-1.255***	-0.947***	-0.774***	-0.622***
	(0.159)	(0.112)	(0.241)	(0.208)	(0.175)	(0.128)	(0.107)	(0.219)	(0.173)	(0.141)
Young immigrants	-0.725**	-1.052***	-0.570	-0.681*	-0.621*	-0.756***	-0.900***	-0.648*	-0.515*	-0.362
	(0.234)	(0.313)	(0.423)	(0.281)	(0.291)	(0.229)	(0.194)	(0.274)	(0.217)	(0.251)
Education (Reference group: HS graduates)										
< high school	-0.747***		-1.280***	-0.624***	-0.298**	-0.767***		-1.159***	-0.797***	-0.345***
	(0.071)		(0.213)	(0.109)	(0.101)	(0.076)		(0.174)	(0.113)	(0.067)
College or trade school	0.255***		0.195*	0.320***	0.252*	0.269***		0.246**	0.257**	0.238**
	(0.051)		(0.097)	(0.091)	(0.105)	(0.050)		(0.087)	(0.081)	(0.087)
≥ bachelor's degree			0.768***	1.060***	1.130***			0.665***	0.992***	1.111***
			(0.107)	(0.132)	(0.147)			(0.103)	(0.105)	(0.137)
> bachelor's degree		0.279***					0.283***			
		(0.083)					(0.079)			
Foreign education x < high school	-0.328		-0.521	0.134	0.287*	-0.217		-0.410	0.215	0.285*
	(0.196)		(0.338)	(0.166)	(0.126)	(0.169)		(0.290)	(0.155)	(0.127)

(continued)

Table 2.7. continued

	Men					Women				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Foreign education x high school	0.060		-0.868*	-0.207	0.059	-0.176		-0.854**	-0.309	0.043
	(0.176)		(0.365)	(0.205)	(0.137)	(0.105)		(0.279)	(0.159)	(0.141)
Foreign education x college or trade			-0.312	-0.051	-0.020			-0.689**	-0.477**	-0.193
			(0.267)	(0.225)	(0.165)			(0.255)	(0.172)	(0.121)
Foreign education x ≥ bachelor's degree			0.006	-0.183	-0.375*			-0.245	-0.648***	-0.753***
			(0.180)	(0.174)	(0.163)			(0.221)	(0.180)	(0.152)
Foreign education x > bachelor's degree		0.106					-0.031			
		(0.144)					(0.160)			
N	5900	2310	8210	8210	8210	6553	2965	9518	9518	9518
R^2	0.267	0.198	0.213	0.206	0.166	0.305	0.241	0.232	0.234	0.190
Adjusted R^2	0.265	0.192	0.210	0.204	0.164	0.303	0.237	0.230	0.232	0.188
Dependent variable: Standardized Literacy Score (with mean of 0 and variance of 1)										
Adult immigrants	-1.179***	-0.863***	-0.923***	-0.771***	-0.610***	-1.023***	-1.025***	-0.760***	-0.578***	-0.455**
	(0.154)	(0.111)	(0.229)	(0.197)	(0.178)	(0.121)	(0.108)	(0.204)	(0.164)	(0.151)

(continued)

Table 2.7. continued

	Men					Women				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Young immigrants (migrated at <14 years)	-0.830***	-0.887**	-0.747*	-0.586*	-0.653**	-0.721***	-0.750***	-0.498	-0.305	-0.398
	(0.237)	(0.287)	(0.370)	(0.253)	(0.238)	(0.202)	(0.194)	(0.287)	(0.215)	(0.255)
Education (Reference group: HS graduates)										
< high school	-0.757***		-1.261***	-0.603***	-0.238**	-0.789***		-1.268***	-0.810***	-0.343***
	(0.082)		(0.242)	(0.120)	(0.086)	(0.078)		(0.191)	(0.108)	(0.082)
College or trade school	0.342***		0.344**	0.383***	0.294**	0.264***		0.260**	0.244*	0.224*
	(0.053)		(0.121)	(0.106)	(0.097)	(0.050)		(0.091)	(0.102)	(0.092)
≥ bachelor's degree			0.880***	1.101***	1.152***			0.733***	1.014***	1.089***
			(0.144)	(0.125)	(0.135)			(0.113)	(0.138)	(0.124)
> bachelor's degree		0.203*					0.257**			
		(0.088)					(0.081)			
Foreign education x < high school	-0.147		-0.371	0.029	0.180	-0.136		-0.230	0.195	0.193
	(0.194)		(0.337)	(0.147)	(0.147)	(0.167)		(0.278)	(0.154)	(0.114)

(continued)

Table 2.7. continued

	Men					Women				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Foreign education x high school	0.252		-1.045**	-0.317	0.053	-0.148		-0.807**	-0.330	-0.071
	(0.174)		(0.404)	(0.189)	(0.210)	(0.110)		(0.297)	(0.174)	(0.147)
Foreign education x college or trade school			-0.140	-0.056	0.085			-0.659*	-0.399*	-0.217
			(0.301)	(0.234)	(0.175)			(0.261)	(0.170)	(0.139)
Foreign education x ≥ bachelor's degree			0.192	-0.096	-0.259			-0.235	-0.637***	-0.672***
			(0.169)	(0.181)	(0.172)			(0.190)	(0.186)	(0.162)
Foreign education x > bachelor's degree		0.170					-0.060			
		(0.129)					(0.168)			
N	5900	2310	8210	8210	8210	6553	2965	9518	9518	9518
R^2	0.254	0.120	0.210	0.199	0.158	0.273	0.169	0.224	0.219	0.169
Adjusted R^2	0.252	0.114	0.208	0.197	0.156	0.271	0.164	0.222	0.218	0.167

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. The ordinary least squares (OLS) and unconditional quantile regression methods were used to calculate point estimates using all 10 plausible values for literacy and numeracy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. All regressions include age and its polynomials, rural and urban indicators, and provinces. Young immigrants are those who migrated to Canada at 14 years old or younger.

Table 2.8. Differences in basic skills proficiency in various subsamples of educational attainments and across quantiles, for nine subpopulation groups

	Male					Female				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
	Dependent variable: Standardized Literacy Score (with mean 0 and variance 1)									
Second generation	0.020	-0.065	0.067	-0.033	-0.044	0.021	-0.044	-0.022	0.009	0.065
	(0.053)	(0.099)	(0.093)	(0.086)	(0.092)	(0.063)	(0.085)	(0.085)	(0.095)	(0.102)
Adult refugees	-1.464***	-1.218***	-1.438***	-1.210***	-0.791***	-1.323***	-1.572***	-1.343**	-1.046***	-0.783***
	(0.237)	(0.310)	(0.428)	(0.239)	(0.199)	(0.222)	(0.328)	(0.467)	(0.277)	(0.171)
Adult economic immigrants	-0.858***	-1.111***	-0.654**	-0.851***	-0.762***	-0.899***	-1.158***	-0.724**	-0.617***	-0.502**
	(0.180)	(0.116)	(0.240)	(0.239)	(0.197)	(0.164)	(0.119)	(0.236)	(0.180)	(0.164)
Adult family reunification immigrants	-1.272***	-1.500***	-1.256***	-1.196***	-0.909***	-1.174***	-1.436***	-1.086***	-0.887***	-0.665***
	(0.163)	(0.203)	(0.300)	(0.240)	(0.200)	(0.141)	(0.132)	(0.235)	(0.193)	(0.149)
Adult other categories	-0.837***	-0.883***	-0.692*	-0.798***	-0.550*	-0.814***	-1.059***	-0.600*	-0.536*	-0.426*
	(0.226)	(0.203)	(0.320)	(0.225)	(0.249)	(0.215)	(0.183)	(0.305)	(0.245)	(0.205)
Adult temporary residents	-1.159**	-1.034***	-0.784*	-0.883***	-0.698*	-1.509***	-1.345***	-1.301***	-0.846***	-0.660***
	(0.370)	(0.259)	(0.388)	(0.266)	(0.280)	(0.283)	(0.228)	(0.319)	(0.212)	(0.174)
Young refugee immigrants	-0.764	-1.389**	-0.418	-0.784	-0.658	-0.962**	-0.563	-0.719	-0.880	-0.713*
	(0.408)	(0.465)	(0.461)	(0.472)	(0.431)	(0.309)	(0.731)	(0.566)	(0.538)	(0.338)

(continued)

Table 2.8. continued

	Male					Female				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Young non-refugee immigrants	-0.723**	-1.200***	-0.734	-0.773**	-0.673*	-0.628*	-0.920***	-0.595*	-0.460*	-0.286
	(0.240)	(0.333)	(0.458)	(0.299)	(0.317)	(0.252)	(0.198)	(0.290)	(0.229)	(0.280)
Education (Reference group: HS graduates)										
< high school	-0.745***		-1.278***	-0.621***	-0.296**	-0.769***		-1.156***	-0.795***	-0.343***
	(0.070)		(0.213)	(0.108)	(0.101)	(0.077)		(0.173)	(0.114)	(0.067)
College or trade school	0.257***		0.198*	0.324***	0.255*	0.258***		0.240**	0.251**	0.234**
	(0.052)		(0.097)	(0.091)	(0.105)	(0.049)		(0.088)	(0.081)	(0.087)
≥ bachelor's degree			0.744***	1.050***	1.130***			0.650***	0.977***	1.099***
			(0.105)	(0.132)	(0.147)			(0.105)	(0.105)	(0.136)
> bachelor's degree		0.273***					0.268***			
		(0.083)					(0.080)			
Foreign education x < high school	-0.294		-0.364	0.223	0.326*	-0.170		-0.308	0.272	0.318*
	(0.195)		(0.344)	(0.165)	(0.127)	(0.173)		(0.290)	(0.162)	(0.131)

(continued)

Table 2.8. continued

	Male					Female				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Foreign education x high school	-0.046		-0.785*	-0.165	0.071	-0.234*		-0.783**	-0.271	0.064
	(0.178)		(0.363)	(0.201)	(0.140)	(0.113)		(0.277)	(0.158)	(0.141)
Foreign education x college or trade school			-0.338	-0.067	-0.027			-0.707**	-0.498**	-0.209
			(0.265)	(0.225)	(0.166)			(0.256)	(0.175)	(0.123)
Foreign education x ≥ bachelor's degree			-0.117	-0.247	-0.389*			-0.268	-0.670***	-0.769***
			(0.177)	(0.188)	(0.172)			(0.219)	(0.181)	(0.152)
Foreign education x > bachelor's degree		0.067					-0.024			
		(0.148)					(0.159)			
N	5900	2310	8210	8210	8210	6553	2965	9518	9518	9518
R^2	0.274	0.209	0.22	0.209	0.168	0.312	0.25	0.237	0.237	0.192
Adjusted R^2	0.271	0.201	0.217	0.206	0.165	0.309	0.244	0.235	0.235	0.19

(continued)

Table 2.8. continued

	Male					Female				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
	Dependent variable: Standardized Numeracy Score (with mean 0 and variance 1)									
Gen 2	0.010	-0.178	0.009	-0.049	-0.079	-0.058	-0.064	-0.072	-0.054	-0.021
	(0.069)	(0.096)	(0.119)	(0.100)	(0.101)	(0.066)	(0.083)	(0.092)	(0.080)	(0.091)
Adult refugees	-1.310***	-1.345***	-1.365***	-1.169***	-0.779***	-1.156***	-1.390***	-1.108**	-0.914***	-0.688***
	(0.213)	(0.305)	(0.389)	(0.250)	(0.202)	(0.201)	(0.319)	(0.378)	(0.242)	(0.192)
Adult economic immigrants	-0.712***	-0.862***	-0.546*	-0.557**	-0.515*	-0.727***	-0.868***	-0.514*	-0.392*	-0.337*
	(0.193)	(0.106)	(0.226)	(0.205)	(0.200)	(0.152)	(0.124)	(0.232)	(0.178)	(0.165)
Adult family reunification immigrants	-1.370***	-1.428***	-1.437***	-1.099***	-0.861***	-1.147***	-1.265***	-0.967***	-0.753***	-0.581***
	(0.151)	(0.199)	(0.319)	(0.254)	(0.186)	(0.138)	(0.158)	(0.241)	(0.188)	(0.169)
Adult other categories	-0.873***	-0.895***	-0.806**	-0.735**	-0.645**	-0.767***	-1.045***	-0.663*	-0.480*	-0.353
	(0.220)	(0.220)	(0.295)	(0.241)	(0.233)	(0.194)	(0.192)	(0.314)	(0.224)	(0.228)
Adult temporary residents	-1.232***	-0.822**	-0.909*	-0.676*	-0.527	-1.311***	-1.160***	-1.074***	-0.713**	-0.492*
	(0.369)	(0.262)	(0.446)	(0.284)	(0.278)	(0.299)	(0.238)	(0.324)	(0.228)	(0.210)
Young refugee immigrants	-1.055*	-1.592***	-1.246	-0.848	-0.698	-0.738*	0.101	-0.594	-0.445	-0.447
	(0.512)	(0.434)	(0.740)	(0.489)	(0.372)	(0.364)	(1.148)	(0.724)	(0.562)	(0.449)

(continued)

Table 2.8. continued

	Male					Female				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Young non-refugee immigrants	-0.795***	-1.134***	-0.874*	-0.713**	-0.777**	-0.697**	-0.815***	-0.508	-0.318	-0.412
	(0.235)	(0.289)	(0.392)	(0.272)	(0.260)	(0.218)	(0.201)	(0.301)	(0.226)	(0.279)
Education (Reference group: high school)										
< high school	-0.753***		-1.254***	-0.599***	-0.234**	-0.792***		-1.266***	-0.808***	-0.341***
	(0.081)		(0.241)	(0.120)	(0.086)	(0.078)		(0.190)	(0.108)	(0.082)
College or trade school	0.344***		0.351**	0.390***	0.300**	0.253***		0.256**	0.240*	0.221*
	(0.053)		(0.122)	(0.107)	(0.097)	(0.050)		(0.092)	(0.102)	(0.092)
≥ bachelor's degree			0.850***	1.084***	1.147***			0.718***	1.001***	1.080***
			(0.141)	(0.125)	(0.136)			(0.114)	(0.137)	(0.125)
> bachelor's degree		0.196*					0.235**			
		(0.085)					(0.080)			
Foreign education x < high school	-0.069		-0.137	0.169	0.272	-0.085		-0.126	0.268	0.239*
	(0.197)		(0.351)	(0.155)	(0.143)	(0.168)		(0.284)	(0.159)	(0.119)

(continued)

Table 2.8. continued

	Male					Female				
	Subsamples by education attainment (OLS)		Unconditional Quantiles			Subsamples by education attainment (OLS)		Unconditional Quantiles		
	< bachelor's	≥ bachelor's	25th	50th	75th	< bachelor's	≥ bachelor's	25th	50th	75th
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Foreign education x high school	0.119		-0.923*	-0.248	0.091	-0.226		-0.725*	-0.272	-0.034
	(0.172)		(0.390)	(0.190)	(0.216)	(0.117)		(0.292)	(0.173)	(0.148)
Foreign education x college or trade school			-0.173	-0.080	0.074			-0.673*	-0.414*	-0.229
			(0.293)	(0.230)	(0.178)			(0.262)	(0.172)	(0.141)
Foreign education x ≥ bachelor's degree			0.019	-0.208	-0.320			-0.254	-0.656***	-0.685***
			(0.170)	(0.177)	(0.183)			(0.191)	(0.185)	(0.162)
Foreign education x > bachelor's degree		0.115					-0.050			
		(0.128)					(0.164)			
N	5900	2310	8210	8210	8210	6553	2965	9518	9518	9518
R^2	0.264	0.144	0.220	0.206	0.162	0.281	0.182	0.230	0.224	0.171
Adjusted R^2	0.260	0.135	0.218	0.203	0.159	0.279	0.176	0.227	0.221	0.168

Source: Authors' calculations. PIAAC 2012.
Notes: * p<0.05, ** p<0.01, *** p<0.001. The ordinary least squares (OLS) and unconditional quantile regression methods were used to calculate point estimates using all 10 plausible values for literacy and numeracy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. All regressions include age and its polynomials, rural and urban indicators, and provinces.

Table 2.9. Earnings gaps across the three broad categories

	Dependent variable: log hourly wages									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy			0.083***		-0.011			0.089***		0.035
			(0.013)		(0.022)			(0.011)		(0.023)
Numeracy				0.103***	0.112***				0.093***	0.065**
				(0.012)	(0.022)				(0.011)	(0.023)
Adult immigrants	-0.333***	-0.411***	-0.337***	-0.329***	-0.331***	-0.392***	-0.335***	-0.278***	-0.289***	-0.280***
	(0.052)	(0.076)	(0.076)	(0.074)	(0.074)	(0.055)	(0.075)	(0.073)	(0.074)	(0.074)
Young immigrants	-0.204	-0.323*	-0.267*	-0.246	-0.246	-0.305***	-0.318***	-0.286***	-0.288***	-0.283***
	(0.125)	(0.133)	(0.130)	(0.129)	(0.128)	(0.078)	(0.074)	(0.074)	(0.072)	(0.073)
Education (Reference group: high school graduates)										
< high school		-0.103*	-0.041	-0.028	-0.030		-0.189***	-0.130**	-0.131**	-0.125**
		(0.044)	(0.045)	(0.046)	(0.046)		(0.042)	(0.043)	(0.043)	(0.043)
College or trade school		0.158***	0.138***	0.124***	0.124***		0.190***	0.170***	0.170***	0.167***
		(0.030)	(0.031)	(0.032)	(0.032)		(0.024)	(0.024)	(0.024)	(0.024)
≥ bachelor's degree		0.460***	0.380***	0.354***	0.355***		0.522***	0.446***	0.443***	0.436***
		(0.037)	(0.040)	(0.040)	(0.040)		(0.028)	(0.030)	(0.030)	(0.030)
Foreign education x < high school		-0.110	-0.046	-0.048	-0.052		-0.049	-0.010	-0.004	-0.002
		(0.097)	(0.097)	(0.098)	(0.099)		(0.079)	(0.084)	(0.085)	(0.085)
Foreign education x high school		-0.202**	-0.142	-0.122	-0.124		-0.084	-0.047	-0.040	-0.038
		(0.077)	(0.078)	(0.078)	(0.078)		(0.070)	(0.072)	(0.074)	(0.073)
Foreign education x college or trade school		-0.074	-0.067	-0.076	-0.078		-0.160*	-0.129	-0.118	-0.118
		(0.080)	(0.079)	(0.077)	(0.077)		(0.073)	(0.071)	(0.074)	(0.073)

(continued)

Table 2.9. continued

	Dependent variable: log hourly wages									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Foreign education x ≥ bachelor's degree		-0.136*	-0.127*	-0.137*	-0.138*		-0.300***	-0.262***	-0.253***	-0.252***
		(0.058)	(0.058)	(0.057)	(0.057)		(0.062)	(0.061)	(0.062)	(0.062)
Rural/urban and provinces (Reference group: Large urban in Ontario)										
Rural		-0.011	0.003	0.001	-0.000		-0.058**	-0.052*	-0.057**	-0.055*
		(0.027)	(0.028)	(0.028)	(0.028)		(0.022)	(0.021)	(0.021)	(0.021)
Small urban		-0.010	0.001	-0.002	-0.002		-0.096***	-0.088***	-0.087***	-0.087***
		(0.030)	(0.030)	(0.030)	(0.030)		(0.027)	(0.026)	(0.026)	(0.026)
Medium urban		-0.048	-0.049	-0.048	-0.048		-0.055	-0.049	-0.048	-0.047
		(0.040)	(0.041)	(0.040)	(0.040)		(0.037)	(0.037)	(0.036)	(0.036)
Alberta		0.241***	0.231***	0.230***	0.230***		0.112**	0.108**	0.109**	0.108**
		(0.040)	(0.041)	(0.040)	(0.040)		(0.038)	(0.037)	(0.037)	(0.037)
British Columbia		0.002	0.006	0.011	0.011		0.038	0.030	0.030	0.029
		(0.036)	(0.037)	(0.036)	(0.036)		(0.028)	(0.028)	(0.028)	(0.028)
Prairie provinces		0.020	0.024	0.026	0.026		-0.045	-0.045	-0.047	-0.047
		(0.027)	(0.026)	(0.026)	(0.026)		(0.026)	(0.025)	(0.025)	(0.025)
Atlantic provinces		-0.202***	-0.194***	-0.187***	-0.187***		-0.161***	-0.151***	-0.147***	-0.148***
		(0.026)	(0.026)	(0.026)	(0.026)		(0.020)	(0.020)	(0.020)	(0.020)
Territories		0.217***	0.209***	0.221***	0.222***		0.368***	0.353***	0.357***	0.354***
		(0.044)	(0.051)	(0.052)	(0.052)		(0.087)	(0.074)	(0.071)	(0.070)
Quebec		-0.092***	-0.084***	-0.086***	-0.086***		-0.082***	-0.067***	-0.079***	-0.074***
		(0.024)	(0.025)	(0.025)	(0.025)		(0.018)	(0.018)	(0.018)	(0.018)
Age	0.069***	0.066***	0.065***	0.064***	0.064***	0.057***	0.058***	0.057***	0.056***	0.056***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
$Age^2/100$	-0.073***	-0.068***	-0.066***	-0.064***	-0.064***	-0.065***	-0.059***	-0.057***	-0.056***	-0.056***
	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)

(continued)

Table 2.9. continued

	Dependent variable: log hourly wages									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Year in Canada	0.014**	0.018***	0.017***	0.018***	0.018***	0.014*	0.013*	0.013**	0.013*	0.013**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Year in Canada^2/100	-0.013	-0.020*	-0.020*	-0.021*	-0.021*	-0.012	-0.011	-0.013	-0.012	-0.013
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.012)	(0.010)	(0.010)	(0.010)	(0.010)
Constant	1.774***	1.656***	1.652***	1.682***	1.685***	1.942***	1.641***	1.644***	1.691***	1.677***
	(0.182)	(0.180)	(0.178)	(0.180)	(0.181)	(0.178)	(0.165)	(0.169)	(0.170)	(0.171)
N	5269	5269	5269	5269	5269	5807	5807	5807	5807	5807
R^2	0.054	0.221	0.240	0.252	0.252	0.055	0.274	0.297	0.300	0.301
Adjusted R^2	0.053	0.218	0.237	0.249	0.249	0.054	0.271	0.294	0.297	0.299

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) was used to calculate point estimates using all 10 plausible values for numeracy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The reference group includes the Canadian-born who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey. Young immigrants are those who migrated to Canada at 14 years old or younger.

Table 2.10. Earnings gaps across nine population subgroups

	Dependent variable: log hourly wages									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy			0.080***		-0.009			0.086***		0.034
			(0.013)		(0.022)			(0.011)		(0.023)
Numeracy				0.100***	0.107***				0.090***	0.063**
				(0.013)	(0.021)				(0.011)	(0.023)
Second generation	0.055	-0.020	-0.019	-0.014	-0.013	0.095**	0.009	0.004	0.009	0.007
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.029)	(0.026)	(0.026)	(0.026)	(0.026)
Adult refugees	-0.669***	-0.588***	-0.479***	-0.462***	-0.466***	-0.496***	-0.430***	-0.358**	-0.363**	-0.354**
	(0.105)	(0.108)	(0.104)	(0.102)	(0.102)	(0.131)	(0.110)	(0.117)	(0.117)	(0.118)
Adult economic immigrants	-0.265***	-0.384***	-0.316***	-0.316***	-0.318***	-0.256***	-0.261***	-0.220**	-0.234**	-0.226**
	(0.050)	(0.068)	(0.069)	(0.068)	(0.068)	(0.061)	(0.074)	(0.071)	(0.072)	(0.072)
Adult family reunification immigrants	-0.626***	-0.572***	-0.468***	-0.441***	-0.443***	-0.500***	-0.391***	-0.323***	-0.322***	-0.315***
	(0.059)	(0.079)	(0.080)	(0.078)	(0.079)	(0.074)	(0.081)	(0.081)	(0.083)	(0.083)
Adult other categories	-0.478***	-0.526***	-0.476***	-0.456**	-0.457**	-0.342***	-0.289***	-0.257**	-0.252**	-0.250**
	(0.123)	(0.145)	(0.142)	(0.143)	(0.143)	(0.079)	(0.086)	(0.085)	(0.086)	(0.086)
Adult temporary residents	-0.350**	-0.338*	-0.273*	-0.258*	-0.259*	-0.510***	-0.427***	-0.357***	-0.366***	-0.356***
	(0.129)	(0.134)	(0.130)	(0.123)	(0.123)	(0.077)	(0.107)	(0.103)	(0.101)	(0.102)
Young refugee immigrants	-0.642*	-0.649**	-0.574*	-0.513*	-0.512*	-0.665***	-0.461***	-0.410***	-0.422***	-0.413***
	(0.262)	(0.249)	(0.232)	(0.208)	(0.207)	(0.143)	(0.111)	(0.113)	(0.124)	(0.121)
Young non-refugee immigrants	-0.349**	-0.389**	-0.317*	-0.294*	-0.295*	-0.285***	-0.304***	-0.276***	-0.271***	-0.269***
	(0.134)	(0.139)	(0.136)	(0.136)	(0.136)	(0.084)	(0.076)	(0.077)	(0.075)	(0.075)
Education (Reference group: high school graduates)										
< high school		-0.104*	-0.044	-0.031	-0.033		-0.188***	-0.132**	-0.132**	-0.126**
		(0.044)	(0.045)	(0.046)	(0.046)		(0.042)	(0.043)	(0.043)	(0.043)

(continued)

Table 2.10. continued

	Dependent variable: log hourly wages									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
College or trade school		0.159***	0.140***	0.126***	0.125***		0.188***	0.168***	0.168***	0.166***
		(0.030)	(0.031)	(0.032)	(0.032)		(0.024)	(0.024)	(0.024)	(0.024)
≥ bachelor's degree		0.453***	0.378***	0.353***	0.354***		0.516***	0.443***	0.440***	0.433***
		(0.037)	(0.039)	(0.039)	(0.040)		(0.028)	(0.030)	(0.030)	(0.030)
Foreign education x < high school		-0.057	-0.007	-0.018	-0.021		-0.012	0.018	0.021	0.023
		(0.099)	(0.100)	(0.101)	(0.101)		(0.087)	(0.091)	(0.092)	(0.092)
Foreign education x high school		-0.161	-0.115	-0.103	-0.104		-0.061	-0.030	-0.026	-0.024
		(0.088)	(0.085)	(0.084)	(0.084)		(0.071)	(0.072)	(0.075)	(0.074)
Foreign education x college or trade school		-0.095	-0.086	-0.093	-0.094		-0.163*	-0.132	-0.122	-0.122
		(0.079)	(0.078)	(0.077)	(0.077)		(0.072)	(0.070)	(0.073)	(0.072)
Foreign education x ≥ bachelor's degree		-0.168**	-0.156**	-0.161**	-0.162**		-0.303***	-0.266***	-0.258***	-0.256***
		(0.057)	(0.058)	(0.057)	(0.057)		(0.062)	(0.062)	(0.063)	(0.062)
Rural/urban and provinces (Reference group: Large urban in Ontario)										
Rural		-0.015	-0.000	-0.002	-0.003		-0.060**	-0.054*	-0.058**	-0.056*
		(0.028)	(0.028)	(0.028)	(0.029)		(0.022)	(0.022)	(0.022)	(0.022)
Small urban		-0.014	-0.004	-0.005	-0.006		-0.098***	-0.091***	-0.089***	-0.089***
		(0.031)	(0.031)	(0.031)	(0.031)		(0.027)	(0.026)	(0.026)	(0.026)
Medium urban		-0.050	-0.052	-0.050	-0.050		-0.058	-0.051	-0.050	-0.050
		(0.040)	(0.041)	(0.040)	(0.040)		(0.037)	(0.037)	(0.036)	(0.036)
Alberta		0.234***	0.225***	0.226***	0.226***		0.109**	0.106**	0.107**	0.106**
		(0.041)	(0.041)	(0.041)	(0.041)		(0.038)	(0.037)	(0.037)	(0.037)

(continued)

Table 2.10. continued

	Dependent variable: log hourly wages									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
British Columbia		-0.006	-0.000	0.005	0.005		0.034	0.028	0.027	0.027
		(0.037)	(0.038)	(0.038)	(0.038)		(0.029)	(0.029)	(0.029)	(0.029)
Prairie provinces		0.015	0.020	0.023	0.023		-0.045	-0.046	-0.047	-0.047
		(0.028)	(0.027)	(0.027)	(0.027)		(0.026)	(0.026)	(0.026)	(0.026)
Atlantic provinces		-0.208***	-0.199***	-0.191***	-0.191***		-0.161***	-0.152***	-0.147***	-0.148***
		(0.028)	(0.027)	(0.027)	(0.027)		(0.022)	(0.022)	(0.022)	(0.022)
Territories		0.215***	0.210***	0.222***	0.223***		0.365***	0.351***	0.356***	0.352***
		(0.044)	(0.050)	(0.052)	(0.052)		(0.081)	(0.071)	(0.068)	(0.067)
Quebec		-0.097***	-0.088***	-0.089***	-0.089***		-0.082***	-0.067***	-0.079***	-0.074***
		(0.026)	(0.026)	(0.026)	(0.026)		(0.020)	(0.020)	(0.020)	(0.020)
Age	0.068***	0.066***	0.065***	0.064***	0.064***	0.055***	0.056***	0.056***	0.055***	0.055***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
$Age^2/100$	-0.072***	-0.068***	-0.066***	-0.064***	-0.064***	-0.062***	-0.058***	-0.056***	-0.055***	-0.056***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)
Year in Canada	0.024***	0.024***	0.022***	0.022***	0.022***	0.016**	0.013*	0.013*	0.013*	0.013*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Year in $Canada^2/100$	-0.027**	-0.028**	-0.027**	-0.028**	-0.028**	-0.015	-0.011	-0.013	-0.012	-0.013
	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.012)	(0.011)	(0.010)	(0.010)	(0.010)
Constant	1.807***	1.678***	1.671***	1.695***	1.698***	1.980***	1.672***	1.671***	1.715***	1.702***
	(0.184)	(0.181)	(0.180)	(0.182)	(0.184)	(0.176)	(0.168)	(0.172)	(0.173)	(0.174)
N	5269	5269	5269	5269	5269	5807	5807	5807	5807	5807
R^2	0.076	0.228	0.245	0.256	0.256	0.073	0.278	0.299	0.302	0.304
Adjusted R^2	0.074	0.223	0.241	0.252	0.252	0.071	0.275	0.296	0.299	0.300

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) was used to calculate point estimates using all 10 plausible values for numeracy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The Reference group includes the Canadian-born who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey.

Table 2.11. Unconditional quantile wage regressions across the three broad categories

	Dependent variable: log hourly wage								
	25th quantile			50th quantile			75th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Men								
Literacy		0.107***			0.089***			0.082***	
		(0.023)			(0.015)			(0.018)	
Numeracy			0.127***			0.112***			0.095***
			(0.025)			(0.015)			(0.019)
Adult immigrants	-0.441***	-0.346**	-0.340**	-0.421***	-0.343***	-0.332***	-0.288*	-0.215	-0.212
	(0.119)	(0.116)	(0.113)	(0.090)	(0.090)	(0.089)	(0.134)	(0.129)	(0.132)
Young immigrants	-0.521**	-0.449**	-0.425**	-0.378**	-0.319**	-0.294*	-0.084	-0.028	-0.012
	(0.175)	(0.168)	(0.164)	(0.119)	(0.119)	(0.117)	(0.153)	(0.149)	(0.148)
Education (Reference group: HS graduates)									
< high school	-0.159*	-0.079	-0.066	-0.097	-0.031	-0.015	-0.114**	-0.052	-0.044
	(0.080)	(0.085)	(0.085)	(0.053)	(0.052)	(0.052)	(0.044)	(0.046)	(0.047)
College or trade school	0.161***	0.136***	0.119**	0.222***	0.201***	0.185***	0.134***	0.114**	0.102*
	(0.041)	(0.041)	(0.042)	(0.039)	(0.039)	(0.040)	(0.040)	(0.040)	(0.040)
≥ bachelor's degree	0.379***	0.277***	0.249***	0.516***	0.431***	0.400***	0.567***	0.489***	0.470***
	(0.073)	(0.066)	(0.065)	(0.050)	(0.052)	(0.052)	(0.049)	(0.052)	(0.051)
Foreign education x < high school	-0.215	-0.134	-0.139	-0.020	0.048	0.047	0.045	0.107	0.101
	(0.154)	(0.154)	(0.157)	(0.113)	(0.114)	(0.117)	(0.119)	(0.120)	(0.119)
Foreign education x high school	-0.457**	-0.379*	-0.359*	-0.198*	-0.134	-0.111	-0.127	-0.067	-0.054
	(0.154)	(0.148)	(0.148)	(0.082)	(0.087)	(0.087)	(0.084)	(0.087)	(0.088)
Foreign education x college or trade school	-0.157	-0.148	-0.160	-0.038	-0.031	-0.041	-0.051	-0.045	-0.054
	(0.113)	(0.110)	(0.108)	(0.090)	(0.089)	(0.087)	(0.101)	(0.099)	(0.099)

(continued)

Table 2.11. continued

	Dependent variable: log hourly wage								
	25th quantile			50th quantile			75th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Foreign education x ≥ bachelor's degree	-0.131	-0.120	-0.132	-0.046	-0.036	-0.046	-0.233*	-0.224*	-0.234*
	(0.078)	(0.077)	(0.074)	(0.072)	(0.073)	(0.072)	(0.106)	(0.106)	(0.105)
N	5269	5269	5269	5269	5269	5269	5269	5269	5269
R^2	0.144	0.164	0.174	0.188	0.205	0.216	0.189	0.201	0.206
Adjusted R^2	0.140	0.161	0.171	0.185	0.201	0.213	0.185	0.198	0.203
				Women					
Literacy		0.107***			0.097***			0.097***	
		(0.020)			(0.016)			(0.016)	
Numeracy			0.102***			0.102***			0.103***
			(0.020)			(0.015)			(0.017)
Adult immigrants	-0.529***	-0.460***	-0.478***	-0.277**	-0.215*	-0.226*	-0.206*	-0.144	-0.155
	(0.128)	(0.128)	(0.128)	(0.090)	(0.088)	(0.090)	(0.092)	(0.090)	(0.090)
Young immigrants	-0.446**	-0.407**	-0.413**	-0.181	-0.146	-0.148	-0.131	-0.096	-0.098
	(0.153)	(0.153)	(0.151)	(0.116)	(0.117)	(0.116)	(0.094)	(0.095)	(0.093)
Education (Reference group: HS graduates)									
< high school	-0.328***	-0.258**	-0.264**	-0.201***	-0.137**	-0.137**	-0.068	-0.005	-0.004
	(0.094)	(0.095)	(0.095)	(0.052)	(0.053)	(0.053)	(0.042)	(0.042)	(0.043)
College or trade school	0.285***	0.260***	0.262***	0.236***	0.214***	0.214***	0.160***	0.137***	0.137***
	(0.053)	(0.052)	(0.052)	(0.041)	(0.041)	(0.041)	(0.032)	(0.032)	(0.033)
≥ bachelor's degree	0.506***	0.414***	0.418***	0.629***	0.547***	0.542***	0.676***	0.593***	0.589***
	(0.057)	(0.057)	(0.057)	(0.047)	(0.047)	(0.047)	(0.047)	(0.051)	(0.050)

(continued)

Table 2.11. continued

	Dependent variable: log hourly wage								
	25th quantile			50th quantile			75th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Foreign education x < high school	-0.049	-0.003	-0.000	-0.107	-0.066	-0.059	0.052	0.094	0.102
	(0.194)	(0.193)	(0.194)	(0.088)	(0.092)	(0.093)	(0.088)	(0.091)	(0.091)
Foreign education x high school	-0.132	-0.087	-0.084	-0.091	-0.051	-0.043	0.033	0.074	0.082
	(0.136)	(0.137)	(0.139)	(0.114)	(0.114)	(0.116)	(0.090)	(0.091)	(0.093)
Foreign education x college or trade school	-0.194	-0.157	-0.148	-0.198	-0.164	-0.152	-0.054	-0.020	-0.007
	(0.125)	(0.122)	(0.125)	(0.103)	(0.103)	(0.106)	(0.087)	(0.085)	(0.087)
Foreign education x ≥ bachelor's degree	-0.231*	-0.186	-0.180	-0.345***	-0.304***	-0.294***	-0.356***	-0.315***	-0.304***
	(0.099)	(0.099)	(0.100)	(0.078)	(0.079)	(0.080)	(0.089)	(0.088)	(0.089)
N	5807	5807	5807	5807	5807	5807	5807	5807	5807
R^2	0.182	0.199	0.198	0.229	0.246	0.248	0.206	0.221	0.224
Adjusted R^2	0.179	0.195	0.195	0.227	0.243	0.245	0.203	0.218	0.221

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The Firpo et al. (2009) method of unconditional quantile regressions was used to derive estimated coefficients. All 10 plausible value of each test scores are used. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The Reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey.

Table 2.12. Unconditional quantile regressions of wages across the nine population subgroups

	Dependent variable: log hourly wage								
	25th quantile			50th quantile			75th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Men					
Literacy		0.100***			0.085***			0.079***	
		(0.023)			(0.015)			(0.019)	
Numeracy			0.119***			0.109***			0.093***
			(0.025)			(0.015)			(0.019)
Second generation	-0.020	-0.020	-0.013	-0.013	-0.013	-0.007	-0.006	-0.006	-0.001
	(0.047)	(0.048)	(0.048)	(0.042)	(0.042)	(0.042)	(0.048)	(0.047)	(0.047)
Adult refugee	-0.652***	-0.514***	-0.502***	-0.647***	-0.531***	-0.510***	-0.427**	-0.319*	-0.310*
	(0.149)	(0.137)	(0.134)	(0.135)	(0.132)	(0.130)	(0.150)	(0.145)	(0.147)
Adult economic immigrant	-0.387***	-0.302**	-0.306**	-0.425***	-0.353***	-0.350***	-0.308*	-0.241	-0.244
	(0.112)	(0.107)	(0.105)	(0.092)	(0.092)	(0.093)	(0.155)	(0.149)	(0.152)
Adult family reunification immigrant	-0.773***	-0.644***	-0.617***	-0.619***	-0.509***	-0.476***	-0.433**	-0.331*	-0.311*
	(0.123)	(0.114)	(0.110)	(0.102)	(0.101)	(0.099)	(0.139)	(0.134)	(0.135)
Adult other categories	-0.515**	-0.452**	-0.432**	-0.533***	-0.480***	-0.458**	-0.197	-0.148	-0.132
	(0.165)	(0.159)	(0.160)	(0.146)	(0.142)	(0.144)	(0.197)	(0.191)	(0.192)
Adult temporary residents	-0.370	-0.288	-0.275	-0.255	-0.186	-0.168	-0.203	-0.138	-0.128
	(0.194)	(0.188)	(0.181)	(0.152)	(0.150)	(0.147)	(0.149)	(0.144)	(0.143)
Young refugee immigrants	-1.152***	-1.058***	-0.990***	-0.505*	-0.426*	-0.357*	-0.042	0.032	0.085
	(0.308)	(0.286)	(0.258)	(0.213)	(0.197)	(0.174)	(0.236)	(0.220)	(0.201)
Young non-refugee immigrants	-0.616***	-0.526**	-0.503**	-0.514***	-0.439***	-0.411**	-0.189	-0.118	-0.100
	(0.174)	(0.166)	(0.164)	(0.131)	(0.131)	(0.130)	(0.164)	(0.160)	(0.159)
Education (Reference group: HS graduates)									
< high school	-0.159*	-0.084	-0.072	-0.097	-0.033	-0.017	-0.112*	-0.053	-0.044
	(0.080)	(0.085)	(0.085)	(0.053)	(0.052)	(0.052)	(0.044)	(0.046)	(0.047)
College or trade school	0.163***	0.139***	0.124**	0.223***	0.203***	0.187***	0.135***	0.116**	0.104**
	(0.041)	(0.041)	(0.042)	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)

(continued)

Table 2.12. continued

	Dependent variable: log hourly wage								
	25th quantile			50th quantile			75th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
≥ bachelor's degree	0.368***	0.274***	0.248***	0.509***	0.430***	0.399***	0.564***	0.489***	0.470***
	(0.073)	(0.066)	(0.065)	(0.050)	(0.052)	(0.052)	(0.049)	(0.052)	(0.051)
Foreign education x < high school	-0.096	-0.034	-0.049	0.031	0.083	0.074	0.083	0.132	0.120
	(0.147)	(0.148)	(0.151)	(0.113)	(0.115)	(0.118)	(0.114)	(0.116)	(0.116)
Foreign education x high school	-0.368*	-0.311*	-0.298	-0.157	-0.108	-0.093	-0.087	-0.041	-0.032
	(0.161)	(0.154)	(0.153)	(0.093)	(0.094)	(0.093)	(0.088)	(0.088)	(0.088)
Foreign education x college or trade school	-0.187	-0.176	-0.185	-0.061	-0.051	-0.059	-0.059	-0.050	-0.058
	(0.108)	(0.108)	(0.106)	(0.087)	(0.085)	(0.084)	(0.103)	(0.102)	(0.101)
Foreign education x ≥ bachelor's degree	-0.180*	-0.165*	-0.172*	-0.071	-0.058	-0.063	-0.236*	-0.224*	-0.230*
	(0.075)	(0.075)	(0.073)	(0.071)	(0.072)	(0.073)	(0.111)	(0.111)	(0.111)
N	5269	5269	5269	5269	5269	5269	5269	5269	5269
R^2	0.158	0.175	0.184	0.194	0.209	0.220	0.192	0.203	0.208
Adjusted R^2	0.153	0.171	0.179	0.190	0.205	0.215	0.187	0.198	0.203
				Women					
Literacy		0.100***			0.093***			0.097***	
		(0.021)			(0.016)			(0.016)	
Numeracy			0.096***			0.098***			0.103***
			(0.020)			(0.015)			(0.017)
Second generation	-0.006	-0.012	-0.007	-0.047	-0.052	-0.048	-0.014	-0.019	-0.015
	(0.042)	(0.042)	(0.042)	(0.039)	(0.038)	(0.038)	(0.036)	(0.036)	(0.036)
Adult refugee	-0.636**	-0.552*	-0.565*	-0.440**	-0.361*	-0.366*	-0.357*	-0.276*	-0.281*
	(0.210)	(0.219)	(0.219)	(0.142)	(0.156)	(0.155)	(0.144)	(0.135)	(0.134)
Adult economic immigrant	-0.377**	-0.329**	-0.348**	-0.189*	-0.145	-0.160	-0.157	-0.111	-0.127
	(0.119)	(0.117)	(0.119)	(0.087)	(0.086)	(0.087)	(0.091)	(0.087)	(0.088)

(continued)

Table 2.12. continued

	Dependent variable: log hourly wage								
	25th quantile			50th quantile			75th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Adult family reunification immigrant	-0.627***	-0.547***	-0.554***	-0.344***	-0.270**	-0.269**	-0.233*	-0.156	-0.155
	(0.138)	(0.140)	(0.140)	(0.096)	(0.095)	(0.096)	(0.106)	(0.104)	(0.106)
Adult other categories	-0.320*	-0.282	-0.280	-0.189	-0.154	-0.149	-0.403***	-0.367**	-0.361**
	(0.144)	(0.145)	(0.146)	(0.121)	(0.122)	(0.123)	(0.113)	(0.112)	(0.111)
Adult temporary residents	-0.800***	-0.718***	-0.734***	-0.446***	-0.370**	-0.379**	-0.273*	-0.194	-0.203
	(0.206)	(0.205)	(0.205)	(0.118)	(0.118)	(0.119)	(0.115)	(0.111)	(0.109)
Young refugee immigrants	-0.565	-0.506	-0.524	-0.489***	-0.434***	-0.446***	-0.162	-0.104	-0.118
	(0.369)	(0.363)	(0.374)	(0.117)	(0.115)	(0.105)	(0.101)	(0.102)	(0.094)
Young non-refugee immigrants	-0.408**	-0.376*	-0.372*	-0.153	-0.123	-0.116	-0.166	-0.134	-0.127
	(0.148)	(0.150)	(0.148)	(0.117)	(0.120)	(0.117)	(0.101)	(0.101)	(0.099)
Education (Reference group: HS graduates)									
< high school	-0.326***	-0.260**	-0.266**	-0.204***	-0.143**	-0.143**	-0.069	-0.006	-0.006
	(0.094)	(0.095)	(0.095)	(0.052)	(0.053)	(0.053)	(0.042)	(0.042)	(0.043)
College or trade school	0.283***	0.260***	0.262***	0.233***	0.212***	0.212***	0.159***	0.137***	0.137***
	(0.053)	(0.052)	(0.052)	(0.041)	(0.041)	(0.040)	(0.032)	(0.032)	(0.033)
≥ bachelor's degree	0.496***	0.411***	0.415***	0.621***	0.542***	0.538***	0.676***	0.594***	0.589***
	(0.057)	(0.058)	(0.058)	(0.047)	(0.048)	(0.047)	(0.047)	(0.051)	(0.050)
Foreign education x < high school	0.036	0.071	0.070	-0.055	-0.023	-0.020	0.071	0.105	0.109
	(0.204)	(0.204)	(0.204)	(0.092)	(0.095)	(0.097)	(0.095)	(0.097)	(0.097)
Foreign education x high school	-0.080	-0.043	-0.043	-0.067	-0.033	-0.029	0.047	0.082	0.086
	(0.137)	(0.139)	(0.141)	(0.113)	(0.112)	(0.114)	(0.093)	(0.094)	(0.096)

(continued)

Table 2.12. continued

	Dependent variable: log hourly wage								
	25th quantile			50th quantile			75th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Foreign education x college or trade school	-0.203	-0.167	-0.160	-0.206*	-0.172	-0.162	-0.038	-0.002	0.009
	(0.124)	(0.121)	(0.123)	(0.101)	(0.101)	(0.104)	(0.088)	(0.085)	(0.087)
Foreign education x ≥ bachelor's degree	-0.237*	-0.193*	-0.189	-0.355***	-0.314***	-0.306***	-0.352***	-0.310***	-0.300***
	(0.099)	(0.098)	(0.100)	(0.080)	(0.081)	(0.082)	(0.088)	(0.088)	(0.089)
N	5807	5807	5807	5807	5807	5807	5807	5807	5807
R^2	0.191	0.206	0.205	0.235	0.250	0.253	0.209	0.224	0.227
Adjusted R^2	0.188	0.202	0.201	0.232	0.247	0.249	0.205	0.220	0.223

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The Firpo et al. (2009) method of unconditional quantile regressions was used to derive estimated coefficients. All 10 plausible values of each test scores are used. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The Reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey.

APPENDIX

Table A.2.1. Pairwise correlation between literacy and numeracy scores

All Individuals	All Men	All Women	Immigrants	Male Immigrants	Female Immigrants	Canadians	Male Canadians	Female Canadians
All individuals in the sample								
0.871	0.878	0.874	0.876	0.885	0.872	0.860	0.871	0.860
(0.005)	(0.007)	(0.005)	(0.008)	(0.012)	(0.012)	(0.005)	(0.008)	(0.006)
Only individuals with positive self-reported hourly wage								
0.863	0.874	0.860	0.874	0.890	0.860	0.849	0.863	0.843
(0.005)	(0.008)	(0.008)	(0.010)	(0.011)	(0.018)	(0.007)	(0.009)	(0.008)

Source: Authors' calculations. PIAAC 2012.

Notes: Standard errors are in parentheses. These pairwise correlation coefficients are calculated using all ten plausible values for each category of tests.

Table A.2.2. Unconditional quantile regressions at the 10th and 90th percentiles

	Dependent variable: Standardized test scores (with mean of 0 and variance of 1)							
	Literacy				Numeracy			
	10th quantile	90th quantile	10th quantile	90th quantile	10th quantile	90th quantile	10th quantile	90th quantile
	Men		Women		Men		Women	
Three groups of Canadians and immigrants								
Adult immigrants	-1.076**	-0.661**	-1.129***	-0.674***	-1.114**	-0.484*	-0.976**	-0.410
	(0.346)	(0.233)	(0.325)	(0.172)	(0.359)	(0.213)	(0.346)	(0.223)
Young immigrants	-0.806	-0.638*	-0.959*	-0.471	-1.019	-0.503	-0.937*	-0.438
	(0.474)	(0.298)	(0.449)	(0.340)	(0.659)	(0.315)	(0.431)	(0.310)
Education (Reference group: HS graduates)								
< high school	-1.704***	-0.153	-1.490***	-0.145*	-1.718***	-0.106	-1.634***	-0.160*
	(0.335)	(0.101)	(0.307)	(0.071)	(0.341)	(0.086)	(0.387)	(0.066)
College or trade school	0.075	0.173	0.207	0.150	0.211	0.237*	0.223	0.140
	(0.114)	(0.112)	(0.109)	(0.090)	(0.131)	(0.101)	(0.114)	(0.090)
≥ bachelor's degree	0.473***	1.108***	0.440***	0.969***	0.583***	1.209***	0.472***	1.047***
	(0.114)	(0.205)	(0.115)	(0.176)	(0.126)	(0.200)	(0.124)	(0.206)
Foreign education x < high school	-1.897*	0.296	-1.957*	0.326**	-1.456	0.154	-1.769*	0.129
	(0.755)	(0.158)	(0.767)	(0.110)	(0.895)	(0.167)	(0.770)	(0.187)
Foreign education x high school	-1.503*	0.180	-1.159*	0.259	-1.489*	0.145	-1.174*	0.038
	(0.662)	(0.154)	(0.488)	(0.145)	(0.733)	(0.225)	(0.555)	(0.219)
Foreign education x college or trade school	-0.576	0.103	-0.821	0.090	-0.067	0.037	-0.840	-0.098
	(0.451)	(0.178)	(0.441)	(0.123)	(0.429)	(0.221)	(0.478)	(0.214)
Foreign education x ≥ bachelor's degree	0.270	-0.432*	0.132	-0.584***	0.474	-0.483	-0.006	-0.680**
	(0.276)	(0.207)	(0.280)	(0.162)	(0.277)	(0.270)	(0.307)	(0.237)

(continued)

Table A.2.2. continued

	Dependent variable: Standardized test scores (with mean of 0 and variance of 1)							
	Literacy				Numeracy			
	10th quantile	90th quantile	10th quantile	90th quantile	10th quantile	90th quantile	10th quantile	90th quantile
	Men		Women		Men		Women	
N	8210	8210	9518	9518	8210	8210	9518	9518
R^2	0.177	0.104	0.207	0.11	0.179	0.095	0.190	0.099
Adjusted R^2	0.175	0.101	0.205	0.108	0.176	0.093	0.188	0.097
Detailed groups of Canadian-born and immigrant individuals								
Second-generation Canadians	0.093	-0.039	-0.043	0.066	0.068	-0.109	-0.107	0.005
	(0.113)	(0.139)	(0.114)	(0.126)	(0.152)	(0.125)	(0.109)	(0.112)
Adult refugee	-1.944**	-0.620*	-1.755**	-0.736***	-1.558*	-0.561*	-1.468	-0.615**
	(0.652)	(0.243)	(0.633)	(0.189)	(0.650)	(0.280)	(0.788)	(0.231)
Adult economic immigrant	-0.742*	-0.684**	-0.844*	-0.610***	-0.711	-0.413	-0.608	-0.310
	(0.337)	(0.257)	(0.350)	(0.173)	(0.364)	(0.249)	(0.347)	(0.245)
Adult family reunification immigrant	-1.347**	-0.746**	-1.209***	-0.719***	-1.746***	-0.750**	-1.285**	-0.532*
	(0.435)	(0.234)	(0.360)	(0.199)	(0.478)	(0.250)	(0.420)	(0.241)
Adult other categories	-0.524	-0.582	-0.920	-0.490	-0.552	-0.543	-0.991	-0.361
	(0.466)	(0.299)	(0.523)	(0.260)	(0.619)	(0.319)	(0.541)	(0.336)
Adult temporary residents	-0.962	-0.617	-1.682**	-0.601**	-1.047	-0.421	-1.444*	-0.352
	(0.684)	(0.341)	(0.621)	(0.218)	(0.600)	(0.341)	(0.599)	(0.278)
Young refugee immigrants	-1.218	-0.643	-1.039	-0.721	-1.821	-0.626	-0.928	-0.433
	(0.855)	(0.410)	(0.743)	(0.369)	(1.170)	(0.436)	(0.737)	(0.404)
Young non-refugee immigrants	-0.867	-0.673*	-0.890	-0.423	-1.106	-0.619	-0.988*	-0.468
	(0.495)	(0.316)	(0.472)	(0.359)	(0.691)	(0.344)	(0.429)	(0.333)

(continued)

Table A.2.2. continued

	Dependent variable: Standardized test scores (with mean of 0 and variance of 1)							
	Literacy				Numeracy			
	10th quantile	90th quantile	10th quantile	90th quantile	10th quantile	90th quantile	10th quantile	90th quantile
	Men		Women		Men		Women	
Education (Reference group: HS graduates)								
< high school	-1.704***	-0.151	-1.490***	-0.142*	-1.710***	-0.101	-1.631***	-0.156*
	(0.335)	(0.101)	(0.307)	(0.071)	(0.339)	(0.086)	(0.385)	(0.066)
College or trade school	0.075	0.175	0.203	0.146	0.217	0.245*	0.218	0.138
	(0.114)	(0.113)	(0.109)	(0.089)	(0.131)	(0.102)	(0.114)	(0.090)
≥ bachelor's degree	0.434***	1.111***	0.425***	0.960***	0.545***	1.207***	0.452***	1.040***
	(0.111)	(0.206)	(0.117)	(0.176)	(0.124)	(0.199)	(0.122)	(0.206)
Foreign education x < high school	-1.749*	0.312*	-1.852*	0.344**	-1.189	0.246	-1.621*	0.162
	(0.757)	(0.152)	(0.773)	(0.115)	(0.903)	(0.166)	(0.769)	(0.191)
Foreign education x high school	-1.409*	0.180	-1.077*	0.268	-1.357	0.180	-1.049	0.067
	(0.655)	(0.155)	(0.480)	(0.148)	(0.729)	(0.223)	(0.552)	(0.218)
Foreign education x college or trade school	-0.625	0.102	-0.827	0.074	-0.112	0.029	-0.854	-0.109
	(0.442)	(0.181)	(0.446)	(0.126)	(0.410)	(0.221)	(0.483)	(0.212)
Foreign education x ≥ bachelor's degree	0.114	-0.431	0.106	-0.595***	0.288	-0.535	-0.028	-0.690**
	(0.274)	(0.221)	(0.284)	(0.164)	(0.268)	(0.293)	(0.306)	(0.239)
N	8210	8210	9518	9518	8210	8210	9518	9518
R^2	0.185	0.105	0.212	0.111	0.189	0.097	0.197	0.100
Adjusted R^2	0.182	0.101	0.210	0.108	0.187	0.094	0.194	0.097

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The unconditional quantile regression method was used to calculate point estimates using all 10 plausible values for literacy and numeracy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. All regressions include age and its polynomials, years in Canada, rural and urban indicators, and provinces.

Table A.2.3. Different functional forms of literacy and numeracy in earnings regressions for the three broad categories

	Dependent variable: Log(hourly wage)									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Scores										
Literacy	0.083***	0.081***	0.100***	0.092***		0.090***	0.091***	0.109***	0.117***	
	(0.012)	(0.013)	(0.017)	(0.021)		(0.011)	(0.012)	(0.014)	(0.017)	
Literacy^2		-0.005	-0.014	-0.020			0.003	-0.005	0.005	
		(0.006)	(0.009)	(0.012)			(0.007)	(0.008)	(0.012)	
Literacy^3			-0.006	-0.003				-0.006	-0.009*	
			(0.003)	(0.005)				(0.003)	(0.005)	
Literacy^4				0.001					-0.002	
				(0.001)					(0.002)	
Level of literacy (Reference: >325 points)										
< 226					-0.373***					-0.266***
					(0.042)					(0.040)
226 to < 276					-0.173***					-0.211***
					(0.033)					(0.035)
276 to < 326					-0.079**					-0.069*
					(0.027)					(0.029)
Adult Immigrants	-0.381***	-0.381***	-0.382***	-0.383***	-0.381***	-0.323***	-0.322***	-0.323***	-0.322***	-0.325***
	(0.068)	(0.068)	(0.067)	(0.067)	(0.067)	(0.074)	(0.074)	(0.074)	(0.074)	(0.073)
Young Immigrants	-0.298*	-0.298*	-0.304*	-0.304*	-0.311*	-0.317***	-0.316***	-0.319***	-0.318***	-0.322***
	(0.127)	(0.127)	(0.128)	(0.128)	(0.125)	(0.075)	(0.075)	(0.075)	(0.075)	(0.073)

(continued)

Table A.2.3. continued

	Dependent variable: Log(hourly wage)									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	1.680***	1.685***	1.695***	1.698***	1.791***	1.648***	1.644***	1.651***	1.648***	1.775***
	(0.179)	(0.178)	(0.178)	(0.178)	(0.177)	(0.170)	(0.170)	(0.169)	(0.169)	(0.163)
N	5327	5327	5327	5327	5327	5856	5856	5856	5856	5856
Log-likelihood	-3596.831	-3595.531	-3590.179	-3589.11	-3567.292	-3125.826	-3125	-3119.803	-3117.939	-3126.033
R^2	0.237	0.238	0.239	0.239	0.245	0.294	0.294	0.295	0.295	0.293
Adjusted R^2	0.241	0.241	0.242	0.243	0.249	0.297	0.297	0.298	0.298	0.296
RMSE	0.476	0.476	0.476	0.476	0.474	0.413	0.413	0.413	0.413	0.414
Numeracy Scores										
Numeracy	0.102***	0.102***	0.118***	0.113***		0.094***	0.101***	0.111***	0.114***	
	(0.012)	(0.013)	(0.016)	(0.019)		(0.011)	(0.013)	(0.015)	(0.019)	
$Numeracy^2$		-0.000	-0.006	-0.011			0.009	0.002	0.004	
		(0.005)	(0.007)	(0.012)			(0.007)	(0.010)	(0.013)	
$Numeracy^3$			-0.004	-0.003				-0.004	-0.005	
			(0.003)	(0.004)				(0.003)	(0.006)	
$Numeracy^4$				0.001					-0.000	
				(0.001)					(0.002)	
Level of Numeracy (Reference: > 325 points)										
< 226					-0.414***					-0.348***
					(0.042)					(0.042)
226 to < 276					-0.233***					-0.243***
					(0.035)					(0.040)
276 to < 326					-0.116***					-0.117**
					(0.033)					(0.036)

(continued)

Table A.2.3. continued

	Dependent variable: Log(hourly wage)									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Adult Immigrants	-0.380***	-0.379***	-0.378***	-0.378***	-0.363***	-0.332***	-0.331***	-0.330***	-0.330***	-0.329***
	(0.066)	(0.066)	(0.067)	(0.067)	(0.069)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)
Young Immigrants	-0.282*	-0.282*	-0.282*	-0.282*	-0.274*	-0.317***	-0.315***	-0.316***	-0.316***	-0.321***
	(0.125)	(0.125)	(0.126)	(0.126)	(0.126)	(0.073)	(0.073)	(0.073)	(0.073)	(0.072)
Constant	1.713***	1.713***	1.721***	1.724***	1.892***	1.696***	1.688***	1.692***	1.692***	1.863***
	(0.181)	(0.181)	(0.181)	(0.181)	(0.178)	(0.170)	(0.170)	(0.169)	(0.169)	(0.170)
N	5327	5327	5327	5327	5327	5856	5856	5856	5856	5856
Log-likelihood	-3557.156	-3556.955	-3553.519	-3552.965	-3525.684	-3111.552	-3108.321	-3105.994	-3105.082	-3088.052
R^2	0.249	0.248	0.249	0.249	0.257	0.297	0.298	0.298	0.298	0.303
Adjusted R^2	0.252	0.252	0.253	0.253	0.261	0.300	0.301	0.301	0.301	0.306
RMSE	0.473	0.473	0.473	0.473	0.470	0.412	0.412	0.412	0.412	0.411

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate estimated coefficients. All 10 plausible values for each respective test were employed. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The Reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey. The level of literacy and numeracy is calculated as follows: (1) calculate an equally weighted average of all 10 plausible values, and (2) use the thresholds in OECD (2013) to assign level to each individual with a slight modification. There are four groups of individuals: (a) with average test score below 226, (b) with average test score from 226 to below 276, (c) with average test score from 276 to 326, and (d) with average test score above 325.

Table A.2.4. Selective functional forms of literacy and numeracy scores in earnings regressions for the three broad categories

	Dependent variables: log hourly wages							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Men				
Literacy	-0.008	-0.009	-0.009	-0.009	-0.010	0.010	0.010	0.005
	(0.022)	(0.022)	(0.023)	(0.023)	(0.023)	(0.025)	(0.026)	(0.028)
Literacy^2			-0.003	-0.007	-0.008	-0.012	-0.013	-0.012
			(0.006)	(0.011)	(0.011)	(0.008)	(0.013)	(0.013)
Literacy^3						-0.005	-0.005	-0.004
						(0.003)	(0.003)	(0.004)
Numeracy	0.109***	0.125***	0.108***	0.108***	0.125***	0.108***	0.108***	0.114***
	(0.022)	(0.023)	(0.022)	(0.022)	(0.023)	(0.021)	(0.021)	(0.027)
Numeracy^2	-0.000	-0.006		0.004	-0.001		0.002	0.001
	(0.005)	(0.007)		(0.010)	(0.011)		(0.010)	(0.012)
Numeracy^3		-0.004			-0.005			-0.002
		(0.003)			(0.003)			(0.004)
Adult Immigrants	-0.382***	-0.380***	-0.382***	-0.383***	-0.382***	-0.383***	-0.384***	-0.383***
	(0.067)	(0.067)	(0.066)	(0.067)	(0.068)	(0.066)	(0.067)	(0.067)
Young Immigrants	-0.283*	-0.283*	-0.283*	-0.285*	-0.285*	-0.289*	-0.290*	-0.289*
	(0.125)	(0.125)	(0.125)	(0.126)	(0.126)	(0.126)	(0.126)	(0.127)
Constant	1.716***	1.724***	1.718***	1.717***	1.726***	1.729***	1.727***	1.728***
	(0.183)	(0.183)	(0.182)	(0.183)	(0.183)	(0.182)	(0.182)	(0.183)
N	5327	5327	5327	5327	5327	5327	5327	5327
Log-likelihood	-3556.563	-3553.089	-3556.102	-3555.242	-3551.386	-3550.987	-3550.34	-3549.606
R^2	0.248	0.249	0.249	0.249	0.25	0.25	0.25	0.25
Adjusted R^2	0.252	0.253	0.252	0.252	0.253	0.254	0.254	0.254
RMSE	0.473	0.473	0.473	0.473	0.473	0.472	0.472	0.472
				Women				
Literacy	0.037	0.037	0.037	0.036	0.035	0.054*	0.052*	0.050
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.024)	(0.024)	(0.026)

(continued)

Table A.2.4. continued

	Dependent variables: log hourly wages							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy^2			0.004	-0.006	-0.008	-0.004	-0.012	-0.012
			(0.007)	(0.010)	(0.010)	(0.008)	(0.011)	(0.011)
Literacy^3						-0.006	-0.005	-0.005
						(0.003)	(0.004)	(0.005)
Numeracy	0.072**	0.082***	0.067**	0.074**	0.085***	0.067**	0.073**	0.076**
	(0.024)	(0.025)	(0.023)	(0.023)	(0.024)	(0.023)	(0.023)	(0.026)
Numeracy^2	0.010	0.003		0.014	0.008		0.013	0.012
	(0.007)	(0.010)		(0.010)	(0.011)		(0.010)	(0.012)
Numeracy^3		-0.004			-0.004			-0.001
		(0.003)			(0.003)			(0.005)
Adult Immigrants	-0.321***	-0.320***	-0.321***	-0.322***	-0.321***	-0.322***	-0.322***	-0.322***
	(0.074)	(0.074)	(0.073)	(0.074)	(0.074)	(0.073)	(0.074)	(0.074)
Young Immigrants	-0.311***	-0.312***	-0.311***	-0.311***	-0.312***	-0.314***	-0.314***	-0.314***
	(0.074)	(0.074)	(0.073)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)
Constant	1.672***	1.676***	1.677***	1.675***	1.680***	1.684***	1.681***	1.681***
	(0.171)	(0.171)	(0.172)	(0.171)	(0.171)	(0.171)	(0.170)	(0.170)
N	5856	5856	5856	5856	5856	5856	5856	5856
Log-likelihood	-3101.752	-3099.541	-3104.387	-3100.597	-3098.044	-3099.349	-3096.159	-3095.639
R^2	0.299	0.300	0.299	0.299	0.300	0.300	0.300	0.300
Adjusted R^2	0.302	0.303	0.302	0.303	0.303	0.303	0.304	0.304
RMSE	0.412	0.412	0.412	0.412	0.412	0.412	0.412	0.412

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate coefficients. All 10 plausible values for each respective test were employed. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey. All regressions control for age, age squared, year in Canada. and year in Canada squared, the highest educational attainment and its interaction with indicator if an individual obtains the degree abroad, rural/urban indicators, and province of residence indicators. Ref. = Reference.

Table A.2.5. Selective functional forms of continuous and levels of literacy and numeracy in earnings regressions for the three broad categories

	Dependent variables: log hourly wages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Men						
Literacy				-0.007	-0.010	-0.008	
				(0.020)	(0.021)	(0.027)	
Literacy^2					-0.007	-0.007	
					(0.007)	(0.011)	
Literacy^3						-0.000	
						(0.003)	
Level of literacy (Ref: >325 points)							
< 226	-0.182**	-0.182**	-0.172*				-0.082
	(0.067)	(0.067)	(0.068)				(0.065)
226 to < 276	-0.053	-0.043	-0.038				0.019
	(0.049)	(0.053)	(0.053)				(0.053)
276 to < 326	-0.023	-0.014	-0.017				0.003
	(0.032)	(0.035)	(0.035)				(0.036)
Numeracy	0.071***	0.073***	0.085***				
	(0.020)	(0.020)	(0.025)				
Numeracy^2		0.005	0.001				
		(0.006)	(0.009)				
Numeracy^3			-0.002				
			(0.003)				
Level of numeracy (Ref.: >325 points)							
< 226				-0.430***	-0.432***	-0.430***	-0.369***
				(0.067)	(0.067)	(0.070)	(0.067)
226 to < 276				-0.243***	-0.256***	-0.255***	-0.241***
				(0.047)	(0.054)	(0.054)	(0.052)
276 to < 326				-0.120**	-0.131**	-0.132**	-0.119**
				(0.038)	(0.042)	(0.043)	(0.042)
Adult Immigrants	-0.371***	-0.373***	-0.373***	-0.365***	-0.366***	-0.366***	-0.365***
	(0.066)	(0.067)	(0.067)	(0.070)	(0.069)	(0.069)	(0.069)

(continued)

Table A.2.5. continued

	Dependent variables: log hourly wages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Young Immigrants	-0.288*	-0.292*	-0.292*	-0.275*	-0.275*	-0.276*	-0.282*
	(0.125)	(0.125)	(0.125)	(0.126)	(0.126)	(0.127)	(0.127)
Constant	1.735***	1.722***	1.726***	1.902***	1.917***	1.918***	1.876***
	(0.177)	(0.178)	(0.178)	(0.184)	(0.184)	(0.184)	(0.178)
N	5327	5327	5327	5327	5327	5327	5327
Log-likelihood	-3542.354	-3541.321	-3540.036	-3525.005	-3523.39	-3522.994	-3519.366
R^2	0.252	0.252	0.253	0.257	0.257	0.257	0.258
Adjusted R^2	0.256	0.256	0.257	0.261	0.261	0.261	0.262
RMSE	0.472	0.472	0.472	0.470	0.470	0.470	0.470
			Women				
Literacy				0.031	0.028	0.041*	
				(0.017)	(0.018)	(0.020)	
Literacy^2					-0.004	-0.009	
					(0.008)	(0.010)	
Literacy^3						-0.003	
						(0.004)	
Level of literacy (Ref.: >325 points)							
< 226	-0.094	-0.094	-0.092				-0.051
	(0.057)	(0.057)	(0.057)				(0.052)
226 to < 276	-0.101*	-0.087	-0.085				-0.048
	(0.043)	(0.045)	(0.045)				(0.043)
276 to < 326	-0.017	-0.004	-0.006				0.013
	(0.030)	(0.032)	(0.032)				(0.031)
Numeracy	0.068***	0.075***	0.078***				
	(0.017)	(0.019)	(0.021)				
Numeracy^2		0.008	0.006				
		(0.008)	(0.011)				
Numeracy^3			-0.001				
			(0.003)				
Level of numeracy (Ref.: >325 points)							
< 226				-0.277***	-0.282***	-0.276***	-0.302***
				(0.060)	(0.060)	(0.059)	(0.054)

(continued)

Table A.2.5. continued

	Dependent variables: log hourly wages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
226 to < 276				-0.200***	-0.209***	-0.211***	-0.220***
				(0.048)	(0.052)	(0.052)	(0.049)
276 to < 326				-0.096*	-0.103*	-0.111*	-0.122**
				(0.039)	(0.042)	(0.043)	(0.041)
Adult Immigrants	-0.321***	-0.321***	-0.321***	-0.319***	-0.319***	-0.320***	-0.325***
	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.074)
Young Immigrants	-0.315***	-0.314***	-0.315***	-0.314***	-0.314***	-0.315***	-0.320***
	(0.072)	(0.072)	(0.072)	(0.072)	(0.073)	(0.073)	(0.072)
Constant	1.740***	1.723***	1.724***	1.821***	1.833***	1.838***	1.866***
	(0.166)	(0.167)	(0.167)	(0.177)	(0.180)	(0.180)	(0.169)
N	5856	5856	5856	5856	5856	5856	5856
Log-likelihood	-3095.83	-3093.322	-3092.918	-3082.045	-3080.876	-3079.117	-3081.07
R^2	0.301	0.301	0.301	0.304	0.304	0.304	0.304
Adjusted R^2	0.304	0.304	0.304	0.307	0.307	0.308	0.307
RMSE	0.411	0.411	0.411	0.411	0.410	0.410	0.411

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate coefficients. All 10 plausible values for each respective test were employed. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey. The level of literacy and numeracy is calculated as follows: (1) calculate an equally weighted average of all 10 plausible values, and (2) use the thresholds in OECD (2013) to assign level to each individual with a slight modification. There are four groups of individuals: (a) with average test score below 226, (b) with average test score from 226 to below 276, (c) with average test score from 276 to 326, and (d) with average test score above 325. All regressions control for age, age squared, year in Canada. and year in Canada squared, the highest educational attainment and its interaction with indicator if an individual obtains the degree abroad, rural/urban indicators, and province of residence indicators. Ref. = Reference. Group.

Table A.2.6. Different functional forms of literacy and numeracy in earnings regressions for the nine population subgroups

	Dependent variable: Log(hourly wage)									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Score										
Literacy	0.080***	0.078***	0.096***	0.089***		0.088***	0.089***	0.106***	0.115***	
	(0.013)	(0.014)	(0.017)	(0.021)		(0.011)	(0.012)	(0.014)	(0.017)	
Literacy^2		-0.005	-0.013	-0.019			0.004	-0.004	0.005	
		(0.006)	(0.009)	(0.012)			(0.007)	(0.008)	(0.013)	
Literacy^3			-0.005	-0.003				-0.006	-0.009*	
			(0.003)	(0.005)				(0.003)	(0.005)	
Literacy^4				0.001					-0.002	
				(0.001)					(0.002)	
Level of literacy (Reference: >325 points)										
< 226					-0.363***					-0.257***
					(0.043)					(0.041)
226 to < 276					-0.169***					-0.209***
					(0.034)					(0.036)
276 to < 326					-0.080**					-0.069*
					(0.027)					(0.029)
Second-generation Canadians	-0.022	-0.022	-0.023	-0.023	-0.024	0.009	0.009	0.009	0.009	0.009
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.026)	(0.027)	(0.026)	(0.026)	(0.026)

(continued)

Table A.2.6. continued

	Dependent variable: Log(hourly wage)									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Adult refugees	-0.524***	-0.521***	-0.518***	-0.517***	-0.510***	-0.398***	-0.396***	-0.392***	-0.392***	-0.402***
	(0.101)	(0.101)	(0.101)	(0.101)	(0.099)	(0.117)	(0.116)	(0.117)	(0.116)	(0.116)
Adult economic immigrants	-0.371***	-0.372***	-0.373***	-0.374***	-0.374***	-0.266***	-0.264***	-0.264***	-0.263***	-0.262***
	(0.063)	(0.063)	(0.063)	(0.062)	(0.062)	(0.073)	(0.073)	(0.073)	(0.073)	(0.072)
Adult family reunification immigrants	-0.518***	-0.517***	-0.518***	-0.519***	-0.506***	-0.368***	-0.367***	-0.368***	-0.367***	-0.373***
	(0.074)	(0.074)	(0.074)	(0.074)	(0.075)	(0.082)	(0.082)	(0.081)	(0.081)	(0.079)
Adult other categories	-0.519***	-0.521***	-0.520***	-0.520***	-0.519***	-0.304***	-0.303***	-0.300***	-0.300***	-0.297***
	(0.135)	(0.134)	(0.135)	(0.135)	(0.134)	(0.087)	(0.087)	(0.087)	(0.088)	(0.087)
Adult temporary residents	-0.322**	-0.320**	-0.324**	-0.325**	-0.324**	-0.403***	-0.404***	-0.405***	-0.403***	-0.413***
	(0.121)	(0.120)	(0.121)	(0.121)	(0.121)	(0.101)	(0.102)	(0.102)	(0.102)	(0.103)
Young refugee immigrants	-0.605**	-0.605**	-0.606**	-0.608**	-0.604**	-0.431***	-0.428***	-0.425***	-0.423***	-0.406***
	(0.232)	(0.233)	(0.232)	(0.233)	(0.229)	(0.115)	(0.115)	(0.115)	(0.115)	(0.106)
Young non-refugee immigrants	-0.353**	-0.353**	-0.358**	-0.358**	-0.360**	-0.308***	-0.307***	-0.310***	-0.310***	-0.315***
	(0.133)	(0.134)	(0.134)	(0.135)	(0.133)	(0.078)	(0.077)	(0.077)	(0.077)	(0.075)
Constant	1.700***	1.705***	1.715***	1.718***	1.808***	1.673***	1.669***	1.674***	1.671***	1.797***
	(0.181)	(0.180)	(0.180)	(0.180)	(0.180)	(0.173)	(0.173)	(0.172)	(0.172)	(0.166)

(continued)

Table A.2.6. continued

	Dependent variable: Log(hourly wage)									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
N	5327	5327	5327	5327	5327	5856	5856	5856	5856	5856
Log-likelihood	-3581.173	-3580.003	-3574.919	-3573.915	-3553.425	-3115.57	-3114.558	-3109.34	-3107.565	-3114.403
R^2	0.241	0.241	0.242	0.243	0.249	0.295	0.296	0.297	0.297	0.296
Adjusted R^2	0.245	0.245	0.247	0.247	0.253	0.299	0.299	0.300	0.301	0.299
RMSE	0.475	0.475	0.475	0.475	0.473	0.413	0.413	0.413	0.413	0.413
Numeracy Scores										
Numeracy	0.099***	0.099***	0.113***	0.109***		0.092***	0.099***	0.108***	0.111***	
	(0.013)	(0.013)	(0.017)	(0.019)		(0.011)	(0.014)	(0.015)	(0.019)	
$Numeracy^2$		-0.000	-0.006	-0.009			0.010	0.003	0.004	
		(0.005)	(0.007)	(0.012)			(0.007)	(0.010)	(0.014)	
$Numeracy^3$			-0.004	-0.003				-0.004	-0.005	
			(0.003)	(0.004)				(0.003)	(0.006)	
$Numeracy^4$				0.001					-0.000	
				(0.001)					(0.002)	
Level of Numeracy (Reference: >325 points)										
< 226					-0.401***					-0.340***
					(0.043)					(0.043)
226 to < 276					-0.227***					-0.241***
					(0.036)					(0.041)
276 to < 326					-0.115***					-0.117**
					(0.033)					(0.037)

(continued)

Table A.2.6. continued

	Dependent variable: Log(hourly wage)									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Second-generation Canadians	-0.017	-0.017	-0.017	-0.017	-0.019	0.013	0.012	0.013	0.013	0.011
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Adult refugees	-0.514***	-0.513***	-0.508***	-0.507***	-0.492***	-0.401***	-0.398***	-0.394***	-0.395***	-0.388***
	(0.099)	(0.099)	(0.099)	(0.099)	(0.100)	(0.116)	(0.115)	(0.116)	(0.116)	(0.115)
Adult economic immigrants	-0.377***	-0.377***	-0.375***	-0.374***	-0.358***	-0.278***	-0.274***	-0.274***	-0.274***	-0.276***
	(0.063)	(0.063)	(0.063)	(0.063)	(0.064)	(0.074)	(0.074)	(0.073)	(0.073)	(0.073)
Adult family reunification immigrants	-0.497***	-0.497***	-0.495***	-0.494***	-0.469***	-0.365***	-0.365***	-0.365***	-0.365***	-0.361***
	(0.073)	(0.073)	(0.074)	(0.074)	(0.074)	(0.082)	(0.082)	(0.081)	(0.082)	(0.080)
Adult other categories	-0.505***	-0.505***	-0.502***	-0.502***	-0.477***	-0.297***	-0.294***	-0.292***	-0.292***	-0.289***
	(0.136)	(0.136)	(0.137)	(0.137)	(0.141)	(0.088)	(0.088)	(0.088)	(0.088)	(0.086)
Adult temporary residents	-0.313**	-0.312**	-0.316**	-0.316**	-0.312**	-0.409***	-0.414***	-0.413***	-0.412***	-0.410***
	(0.115)	(0.115)	(0.118)	(0.118)	(0.120)	(0.098)	(0.099)	(0.100)	(0.100)	(0.099)
Young refugee immigrants	-0.549**	-0.549**	-0.542**	-0.541**	-0.510**	-0.442***	-0.437***	-0.436***	-0.436***	-0.445***
	(0.208)	(0.208)	(0.205)	(0.205)	(0.187)	(0.126)	(0.125)	(0.127)	(0.127)	(0.133)
Young non-refugee immigrants	-0.335*	-0.335*	-0.334*	-0.333*	-0.323*	-0.300***	-0.298***	-0.299***	-0.299***	-0.302***
	(0.133)	(0.134)	(0.134)	(0.134)	(0.134)	(0.075)	(0.075)	(0.075)	(0.075)	(0.073)

(continued)

Table A.2.6. continued

	Dependent variable: Log(hourly wage)									
	Men					Women				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	1.727***	1.727***	1.734***	1.737***	1.902***	1.718***	1.709***	1.713***	1.712***	1.883***
	(0.184)	(0.184)	(0.184)	(0.184)	(0.181)	(0.174)	(0.173)	(0.172)	(0.172)	(0.173)
N	5327	5327	5327	5327	5327	5856	5856	5856	5856	5856
Log-likelihood	-3545.066	-3544.843	-3541.874	-3541.431	-3515.588	-3102.254	-3098.452	-3096.17	-3095.308	-3078.991
R^2	0.251	0.251	0.252	0.252	0.259	0.299	0.299	0.300	0.300	0.304
Adjusted R^2	0.255	0.255	0.256	0.256	0.263	0.302	0.303	0.304	0.304	0.308
RMSE	0.472	0.472	0.472	0.472	0.470	0.412	0.412	0.412	0.412	0.410

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate estimated coefficients. All 10 plausible values for each respective test were employed. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The Reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey. The level of literacy and numeracy is calculated as follows: (1) calculate an equally weighted average of all 10 plausible values, and (2) use the thresholds in OECD (2013) to assign level to each individual with a slight modification. There are four groups of individuals: (a) with average test score below 226, (b) with average test score from 226 to below 276, (c) with average test score from 276 to 326, and (d) with average test score above 325.

Table A.2.7. Selective functional forms of literacy and numeracy test scores in earnings regressions for the nine population subgroups

	Dependent variable: log hourly wage							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy	-0.007	-0.007	-0.007	-0.008	-0.008	0.011	0.011	0.007
	(0.022)	(0.022)	(0.023)	(0.023)	(0.023)	(0.025)	(0.026)	(0.028)
Literacy^2			-0.003	-0.006	-0.008	-0.011	-0.013	-0.012
			(0.006)	(0.011)	(0.011)	(0.009)	(0.013)	(0.013)
Literacy^3						-0.005	-0.005	-0.004
						(0.003)	(0.003)	(0.004)
Numeracy	0.104***	0.119***	0.103***	0.103***	0.119***	0.103***	0.103***	0.108***
	(0.022)	(0.023)	(0.022)	(0.021)	(0.023)	(0.021)	(0.021)	(0.027)
Numeracy^2	-0.000	-0.006		0.004	-0.001		0.002	0.001
	(0.005)	(0.007)		(0.010)	(0.011)		(0.010)	(0.012)
Numeracy^3		-0.004			-0.004			-0.001
		(0.003)			(0.003)			(0.004)
Second-generation Canadians	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)
Adult refugees	-0.516***	-0.510***	-0.515***	-0.514***	-0.508***	-0.512***	-0.512***	-0.510***
	(0.099)	(0.100)	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)
Adult economic immigrants	-0.379***	-0.377***	-0.380***	-0.380***	-0.378***	-0.380***	-0.380***	-0.380***
	(0.063)	(0.063)	(0.063)	(0.063)	(0.064)	(0.063)	(0.063)	(0.063)
Adult family reunification immigrants	-0.499***	-0.497***	-0.499***	-0.501***	-0.498***	-0.500***	-0.501***	-0.500***
	(0.073)	(0.074)	(0.073)	(0.073)	(0.074)	(0.073)	(0.074)	(0.074)
Adult other categories	-0.506***	-0.503***	-0.508***	-0.508***	-0.505***	-0.507***	-0.507***	-0.507***
	(0.136)	(0.137)	(0.136)	(0.136)	(0.137)	(0.136)	(0.136)	(0.137)
Adult temporary residents	-0.313**	-0.317**	-0.313**	-0.315**	-0.319**	-0.317**	-0.318**	-0.319**
	(0.116)	(0.118)	(0.115)	(0.116)	(0.119)	(0.116)	(0.117)	(0.117)
Young refugee immigrants	-0.548**	-0.541**	-0.548**	-0.551**	-0.544**	-0.550**	-0.551**	-0.550**
	(0.207)	(0.204)	(0.208)	(0.210)	(0.207)	(0.207)	(0.208)	(0.208)

(continued)

Table A.2.7. continued

	Dependent variable: log hourly wage							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Young non-refugee immigrants	-0.336*	-0.335*	-0.336*	-0.337*	-0.336*	-0.341*	-0.342*	-0.341*
	(0.133)	(0.133)	(0.133)	(0.134)	(0.134)	(0.134)	(0.134)	(0.135)
Constant	1.729***	1.737***	1.731***	1.730***	1.739***	1.742***	1.741***	1.741***
	(0.185)	(0.185)	(0.185)	(0.185)	(0.185)	(0.184)	(0.184)	(0.185)
N	5327	5327	5327	5327	5327	5327	5327	5327
Log-likelihood	-3544.495	-3541.497	-3544.099	-3543.236	-3539.901	-3539.254	-3538.575	-3537.962
R2	0.251	0.252	0.251	0.251	0.252	0.252	0.252	0.252
Adjusted R2	0.255	0.256	0.255	0.256	0.257	0.257	0.257	0.257
RMSE	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472
			Women					
Literacy	0.037	0.036	0.036	0.035	0.035	0.054*	0.051*	0.050
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.024)	(0.024)	(0.027)
$Literacy^2$			0.004	-0.006	-0.008	-0.003	-0.012	-0.012
			(0.007)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)
$Literacy^3$						-0.006	-0.005	-0.005
						(0.003)	(0.003)	(0.005)
Numeracy	0.071**	0.080**	0.065**	0.073**	0.084***	0.065**	0.072**	0.074**
	(0.024)	(0.025)	(0.023)	(0.023)	(0.025)	(0.023)	(0.023)	(0.027)
$Numeracy^2$	0.010	0.004		0.015	0.009		0.014	0.012
	(0.007)	(0.010)		(0.010)	(0.011)		(0.010)	(0.012)
$Numeracy^3$		-0.004			-0.004			-0.001
		(0.003)			(0.003)			(0.005)
Second-generation Canadians	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Adult refugees	-0.388***	-0.384***	-0.389***	-0.388***	-0.385***	-0.386***	-0.385***	-0.385**
	(0.116)	(0.117)	(0.116)	(0.116)	(0.117)	(0.117)	(0.117)	(0.117)
Adult economic immigrants	-0.265***	-0.264***	-0.267***	-0.266***	-0.266***	-0.267***	-0.266***	-0.266***
	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)

(continued)

Table A.2.7. continued

	Dependent variable: log hourly wage							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Adult family reunification immigrants	-0.358***	-0.358***	-0.357***	-0.359***	-0.358***	-0.358***	-0.360***	-0.359***
	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.081)	(0.082)
Adult other categories	-0.292***	-0.289***	-0.293***	-0.294***	-0.291***	-0.291***	-0.292***	-0.292***
	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.088)	(0.087)	(0.087)
Adult temporary residents	-0.404***	-0.403***	-0.400***	-0.402***	-0.402***	-0.402***	-0.404***	-0.404***
	(0.100)	(0.101)	(0.100)	(0.100)	(0.101)	(0.100)	(0.101)	(0.101)
Young refugee immigrants	-0.427***	-0.426***	-0.429***	-0.428***	-0.428***	-0.426***	-0.426***	-0.426***
	(0.122)	(0.123)	(0.123)	(0.122)	(0.123)	(0.123)	(0.122)	(0.122)
Young non-refugee immigrants	-0.297***	-0.297***	-0.297***	-0.297***	-0.298***	-0.300***	-0.300***	-0.301***
	(0.076)	(0.076)	(0.076)	(0.076)	(0.076)	(0.076)	(0.076)	(0.076)
Constant	1.694***	1.698***	1.699***	1.697***	1.701***	1.704***	1.702***	1.703***
	(0.175)	(0.174)	(0.175)	(0.175)	(0.174)	(0.174)	(0.173)	(0.173)
N	5856	5856	5856	5856	5856	5856	5856	5856
Log-likelihood	-3092.135	-3089.965	-3095.166	-3091.1	-3088.597	-3090.115	-3086.676	-3086.18
R2	0.301	0.301	0.300	0.301	0.301	0.301	0.302	0.302
Adjusted R2	0.305	0.305	0.304	0.305	0.305	0.305	0.306	0.306
RMSE	0.411	0.411	0.412	0.411	0.411	0.411	0.411	0.411

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate coefficients. All 10 plausible values for each respective test were employed. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey. All regressions control for age, age squared, year in Canada. and year in Canada squared, the highest educational attainment and its interaction with indicator if an individual obtains the degree abroad, rural/urban indicators, and province of residence indicators. Ref. = Reference group.

Table A.2.8. Selective functional forms of levels of literacy and numeracy test scores in earnings regressions for the nine population subgroups

	Dependent variable: log hourly wage						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Men							
Literacy				-0.006	-0.009	-0.007	
				(0.020)	(0.022)	(0.027)	
Literacy^2					-0.006	-0.007	
					(0.008)	(0.011)	
Literacy^3						-0.000	
						(0.004)	
Level of literacy (Ref.: > 325 points)							
< 226	-0.182**	-0.181**	-0.173*				-0.086
	(0.066)	(0.066)	(0.067)				(0.064)
226 to < 276	-0.055	-0.045	-0.041				0.016
	(0.049)	(0.054)	(0.054)				(0.053)
276 to < 326	-0.026	-0.017	-0.020				0.000
	(0.031)	(0.035)	(0.035)				(0.036)
Numeracy	0.068***	0.070***	0.080**				
	(0.020)	(0.020)	(0.025)				
Numeracy^2		0.005	0.001				
		(0.007)	(0.009)				
Numeracy^3			-0.002				
			(0.003)				
Level of numeracy (Ref.: > 325 points)							
< 226				-0.416***	-0.417***	-0.415***	-0.354***
				(0.066)	(0.066)	(0.069)	(0.065)
226 to < 276				-0.236***	-0.249***	-0.248***	-0.234***
				(0.047)	(0.054)	(0.054)	(0.053)
276 to < 326				-0.119**	-0.129**	-0.130**	-0.117**
				(0.038)	(0.043)	(0.043)	(0.042)
Second-generation Canadians	-0.020	-0.019	-0.020	-0.019	-0.019	-0.019	-0.020
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)

(continued)

Table A.2.8. continued

	Dependent variable: log hourly wage						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Adult refugees	-0.491***	-0.492***	-0.490***	-0.495***	-0.492***	-0.493***	-0.482***
	(0.098)	(0.098)	(0.098)	(0.101)	(0.100)	(0.101)	(0.099)
Adult economic immigrants	-0.369***	-0.370***	-0.370***	-0.360***	-0.362***	-0.362***	-0.362***
	(0.062)	(0.062)	(0.062)	(0.064)	(0.064)	(0.064)	(0.064)
Adult family reunification immigrants	-0.483***	-0.486***	-0.486***	-0.471***	-0.472***	-0.472***	-0.471***
	(0.074)	(0.074)	(0.075)	(0.075)	(0.074)	(0.074)	(0.075)
Adult other categories	-0.504***	-0.504***	-0.503***	-0.478***	-0.481***	-0.481***	-0.485***
	(0.135)	(0.135)	(0.136)	(0.142)	(0.141)	(0.141)	(0.142)
Adult temporary residents	-0.307**	-0.311**	-0.313**	-0.315**	-0.314**	-0.314**	-0.313**
	(0.115)	(0.117)	(0.118)	(0.120)	(0.119)	(0.118)	(0.118)
Young refugee immigrants	-0.559**	-0.564**	-0.560**	-0.509**	-0.512**	-0.513**	-0.531**
	(0.215)	(0.216)	(0.215)	(0.186)	(0.189)	(0.189)	(0.201)
Young non-refugee immigrants	-0.335*	-0.338*	-0.338*	-0.324*	-0.324*	-0.324*	-0.327*
	(0.133)	(0.133)	(0.133)	(0.134)	(0.133)	(0.135)	(0.134)
Constant	1.751***	1.740***	1.743***	1.911***	1.925***	1.926***	1.887***
	(0.179)	(0.179)	(0.180)	(0.187)	(0.187)	(0.187)	(0.180)
N	5327	5327	5327	5327	5327	5327	5327
Log-likelihood	-3530.77	-3529.81	-3528.672	-3514.943	-3513.373	-3512.915	-3509.296
R2	0.255	0.255	0.255	0.259	0.259	0.259	0.26
Adjusted R2	0.259	0.259	0.26	0.264	0.264	0.264	0.265
RMSE	0.471	0.471	0.471	0.47	0.469	0.469	0.469
Women							
Literacy				0.030	0.028	0.040*	
				(0.017)	(0.018)	(0.020)	
Literacy^2					-0.004	-0.009	
					(0.008)	(0.010)	
Literacy^3						-0.004	
						(0.004)	

(continued)

Table A.2.8. continued

	Dependent variable: log hourly wage						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Level of literacy							
< 226	-0.092	-0.092	-0.090				-0.049
	(0.057)	(0.057)	(0.057)				(0.052)
226 to < 276	-0.103*	-0.087	-0.086				-0.049
	(0.043)	(0.045)	(0.046)				(0.044)
276 to < 326	-0.019	-0.005	-0.006				0.013
	(0.030)	(0.032)	(0.033)				(0.031)
Numeracy	0.066***	0.073***	0.076***				
	(0.017)	(0.019)	(0.021)				
$Numeracy^2$		0.009	0.007				
		(0.008)	(0.011)				
$Numeracy^3$			-0.001				
			(0.003)				
Level of Numeracy							
< 226				-0.271***	-0.276***	-0.270***	-0.295***
				(0.060)	(0.061)	(0.060)	(0.055)
226 to < 276				-0.199***	-0.207***	-0.208***	-0.217***
				(0.049)	(0.052)	(0.052)	(0.049)
276 to < 326				-0.097*	-0.103*	-0.111*	-0.122**
				(0.040)	(0.042)	(0.044)	(0.041)
Second-generation Canadians	0.011	0.011	0.011	0.010	0.010	0.010	0.011
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Adult refugees	-0.394***	-0.390***	-0.390***	-0.379**	-0.379**	-0.378**	-0.387***
	(0.117)	(0.117)	(0.117)	(0.116)	(0.116)	(0.117)	(0.116)
Adult economic immigrants	-0.266***	-0.264***	-0.264***	-0.267***	-0.268***	-0.268***	-0.271***
	(0.073)	(0.073)	(0.072)	(0.073)	(0.073)	(0.073)	(0.073)
Adult family reunification immigrants	-0.357***	-0.358***	-0.358***	-0.352***	-0.352***	-0.354***	-0.359***
	(0.081)	(0.081)	(0.081)	(0.081)	(0.081)	(0.081)	(0.080)

(continued)

Table A.2.8. continued

	Dependent variable: log hourly wage						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Adult other categories	-0.287**	-0.286**	-0.285**	-0.287***	-0.288***	-0.288***	-0.285**
	(0.088)	(0.088)	(0.088)	(0.086)	(0.086)	(0.086)	(0.087)
Adult temporary residents	-0.401***	-0.405***	-0.405***	-0.399***	-0.398***	-0.400***	-0.408***
	(0.100)	(0.101)	(0.101)	(0.100)	(0.100)	(0.100)	(0.101)
Young refugee immigrants	-0.413***	-0.411***	-0.412***	-0.434***	-0.436***	-0.433***	-0.425***
	(0.118)	(0.118)	(0.118)	(0.130)	(0.130)	(0.129)	(0.125)
Young non-refugee immigrants	-0.302***	-0.301***	-0.301***	-0.298***	-0.298***	-0.299***	-0.303***
	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.073)
Constant	1.761***	1.742***	1.743***	1.842***	1.852***	1.858***	1.885***
	(0.169)	(0.170)	(0.170)	(0.180)	(0.183)	(0.183)	(0.172)
N	5856	5856	5856	5856	5856	5856	5856
Log-likelihood	-3086.462	-3083.594	-3083.204	-3073.371	-3072.344	-3070.468	-3071.96
R2	0.302	0.303	0.303	0.305	0.305	0.306	0.305
Adjusted R2	0.306	0.307	0.307	0.309	0.309	0.310	0.309
RMSE	0.411	0.411	0.411	0.410	0.410	0.410	0.410

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate coefficients. All 10 plausible values for each respective test were employed. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey. The level of literacy and numeracy is calculated as follows: (1) calculate an equally weighted average of all 10 plausible values, and (2) use the thresholds in OECD (2013) to assign level to each individual with a slight modification. There are four groups of individuals: (a) with average test score below 226, (b) with average test score from 226 to below 276, (c) with average test score from 276 to 326, and (d) with average test score above 325. All regressions control for age, age squared, year in Canada. and year in Canada squared, the highest educational attainment and its interaction with indicator if an individual obtains the degree abroad, rural/urban indicators, and province of residence indicators. Ref. = Reference group.

Table A.2.9. Interaction of test scores with each category of immigrants and the Canadian-born

	Dependent variable: log hourly wage					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Three broad groups of immigrants and Canadian-born (Reference group: the Canadian born)						
Literacy	0.069***		-0.016	0.085***		0.030
	(0.015)		(0.030)	(0.013)		(0.023)
Numeracy		0.090***	0.103***		0.093***	0.069**
		(0.015)	(0.029)		(0.014)	(0.025)
Adult immigrants	-0.340***	-0.333***	-0.339***	-0.278***	-0.288***	-0.282***
	(0.077)	(0.074)	(0.074)	(0.073)	(0.074)	(0.074)
Young immigrants	-0.276*	-0.252	-0.256*	-0.289***	-0.288***	-0.281***
	(0.132)	(0.129)	(0.130)	(0.076)	(0.072)	(0.078)
Literacy x Adult Immigrants	0.052		0.032	0.014		0.026
	(0.027)		(0.059)	(0.023)		(0.044)
Literacy x Young Immigrants	-0.000		-0.070	-0.005		-0.029
	(0.075)		(0.142)	(0.045)		(0.126)
Numeracy x Adult Immigrants		0.046	0.020		0.001	-0.019
		(0.026)	(0.056)		(0.025)	(0.047)
Numeracy x Young Immigrants		0.009	0.061		-0.001	0.024
		(0.060)	(0.115)		(0.049)	(0.128)
Education						
< high school	-0.052	-0.038	-0.041	-0.133**	-0.131**	-0.126**
	(0.045)	(0.046)	(0.046)	(0.043)	(0.044)	(0.044)
College or trade school	0.142***	0.127***	0.127***	0.171***	0.170***	0.168***
	(0.031)	(0.032)	(0.032)	(0.024)	(0.024)	(0.024)
≥ bachelor's degree	0.390***	0.362***	0.365***	0.449***	0.443***	0.438***
	(0.040)	(0.040)	(0.041)	(0.032)	(0.031)	(0.032)
Foreign education x < high school	0.051	0.034	0.047	0.009	-0.003	0.009
	(0.110)	(0.109)	(0.112)	(0.092)	(0.092)	(0.092)
Foreign education x high school	-0.084	-0.068	-0.063	-0.036	-0.039	-0.033
	(0.084)	(0.084)	(0.085)	(0.074)	(0.074)	(0.075)
Foreign education x college or trade school	-0.044	-0.061	-0.055	-0.123	-0.118	-0.116
	(0.080)	(0.078)	(0.079)	(0.073)	(0.077)	(0.076)
Foreign education x ≥ bachelor's degree	-0.135*	-0.149**	-0.147*	-0.263***	-0.253***	-0.253***
	(0.058)	(0.058)	(0.058)	(0.061)	(0.063)	(0.062)

(continued)

Table A.2.9. continued

	Dependent variable: log hourly wage					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Rural/urban and provinces						
Rural	0.000	-0.001	-0.002	-0.053*	-0.057**	-0.055**
	(0.028)	(0.028)	(0.028)	(0.021)	(0.021)	(0.021)
Small urban	-0.001	-0.003	-0.003	-0.089***	-0.088***	-0.087***
	(0.030)	(0.030)	(0.030)	(0.026)	(0.026)	(0.026)
Medium urban	-0.050	-0.049	-0.049	-0.049	-0.048	-0.047
	(0.041)	(0.040)	(0.040)	(0.037)	(0.036)	(0.036)
Alberta	0.232***	0.230***	0.231***	0.108**	0.109**	0.108**
	(0.041)	(0.040)	(0.040)	(0.037)	(0.037)	(0.037)
British Columbia	0.004	0.009	0.009	0.030	0.030	0.029
	(0.037)	(0.036)	(0.037)	(0.028)	(0.028)	(0.028)
Prairie provinces	0.024	0.026	0.026	-0.045	-0.047	-0.047
	(0.026)	(0.026)	(0.026)	(0.025)	(0.025)	(0.025)
Atlantic provinces	-0.197***	-0.190***	-0.190***	-0.152***	-0.147***	-0.148***
	(0.026)	(0.027)	(0.027)	(0.020)	(0.020)	(0.021)
Territories	0.209***	0.220***	0.222***	0.352***	0.357***	0.353***
	(0.050)	(0.051)	(0.051)	(0.073)	(0.071)	(0.070)
Quebec	-0.088***	-0.088***	-0.090***	-0.067***	-0.079***	-0.074***
	(0.025)	(0.025)	(0.025)	(0.018)	(0.018)	(0.018)
Age	0.065***	0.064***	0.064***	0.057***	0.056***	0.056***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
$Age^2/100$	-0.066***	-0.064***	-0.064***	-0.057***	-0.056***	-0.057***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Year in Canada	0.018***	0.018***	0.018***	0.013**	0.013**	0.013**
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Year in $Canada^2/100$	-0.020*	-0.021*	-0.022*	-0.013	-0.012	-0.013
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Constant	1.653***	1.683***	1.685***	1.642***	1.692***	1.676***
	(0.174)	(0.176)	(0.178)	(0.170)	(0.170)	(0.171)
N	5269	5269	5269	5807	5807	5807
R^2	0.242	0.253	0.254	0.297	0.300	0.302
Adjusted R^2	0.238	0.250	0.250	0.294	0.297	0.299
The nine subpopulation groups (Reference group: the third-generation Canadians)						
Literacy	0.072***		-0.013	0.082***		0.019
	(0.016)		(0.032)	(0.014)		(0.026)
Numeracy		0.091***	0.102**		0.094***	0.079**
		(0.016)	(0.031)		(0.014)	(0.026)

(continued)

Table A.2.9. continued

	Dependent variable: log hourly wage					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Second-generation Canadians	-0.016	-0.013	-0.012	0.000	0.009	-0.007
	(0.041)	(0.042)	(0.042)	(0.026)	(0.026)	(0.031)
Adult refugees	-0.424**	-0.412**	-0.394**	-0.363*	-0.390	-0.375
	(0.136)	(0.127)	(0.133)	(0.181)	(0.205)	(0.203)
Adult economic immigrants	-0.327***	-0.328***	-0.313***	-0.203**	-0.221**	-0.213**
	(0.070)	(0.068)	(0.071)	(0.071)	(0.074)	(0.073)
Adult family reunification immigrants	-0.496***	-0.455***	-0.465***	-0.358***	-0.362***	-0.361***
	(0.086)	(0.083)	(0.085)	(0.087)	(0.087)	(0.087)
Adult other categories	-0.490***	-0.460***	-0.445**	-0.279**	-0.281**	-0.285**
	(0.141)	(0.140)	(0.139)	(0.090)	(0.092)	(0.093)
Adult temporary residents	-0.268	-0.245*	-0.272*	-0.326*	-0.324*	-0.321*
	(0.138)	(0.124)	(0.130)	(0.132)	(0.135)	(0.138)
Young refugee immigrants	-0.574**	-0.406	-0.395	-0.427**	-0.493**	-0.439**
	(0.192)	(0.214)	(0.270)	(0.149)	(0.183)	(0.166)
Young non-refugee immigrants	-0.320*	-0.289*	-0.289*	-0.281***	-0.271***	-0.264**
	(0.140)	(0.141)	(0.142)	(0.081)	(0.076)	(0.082)
Literacy x Second-generation Canadians	-0.014		-0.012	0.016		0.060
	(0.040)		(0.079)	(0.036)		(0.076)
Literacy x Adult refugees	0.078		0.077	0.003		0.066
	(0.066)		(0.126)	(0.113)		(0.204)
Literacy x Adult economic immigrants	0.056		0.071	0.056		0.085
	(0.033)		(0.063)	(0.035)		(0.064)
Literacy x Adult family reunification immigrants	0.005		-0.037	-0.030		0.008
	(0.038)		(0.078)	(0.032)		(0.069)
Literacy x Adult other categories	0.003		0.157	-0.034		0.007
	(0.111)		(0.298)	(0.045)		(0.084)
Literacy x Adult temporary residents	0.059		-0.178	0.039		-0.026
	(0.091)		(0.220)	(0.070)		(0.168)
Literacy x Young refugee immigrants	0.341		-0.011	-0.035		0.139
	(0.275)		(0.535)	(0.150)		(0.241)

(continued)

Table A.2.9. continued

	Dependent variable: log hourly wage					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy x Young non-refugee immigrants	-0.039		-0.054	-0.005		-0.044
	(0.082)		(0.146)	(0.048)		(0.128)
Numeracy x Second-generation Canadians		-0.008	0.002		-0.006	-0.055
		(0.040)	(0.078)		(0.034)	(0.073)
Numeracy x Adult refugees		0.081	0.013		-0.032	-0.081
		(0.065)	(0.132)		(0.119)	(0.223)
Numeracy x Adult economic immigrants		0.043	-0.018		0.028	-0.038
		(0.034)	(0.067)		(0.036)	(0.067)
Numeracy x Adult family reunification immigrants		0.012	0.044		-0.044	-0.050
		(0.036)	(0.075)		(0.035)	(0.073)
Numeracy x Adult other categories		-0.051	-0.186		-0.049	-0.052
		(0.117)	(0.310)		(0.043)	(0.079)
Numeracy x Adult temporary residents		0.073	0.232		0.036	0.059
		(0.066)	(0.194)		(0.073)	(0.179)
Numeracy x Young refugee immigrants		0.278	0.288		-0.138	-0.200
		(0.190)	(0.492)		(0.144)	(0.212)
Numeracy x Young non-refugee immigrants		-0.033	0.009		0.001	0.037
		(0.067)	(0.117)		(0.051)	(0.130)
Education						
< high school	-0.051	-0.037	-0.039	-0.136**	-0.131**	-0.129**
	(0.045)	(0.046)	(0.046)	(0.044)	(0.044)	(0.044)
College or trade school	0.144***	0.130***	0.131***	0.168***	0.168***	0.166***
	(0.031)	(0.032)	(0.032)	(0.024)	(0.024)	(0.024)
≥ bachelor's degree	0.388***	0.362***	0.365***	0.443***	0.438***	0.432***
	(0.040)	(0.040)	(0.040)	(0.032)	(0.032)	(0.032)
Foreign education x < high school	0.042	0.032	0.022	0.004	-0.008	-0.001
	(0.119)	(0.110)	(0.121)	(0.095)	(0.095)	(0.098)

(continued)

Table A.2.9. continued

	Dependent variable: log hourly wage					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Foreign education x high school	-0.066	-0.051	-0.051	-0.035	-0.036	-0.035
	(0.090)	(0.087)	(0.090)	(0.073)	(0.075)	(0.075)
Foreign education x college or trade school	-0.068	-0.086	-0.088	-0.128	-0.122	-0.119
	(0.080)	(0.077)	(0.078)	(0.072)	(0.076)	(0.076)
Foreign education x ≥ bachelor's degree	-0.159**	-0.171**	-0.174**	-0.266***	-0.255***	-0.253***
	(0.058)	(0.056)	(0.055)	(0.063)	(0.064)	(0.063)
Rural/urban and provinces						
Rural	-0.002	-0.003	-0.004	-0.054*	-0.057**	-0.057**
	(0.028)	(0.028)	(0.029)	(0.021)	(0.021)	(0.021)
Small urban	-0.005	-0.006	-0.006	-0.091***	-0.090***	-0.090***
	(0.031)	(0.031)	(0.031)	(0.026)	(0.026)	(0.026)
Medium urban	-0.052	-0.050	-0.051	-0.053	-0.050	-0.051
	(0.041)	(0.041)	(0.041)	(0.036)	(0.036)	(0.036)
Alberta	0.226***	0.224***	0.225***	0.106**	0.105**	0.106**
	(0.042)	(0.041)	(0.041)	(0.037)	(0.037)	(0.038)
British Columbia	-0.003	0.002	0.002	0.027	0.026	0.027
	(0.039)	(0.038)	(0.038)	(0.030)	(0.029)	(0.030)
Prairie provinces	0.019	0.021	0.019	-0.045	-0.048	-0.047
	(0.027)	(0.027)	(0.027)	(0.026)	(0.026)	(0.027)
Atlantic provinces	-0.201***	-0.194***	-0.195***	-0.153***	-0.148***	-0.148***
	(0.028)	(0.028)	(0.028)	(0.022)	(0.022)	(0.022)
Territories	0.208***	0.218***	0.216***	0.352***	0.358***	0.352***
	(0.049)	(0.051)	(0.051)	(0.070)	(0.068)	(0.066)
Quebec	-0.090***	-0.091***	-0.092***	-0.068***	-0.079***	-0.075***
	(0.026)	(0.026)	(0.026)	(0.020)	(0.020)	(0.020)
Age	0.065***	0.063***	0.063***	0.056***	0.055***	0.055***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
$Age^2/100$	-0.066***	-0.064***	-0.064***	-0.056***	-0.055***	-0.056***
	(0.009)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)
Year in Canada	0.023***	0.022***	0.023***	0.014**	0.013*	0.013*
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Year in $Canada^2/100$	-0.029**	-0.028**	-0.029**	-0.014	-0.012	-0.013
	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.010)

(continued)

Table A.2.9. continued

	Dependent variable: log hourly wage					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.674***	1.702***	1.705***	1.672***	1.720***	1.704***
	(0.174)	(0.177)	(0.177)	(0.173)	(0.173)	(0.174)
N	5269	5269	5269	5807	5807	5807
R^2	0.249	0.260	0.262	0.301	0.304	0.308
Adjusted R^2	0.244	0.254	0.256	0.297	0.300	0.302

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) method was used to calculate point estimates using all ten plausible values for numeracy scores. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The Reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of the survey.

Table A.2.10. Earnings gaps between immigrants and the Canadian-born using different subsamples

	Dependent variable: log hourly wages					
	Men			Women		
	Lit=Num	Lit>Num	Lit<Num	Lit=Num	Lit>Num	Lit<Num
	(1)	(2)	(3)	(4)	(5)	(6)
Three broad categories of immigrants and the Canadian-born (Reference group: the Canadian-born)						
Adult Immigrants	-0.407***	-0.369*	-0.383**	-0.477***	-0.296*	-0.237
	(0.119)	(0.165)	(0.134)	(0.115)	(0.129)	(0.134)
Young immigrants (migrated at <14 years)	-0.336	-0.358	-0.121	-0.414***	-0.309	-0.274
	(0.186)	(0.231)	(0.265)	(0.112)	(0.164)	(0.168)
Education (Reference group: HS graduates)						
< high school	-0.188**	-0.076	0.005	-0.185**	-0.250***	-0.077
	(0.070)	(0.098)	(0.083)	(0.067)	(0.074)	(0.093)
College or trade school	0.129*	0.135	0.195***	0.180***	0.202***	0.216***
	(0.059)	(0.070)	(0.052)	(0.041)	(0.039)	(0.041)
≥ bachelor's degree	0.459***	0.353***	0.504***	0.554***	0.499***	0.519***
	(0.065)	(0.068)	(0.065)	(0.052)	(0.041)	(0.058)
Foreign education x < high school	-0.030	0.130	-0.415	-0.006	0.097	-0.152
	(0.120)	(0.144)	(0.221)	(0.121)	(0.169)	(0.192)
Foreign education x high school	-0.254*	-0.128	-0.163	-0.067	0.160	-0.130
	(0.103)	(0.128)	(0.150)	(0.093)	(0.216)	(0.101)
Foreign education x college or trade school	-0.066	-0.125	-0.134	-0.101	-0.237	-0.084
	(0.111)	(0.248)	(0.125)	(0.079)	(0.127)	(0.171)
Foreign education x ≥ bachelor's degree	-0.161	-0.075	-0.203*	-0.240**	-0.364***	-0.229*
	(0.094)	(0.138)	(0.099)	(0.089)	(0.107)	(0.096)

(continued)

Table A.2.10. continued

	Dependent variable: log hourly wages					
	Men			Women		
	Lit=Num	Lit>Num	Lit<Num	Lit=Num	Lit>Num	Lit<Num
	(1)	(2)	(3)	(4)	(5)	(6)
N	2064	1118	2087	2138	2417	1252
R^2	0.292	0.174	0.212	0.335	0.263	0.253
Adjusted R^2	0.285	0.157	0.203	0.328	0.257	0.240
The nine population subgroups of immigrants and the Canadian-born (Reference group: the third generation)						
Second-generation Canadians	0.042	-0.077	-0.010	-0.006	0.048	-0.116
	(0.057)	(0.084)	(0.052)	(0.047)	(0.039)	(0.077)
Adult refugee	-0.646***	-0.605*	-0.485**	-0.599***	-0.288	-0.460
	(0.146)	(0.263)	(0.180)	(0.169)	(0.151)	(0.296)
Adult economic immigrant	-0.373**	-0.349	-0.355**	-0.392**	-0.199	-0.242
	(0.120)	(0.192)	(0.113)	(0.121)	(0.125)	(0.150)
Adult family reunification immigrant	-0.558***	-0.675**	-0.459***	-0.524***	-0.331*	-0.386*
	(0.128)	(0.227)	(0.126)	(0.114)	(0.147)	(0.172)
Adult other categories	-0.428	-0.302	-0.754*	-0.386***	-0.239	-0.267
	(0.225)	(0.211)	(0.314)	(0.117)	(0.142)	(0.211)
Adult temporary residents	-0.404	-0.459	-0.186	-0.544**	-0.364*	-0.362
	(0.227)	(0.236)	(0.180)	(0.179)	(0.176)	(0.210)
Young refugee immigrants	-0.479	-0.685*	-0.005	-0.492***	-0.381*	-0.626*
	(0.674)	(0.332)	(1.459)	(0.146)	(0.164)	(0.250)
Young non-refugee immigrants	-0.422*	-0.437	-0.200	-0.405***	-0.275	-0.319
	(0.199)	(0.269)	(0.281)	(0.109)	(0.170)	(0.181)
Education (Reference group: HS graduates)						
< high school	-0.191**	-0.073	0.006	-0.181**	-0.251***	-0.086
	(0.070)	(0.099)	(0.084)	(0.066)	(0.073)	(0.092)
College or trade school	0.123*	0.140*	0.198***	0.180***	0.200***	0.211***
	(0.059)	(0.071)	(0.051)	(0.041)	(0.039)	(0.042)

(continued)

Table A.2.10. continued

	Dependent variable: log hourly wages					
	Men			Women		
	Lit=Num	Lit>Num	Lit<Num	Lit=Num	Lit>Num	Lit<Num
	(1)	(2)	(3)	(4)	(5)	(6)
≥ bachelor's degree	0.445***	0.349***	0.498***	0.551***	0.494***	0.516***
	(0.066)	(0.068)	(0.066)	(0.053)	(0.041)	(0.058)
Foreign education x < high school	0.037	0.294	-0.414	0.034	0.157	-0.161
	(0.126)	(0.159)	(0.221)	(0.124)	(0.187)	(0.227)
Foreign education x high school	-0.177	-0.053	-0.176	-0.060	0.163	-0.065
	(0.117)	(0.163)	(0.143)	(0.095)	(0.224)	(0.125)
Foreign education x college or trade school	-0.045	-0.038	-0.179	-0.118	-0.232	-0.066
	(0.116)	(0.252)	(0.117)	(0.078)	(0.133)	(0.188)
Foreign education x ≥ bachelor's degree	-0.159	-0.082	-0.249**	-0.266**	-0.372***	-0.203*
	(0.099)	(0.142)	(0.090)	(0.092)	(0.105)	(0.103)
N	2064	1118	2087	2138	2417	1252
R^2	0.299	0.187	0.220	0.340	0.267	0.265
Adjusted R^2	0.289	0.166	0.209	0.331	0.258	0.248

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The ordinary least squares (OLS) was used to calculate point estimates. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The Reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of the survey.

By gender, literacy and numeracy scores are indirectly controlled by grouping individuals into three subsamples: individuals with similar literacy and numeracy scores, with literacy scores higher than numeracy scores, and with numeracy scores higher than literacy scores. To determine the sample of interest, we begin by calculating an equally weighted average literacy and numeracy scores using all ten plausible values for everyone. Then, we rank these averages into ten weighted deciles of literacy and numeracy scores, respectively. We restrict the thresholds for each decile of each test to be the same for both men and women. The subsample of individuals with equal literacy and numeracy scores indicates that the ranking (decile) of literacy scores is identical to that of numeracy scores. The second subsample includes individuals whose literacy score is in a higher-ranking decile than the numeracy score, and the reverse selection is for the third subsample. We are interested in exploring if literacy or numeracy proficiency plays a more significant role in helping us understand earnings gaps between immigrants and the Canadian-born. The top panel of Table 11 shows earnings gaps between immigrants and Canadians using more general definitions of immigrants and

the Canadian-born, and the bottom panel shows the results for the nine population subgroups. In all regressions, all covariates in equation 2, except for test scores, are controlled for.

In the top panel, for men, the earnings gap is more substantial for adult immigrants when they have better literacy skills than numeracy skills compared to when they have balanced literacy and numeracy scores. The trend is reversed for adult female immigrants. One interpretation of this is that numeracy matters more than literacy for immigrants relative to Canadian born. Both genders experience statistically insignificant earnings gaps compared to all Canadians, on average, as they have better numeracy than literacy skills. These results suggest that numeracy skills are perhaps more critical and individuals of either gender with higher numeracy skills are better rewarded in the Canadian labour market than they are for literacy skills. This result supports the claim we made in the previous section that numeracy scores have an independent effect on earnings and the return to these scores are higher than that of the literacy scores. On the other hand, across these subsamples, immigrants who migrated to Canada at a young age do not have any earnings disadvantages compared to the Canadian-born.

When we examine earnings gaps using disaggregated groups of immigrants in the lower panel, adult refugee immigrants experience 30 percent and 40 percent lower wages compared to the third generation for men and women, respectively, among individuals who have similar proficiency in numeracy and literacy. However, estimated coefficients on this category are not statistically different from zero in the other two subsamples, due to perhaps small sample size. For both men and women, adult economic immigrants exhibit no earnings disadvantages compared to the third generation across these homogenous subsamples, except for female adult economic immigrants with balanced literacy and numeracy scores. These women average a 20 percent earnings gap compared to female third-generation Canadians. This result suggests that adult economic immigrants are similarly rewarded on the Canadian labour market, especially when they have the same skills as the third generation. Unfortunately, due to the small sample size when categorizing immigrants and Canadians into more disaggregated groups, estimated coefficients are negative and not statistically significant for most immigration groups. Young non-refugee immigrants and second-generation Canadians have statistically zero earnings gaps compared to the third generation.

Table A.2.11. Unconditional quantile wage regressions at the 10th and 90th percentiles

	Dependent variable: log hourly wage											
	Three broad categories						Nine subpopulation groups					
	10th quantile			90th quantile			10th quantile			90th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Men												
Literacy		0.088***			0.061			0.081***			0.062	
		(0.023)			(0.036)			(0.023)			(0.037)	
Numeracy			0.120***			0.077*			0.111***			0.080*
			(0.024)			(0.039)			(0.024)			(0.040)
Adult immigrants	-0.695**	-0.617**	-0.599**	-0.172	-0.118	-0.110						
	(0.220)	(0.216)	(0.212)	(0.160)	(0.170)	(0.170)						
Young immigrants	-0.802*	-0.743*	-0.711*	-0.120	-0.079	-0.062						
	(0.338)	(0.330)	(0.323)	(0.239)	(0.246)	(0.247)						
Second-generation Canadians							-0.028	-0.028	-0.022	-0.013	-0.012	-0.008
							(0.062)	(0.063)	(0.063)	(0.082)	(0.081)	(0.081)
Adult refugee							-0.908**	-0.797*	-0.768*	-0.240	-0.154	-0.138
							(0.334)	(0.323)	(0.319)	(0.241)	(0.256)	(0.258)
Adult economic immigrant							-0.610**	-0.541**	-0.533**	-0.231	-0.178	-0.176
							(0.210)	(0.205)	(0.203)	(0.152)	(0.164)	(0.162)
Adult family reunification immigrant							-0.978***	-0.872***	-0.832***	-0.151	-0.070	-0.045
							(0.222)	(0.218)	(0.212)	(0.212)	(0.231)	(0.234)
Adult other categories							-0.766*	-0.715*	-0.688*	-0.287	-0.249	-0.231
							(0.311)	(0.306)	(0.306)	(0.225)	(0.230)	(0.231)

(continued)

Table A.211. continued

	Dependent variable: log hourly wage											
	Three broad categories						Nine subpopulation groups					
	10th quantile			90th quantile			10th quantile			90th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Adult temporary residents							-0.725*	-0.658*	-0.635*	-0.026	0.025	0.038
							(0.314)	(0.309)	(0.300)	(0.206)	(0.207)	(0.206)
Young refugee immigrants							-1.801*	-1.724*	-1.649*	-0.206	-0.147	-0.097
							(0.809)	(0.793)	(0.758)	(0.344)	(0.354)	(0.363)
Young non-refugee immigrants							-0.803*	-0.731*	-0.697*	-0.145	-0.089	-0.068
							(0.325)	(0.316)	(0.312)	(0.255)	(0.265)	(0.267)
Education (Reference group: HS graduates)												
< high school	0.059	0.125	0.147	-0.046	-0.001	0.010	0.057	0.118	0.139	-0.047	-0.001	0.011
	(0.074)	(0.075)	(0.077)	(0.066)	(0.072)	(0.074)	(0.073)	(0.074)	(0.076)	(0.066)	(0.073)	(0.075)
College or trade school	0.212*	0.191*	0.172	0.079	0.064	0.053	0.213*	0.193*	0.176*	0.078	0.063	0.051
	(0.090)	(0.089)	(0.088)	(0.061)	(0.057)	(0.055)	(0.090)	(0.089)	(0.088)	(0.061)	(0.057)	(0.054)
≥ bachelor's degree	0.330***	0.246***	0.206**	0.570***	0.513***	0.491***	0.317***	0.241**	0.205**	0.572***	0.514***	0.491***
	(0.073)	(0.074)	(0.072)	(0.111)	(0.096)	(0.093)	(0.072)	(0.073)	(0.072)	(0.112)	(0.096)	(0.093)

(continued)

Table A.2.11. continued

	Dependent variable: log hourly wage											
	Three broad categories						Nine subpopulation groups					
	10th quantile			90th quantile			10th quantile			90th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Foreign education x < high school	-0.131	-0.064	-0.060	-0.179	-0.133	-0.133	-0.014	0.037	0.030	-0.213	-0.174	-0.182
	(0.200)	(0.196)	(0.195)	(0.133)	(0.143)	(0.139)	(0.214)	(0.211)	(0.211)	(0.153)	(0.158)	(0.154)
Foreign education x high school	0.070	0.134	0.163	-0.175	-0.131	-0.115	0.159	0.206	0.224	-0.208	-0.172	-0.161
	(0.358)	(0.362)	(0.365)	(0.114)	(0.124)	(0.125)	(0.358)	(0.360)	(0.362)	(0.136)	(0.140)	(0.138)
Foreign education x college or trade school	0.057	0.064	0.054	-0.113	-0.109	-0.115	0.025	0.034	0.027	-0.120	-0.113	-0.119
	(0.135)	(0.137)	(0.136)	(0.133)	(0.131)	(0.132)	(0.136)	(0.139)	(0.138)	(0.131)	(0.129)	(0.129)
Foreign education x ≥ bachelor's degree	0.090	0.100	0.089	-0.408*	-0.402*	-0.409*	0.029	0.042	0.037	-0.403*	-0.394*	-0.397*
	(0.121)	(0.119)	(0.117)	(0.196)	(0.196)	(0.196)	(0.112)	(0.112)	(0.110)	(0.186)	(0.186)	(0.185)
N	5269	5269	5269	5269	5269	5269	5269	5269	5269	5269	5269	5269
R^2	0.066	0.075	0.083	0.107	0.111	0.113	0.078	0.085	0.092	0.108	0.112	0.114
Adjusted R^2	0.063	0.071	0.079	0.104	0.107	0.109	0.073	0.080	0.087	0.103	0.107	0.109
Women Literacy		0.052*			0.079***			0.048*			0.078***	
		(0.023)			(0.018)			(0.023)			(0.018)	
Numeracy			0.060**			0.088***			0.057**			0.088***
			(0.020)			(0.018)			(0.020)			(0.018)

(continued)

Table A.2.11. continued

	Dependent variable: log hourly wage											
	Three broad categories						Nine subpopulation groups					
	10th quantile			90th quantile			10th quantile			90th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Adult immigrants	-0.547***	-0.514***	-0.517***	-0.191*	-0.140	-0.148						
	(0.140)	(0.138)	(0.139)	(0.086)	(0.087)	(0.084)						
Young immigrants	-0.796**	-0.777**	-0.776**	-0.081	-0.053	-0.053						
	(0.274)	(0.277)	(0.275)	(0.125)	(0.125)	(0.123)						
Second-generation Canadians							-0.020	-0.022	-0.020	0.075	0.071	0.075
							(0.036)	(0.036)	(0.036)	(0.054)	(0.055)	(0.055)
Adult refugee							-0.809**	-0.768**	-0.766**	-0.245	-0.179	-0.180
							(0.251)	(0.251)	(0.254)	(0.135)	(0.130)	(0.127)
Adult economic immigrant							-0.490***	-0.467**	-0.473**	-0.139	-0.102	-0.113
							(0.145)	(0.143)	(0.146)	(0.088)	(0.087)	(0.084)
Adult family reunification immigrant							-0.625***	-0.587**	-0.582**	-0.209	-0.147	-0.143
							(0.182)	(0.184)	(0.183)	(0.110)	(0.110)	(0.109)
Adult other categories							-0.396*	-0.378*	-0.372*	-0.293**	-0.263*	-0.257*
							(0.184)	(0.184)	(0.185)	(0.111)	(0.111)	(0.109)
Adult temporary residents							-0.566**	-0.527*	-0.528*	-0.189	-0.125	-0.129
							(0.215)	(0.210)	(0.208)	(0.124)	(0.123)	(0.121)

(continued)

Table A.2.11. continued

	Dependent variable: log hourly wage											
	Three broad categories						Nine subpopulation groups					
	10th quantile			90th quantile			10th quantile			90th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Young refugee immigrants							-0.850	-0.823	-0.826	-0.104	-0.058	-0.067
							(0.591)	(0.591)	(0.603)	(0.108)	(0.109)	(0.106)
Young non-refugee immigrants							-0.805**	-0.789**	-0.783**	-0.085	-0.060	-0.053
							(0.297)	(0.300)	(0.299)	(0.138)	(0.137)	(0.134)
Education (Reference group: HS graduates)												
< high school	-0.375**	-0.341**	-0.337**	0.026	0.078	0.081	-0.374**	-0.342**	-0.339**	0.029	0.080*	0.083*
	(0.117)	(0.122)	(0.119)	(0.040)	(0.040)	(0.042)	(0.115)	(0.120)	(0.117)	(0.040)	(0.040)	(0.041)
College or trade school	0.163***	0.151**	0.150**	0.132***	0.114***	0.113***	0.162***	0.151***	0.149**	0.131***	0.113***	0.112***
	(0.049)	(0.047)	(0.048)	(0.030)	(0.031)	(0.031)	(0.047)	(0.045)	(0.047)	(0.030)	(0.030)	(0.031)
≥ bachelor's degree	0.246***	0.202***	0.194***	0.520***	0.453***	0.445***	0.241***	0.201***	0.194***	0.516***	0.450***	0.443***
	(0.041)	(0.044)	(0.044)	(0.044)	(0.047)	(0.048)	(0.042)	(0.046)	(0.045)	(0.044)	(0.047)	(0.048)
Foreign education x < high school	-0.281	-0.259	-0.252	0.063	0.097	0.106	-0.248	-0.231	-0.227	0.073	0.100	0.104
	(0.273)	(0.275)	(0.277)	(0.112)	(0.114)	(0.115)	(0.282)	(0.285)	(0.286)	(0.116)	(0.117)	(0.117)

(continued)

Table A.2.11. continued

	Dependent variable: log hourly wage											
	Three broad categories						Nine subpopulation groups					
	10th quantile			90th quantile			10th quantile			90th quantile		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Foreign education x high school	-0.283	-0.261	-0.254	0.093	0.126	0.135	-0.266	-0.249	-0.245	0.106	0.134	0.139
	(0.168)	(0.170)	(0.172)	(0.082)	(0.082)	(0.082)	(0.184)	(0.185)	(0.187)	(0.081)	(0.081)	(0.082)
Foreign education x college or trade school	-0.262	-0.245	-0.235	-0.047	-0.020	-0.007	-0.271	-0.254	-0.246	-0.039	-0.010	0.001
	(0.199)	(0.197)	(0.197)	(0.083)	(0.082)	(0.082)	(0.201)	(0.200)	(0.200)	(0.084)	(0.083)	(0.083)
Foreign education x ≥ bachelor's degree	-0.243*	-0.221*	-0.213	-0.248**	-0.215*	-0.204*	-0.256*	-0.235*	-0.227*	-0.244**	-0.210*	-0.200*
	(0.113)	(0.111)	(0.111)	(0.094)	(0.095)	(0.094)	(0.114)	(0.113)	(0.113)	(0.095)	(0.096)	(0.095)
N	5807	5807	5807	5807	5807	5807	5807	5807	5807	5807	5807	5807
R^2	0.110	0.113	0.115	0.102	0.111	0.113	0.113	0.116	0.118	0.104	0.113	0.115
Adjusted R^2	0.107	0.110	0.111	0.098	0.107	0.110	0.109	0.112	0.113	0.100	0.108	0.111

Source: Authors' calculations. PIAAC 2012.

Notes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parentheses. The Firpo et al. (2009) method of unconditional quantile regressions was used to derive estimated coefficients. All 10 plausible values of each test scores are used. The delete-one jackknife method and all replicate weights were employed to calculate standard errors. All analyses were done separately for men and women. The sample includes individuals aged 25 to 65 with positive self-reported hourly wages for all wage earners. The top and bottom 1% of wage earners are set to equal the hourly wages of the nearest percentiles. The cut-off for each percentile is the weighted cut-off of hourly wages of everyone with positive wages in the sample. The Reference group includes the third generation who obtain a high school diploma in Canada and live in a large urban population centre in Ontario at the time of survey.

CHAPTER 3 – THE UNDERREPRESENTATION OF WOMEN IN CANADA'S ICT SECTOR: WHAT CAN WE LEARN FROM A CANADIAN SURVEY OF ADULT SKILLS?

3.1. INTRODUCTION

Female representation in core information and communication technology (ICT) occupations has remained stable at 23 to 25 percent since 2000 (ICTC 2009, 2013, 2016b). This trend has not changed over a period when the number of young women at universities has surpassed the number of young men. With the demand for ICT workers projected to increase over the next few years, we echo the words from a recent report by the Canadian Advanced Technology Alliance – Women in Technology (CATA-WIT 2010): "an existing and underutilized human resource is Canada's women." Despite the growing trend of women working in those fields that were once considered male-dominated, both ICT education and the ICT industry seem to fail in attracting women in a similar fashion.

Many hypotheses have attempted to explain this underrepresentation. This chapter deals with one of those hypotheses: that women in the main may not have the appropriate capabilities to perform at the same level as men in ICT.[47] We find that, after controlling for

[47] The low representation of women in technology fields made headlines throughout the world in August 2017 when a Google engineer wrote that lack of ability could be the reason. In an internal memo, James Damore was critical of Google's policy promoting gender diversity to increase the low proportion of women employed. He wrote: "The distribution of preferences and abilities of men and women differ in part due to biological causes and . . . these differences may explain why we don't see equal representation of women in tech and leadership" (Ingram and Palli 2017).

numeracy and literacy test scores and appropriate covariates, women tend to score higher on basic ICT tests than men. However, on average, women are much less likely than men to be employed in ICT occupations even after controlling for an array of appropriate covariates, and even for women with high ICT scores. We also find that women in ICT earn less than men, on average, but only by about the same amount as in other occupations. That is, an additional wage penalty does not exist for women in ICT occupations. This finding casts doubt on the hypothesis that unfavourable employment conditions (specifically, lower wages) are responsible for the underrepresentation of women in ICT.

Basic ICT skills are foundational for advanced computer and problem-solving skills. We find that women are more likely than their male counterparts to have these foundational skills. Thus, the underrepresentation of women in ICT does not arise from a lack of natural ability; instead, it appears that women do not, or have not been able to, build on their foundational ICT skills. Literature surrounding low representation of women in STEM education supports this hypothesis, which we briefly summarize in the following section.

The remainder of the chapter is organized as follows: Section 3.2 gives a brief review of the relevant evidence offered to date. Section 3.3 discusses the Programme for the International Assessment of Adult Competencies (PIAAC) data used in the analysis and presents summary statistics. Section 3.4 outlines the empirical model and the results are presented in Section 3.5. Section 3.6 concludes and offers some policy recommendations.

3.2. EXPLAINING LOW FEMALE PARTICIPATION RATES IN ICT

Women's low participation in ICT occupations is not unique to Canada; it is observed in many post-industrialized countries despite the trend of women increasingly participating in post-secondary education and labour force (Lasen 2010). Women's low participation rates in ICT occupations can perhaps be explained by their low enrolment rates in ICT-related fields of study during formal education. Gose (2012) documents a general decline in the number of women completing computer science degrees in the U.S. between 1985 and 2011: the overall number of degrees awarded to both genders remained constant at 39,000, the number of female graduates fell by almost 50 percent, from 14,431 to 7,306. A similar trend has been observed in Canada: Andres and Adamuti-Trache (2007) demonstrate that, between the 1980-81 and 2003-04 academic years, the proportion of Canadian women enrolled in full-time undergraduate programs increased in all fields of study, except for computer science, nursing, and rehabilitation medicine. The proportion of women in undergraduate computer science programs dropped from 27 percent to 18 percent.[48] Anderson et al. (2008:1305) cite a number of previous studies in noting, "When female participation in other science and engineering areas has been growing consistently across industrialized countries, the trend has been the opposite in ICT subjects and careers, and the trend is widespread."

It is reasonable to assume that the low proportion of women in ICT-related fields of study and low participation rates in ICT occupations are positively correlated. Several

[48] During the same period, the proportion of women increased from 46 percent to 58 percent of all undergraduates. This proportion in sciences increased from 40 percent to 48 percent in all sciences, and ten percent to 21 percent in all engineering and applied science.

explanations have been offered as to why the proportion of women is so low: the way young women are socialized, misinformation about what ICT careers entail, lack of female role models, the marketing of technology to young men, discrimination, and hostility against women in the ICT workplace, and innate differences in ability. Many of these explanations inevitably overlap.

Using a survey of Australian high school students, Anderson et al. (2008) identify two factors which are seemingly associated with the aversion towards studying ICT subjects: the perception that these subjects were boring, and a strong aversion to computers. The latter factor seems to be supported by Tømte and Hatlevik (2011). They use the 2006 Programme for the International Student Assessments (PISA) results from Finland and Norway and find a strong positive correlation between self-efficacy and the ICT use, with a stronger positive result for young men than young women. Their results suggest that exposure to technology at a young age may increase familiarity with technology and increase self-efficacy and (perhaps) the willingness to choose a career in ICT.

To change women's perceptions of ICT-related fields of study and careers is a daunting task, given the lack of female role models present in ICT. The lack of role models is a barrier to other women entering post-secondary education in science, mathematics, technology, and engineering, and is often cited as a reason for low female participation in ICT (e.g., CATA-WIT 2010).

Differences in labour market outcomes between men and women have previously been attributed to differences in human capital as well as discrimination. A development in this literature saw the acknowledgment that there are important differences in

"psychological attributes and preferences between men and women" (Bertrand 2011, 1546). More specifically, it has been a challenge to change a young woman's preferences towards ICT. Williams and Ceci (2012, 144) note that women (starting at a young age) are more interested in careers in life sciences than in technical and applied sciences:[49]

> Women are not found in greater numbers in some fields, particularly math-intensive ones, due to a combination of factors. The two most significant reasons are that women are more likely than men to prefer other fields (such as medicine, biology, law and veterinary science, rather than mechanical and electrical engineering, computer science and physics), even when they have comparable mathematical ability, and that family-formation goals extinguish tenure-track aspirations in women more often than in men.

Discussion surrounding differences between men and women in any labour market inevitably suggests labour market discrimination. Ceci and Williams (2011, 3161) argue that discrimination against women in the sciences is yesterday's problem: "In sum, the most salient reasons for women's underrepresentation today are career preferences and fertility/lifestyle choices." Women are underrepresented in the math-intensive fields, but this is because of sex differences in resources, abilities, and choices.

Although the evidence of direct discrimination is scant, there are reports of women experiencing discomfort in ICT and other STEM occupations. Men's domination of the profession and the commensurate stereotypical, negative male attitudes towards women and their abilities may be keeping them out of the profession and driving away those who do enter. More specifically, the lack of women in the workplace may result in women being excluded from information workplace networks (Cukier 2007) and the lack of female peer

[49] Andres and Adamuti-Trache (2007) show that enrolments of women in full-time undergraduate life science programs go up markedly between 1980-81 and 2003-04. For example, the proportion of women in veterinary medicine increased from 47 percent to 80 percent, and zoology from 38 percent to 71 percent.

support during difficult times at work (Cohoon 2002). CATA-WIT (2010) notes that barriers for women include the "old-boys network." The report also mentions that women's retention rate is very low because they may feel undervalued and marginalized, and experience hostile macho cultures, isolation, and systems of risk and rewards that emphasize risk taking, etc. This means that the "culture" of ICT – whether real or perceived – may be enough to dissuade women from taking a serious interest in the field or to persuade them to exit prematurely after entry. Hewlett et al. (2008) provide evidence that female attrition rates in technology are higher than those in both engineering and the sciences. Derived from a series of international surveys, the data show that over 52 percent of women leave their private sector jobs in science, engineering, and technology (SET), a rate considerably higher than that for men. Furthermore, the female exit rate is highest for those in technology (56 percent), with one-half of those abandoning their SET training altogether.

Glass et al. (2013) use longitudinal data for the U.S. over almost 30 years (since 1979) and find that, compared to those in professional fields, women who move out of STEM fields are not likely to return, nor are they likely to have moved into managerial or administrative ranks. These authors are somewhat optimistic about more recent cohorts of young women in STEM as societal changes may have resulted in more acceptance of women in these areas. This is especially important because attrition tends to be higher earlier on in careers.

Evidence does seem to support the assertion that the abilities of young men and women are similar. Thus, it casts doubt on ability differences as a reason for the gender

imbalance in ICT. For example, Hill, Corbett, and St. Rose (2010) study U.S. data and argue that girls and boys leave high school equally prepared to pursue careers in STEM, but fewer girls major in these disciplines. Many girls are performing well on standardized math tests, which suggests that cultural factors, rather than innate abilities, may be at work. The negative stereotype of young girls' ability in math and science can lower their aspirations to pursue the STEM fields. Girls also tend to internalize these stereotypes in underestimating their abilities and holding themselves to higher standards, again leading to less interest in pursuing these fields. Similarly, Ceci and Williams (2011) cast doubt on ability differences as a reason for the dearth of women in math-related fields. They do acknowledge that differences exist (i.e., more men score at the very top of standardized tests such as the GRE-Q or the SAT-M), but these differences do not explain the wide gap in participation rates between men and women (although these results could (arguably) explain differences at the very top levels of some STEM professions).

For Canada, standardized test results paint a strikingly similar picture: young Canadians of either gender have similar abilities. Results for the 2009 PISA mathematics and science scores show that girls aged 15 years performed only slightly below men of the same age (12 points and 5 points, respectively). Given that the mean male score on these two tests was 533 for math and 531 for science, these are small (albeit statistically significant) differences compared to the PISA reading score, where the difference was over 30 points in favour of girls (Knighton, Brochu, and Gluszynski 2010). Moreover, the differential in these scores has remained reasonably stable over the six iterations of the test between 2000 and 2015 (Ferguson 2016; OECD 2016), although the most recent PISA test

scores from 2015 show that the gap between men and women has narrowed slightly: to only nine points in math, one point in science, and 26 points in reading (O'Grady et al. 2016).

Our paper adds to the evidence base regarding the hypothesis of a gender imbalance in ability; we examine this specifically for general computer skills. We explore female basic ICT skills as a possible explanation for low female participation in ICT occupations and further examine the effect of employment in ICT occupations on earnings.

3.3. DATA AND DESCRIPTIVE STATISTICS

This paper employs Statistics Canada's 2012 Survey of Adult Skills, a product of the OECD's PIAAC. The survey collects a wide range of information, such as age, sex, education, and labour market characteristics of individuals aged 16-65 years in Canada. It also assesses individual cognitive skills, namely literacy, numeracy, and problem-solving in a technology-rich environment (PSTRE). The last of those three, PSTRE, is the focus of this study; for simplicity, we refer to it hereafter as basic ICT skills. According to the OECD (2013, 9), PSTRE is defined as "using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks."

Literacy, numeracy, and PSTRE are regarded as foundational, key information-processing competencies that are necessary to build other relevant and complex skills, such as analytic reasoning. PSTRE assesses individuals on three dimensions: the technology dimension, the task dimension, and the cognitive dimension. The measurement scale of these tests is from zero to 500, and it uses the classical item response theory and a multiple

imputation method to derive ten plausible values for each category of tests. A set of 80 replicate weights was imputed to account for sample stratification.[50]

We use two different definitions for ICT occupations because, in the current literature, there is no consensus on how to define these occupations. The first list of ICT occupations is defined by using the combination of O*NET and the 2010 Standard Occupational Classification (SOC), which can be obtained from the O*NET website.[51] Since the PIAAC 2012 only provides information regarding occupations based on the 2011 National Occupation Classification (NOC 2011), we link the intersection of O*NET and SOC occupation codes to the corresponding occupations in the NOC 2011.

Moreover, PIAAC 2012 provides information on the NOC 2011 for all individuals who work at the time of survey or who had a job if they were unemployed at the time of survey. In this chapter, we use the information only for employed individuals with positive earnings. The second list of these occupations is much narrower than those in the first list, and it includes 15 core digital economy occupations defined by the Information and Communications Technology Council, ICTC hereafter (ICTC 2016b). Both lists can be found in Appendix Table A.3.1.

[50] For more information on how test scores are generated and how replicated weights are created, please refer to OECD (2013).

[51] O*NET Online can be accessed at https://www.onetonline.org. This database provides information on occupations that are listed as information and communication technology occupations. Unfortunately, this database is only linked with SOC, and thus we needed to have the combination of SOC and O*NET Online linked with the 2011 National Occupation Classification (NOC 2011) to identify ICT occupations in the PIAAC 2012. We thank Marc Frenette at Statistics Canada for a useful discussion on these linkages.

We examine 16,440 individuals, aged 22 to 59 years.[52] The sample includes individuals with valid information on the level of education, age at immigration, and place of birth. Among these individuals, 13,597 have valid PSTRE scores.[53] Individuals in this age range are likely to have completed their post-secondary education and are also likely not to be retired. Table 3.1 illustrates weighted proportions of individuals' level of basic ICT scores and proportions of some respondents who did not write the ICT assessment. Two patterns are obvious. First, moving from the entire sample to either of the two ICT definitions, respondents are more likely to take computer-based tests and have valid basic ICT (or PSTRE) scores.[54] Second, as we move into the ICT occupations, ICT tests scores do increase. For example, for all women, 14.8 percent of the sample score below 241 on the ICT test and 37.9 percent score 291 and above. For women in the second definition of ICT, these numbers change to 6.0 percent and 72.1 percent, respectively. These results are expected, with those in ICT occupations more likely to have written the ICT tests and to have higher scores.

[52] All analyses were also conducted using the 25-54 age group. The results are not markedly different than those presented here and are available from the authors upon request.

[53] In this chapter, we use the PSTRE scores as basic ICT skills scores. PSTRE score is highly correlated with literacy and numeracy scores in PIAAC 2012, which means basic ICT skills scores may reflect the proficiency in literacy and numeracy. It also captures very basic everyday life and workplace computer skills. As such, the PSTRE score may not be a perfect measure to determine advanced job-related ICT skills, but we proceed under the reasonable assumption that basic and advanced ICT are highly and positively correlated. Future research could examine more specialized skills to determine whether there are differences in gender distributions and, if there are, their impacts on the probability of employment in ICT occupations and on wages.

[54] According to the OECD (2013), there are different reasons for not having valid ICT scores. Individuals may have failed the ICT core test. These core tests are implemented to assess if a respondent is deemed suitable to write computer-based tests. Respondents who attempted only paper-based tests will not have scores for the PSTRE tests. Furthermore, respondents can certainly refuse computer-based test assessments even if they pass the core test. Individual without prior computer experience were assigned paper-based tests.

Summary statistics are contained in Table 3.2, starting with the scores on each of the three PIAAC tests by sex and occupational definition.[55] This table is based on a sample of 13,597 individuals who have valid basic ICT scores. Men have higher mean scores compared to women within each category.[56] Another noticeable pattern in the data is that the mean values tend to increase as one moves rightward from the entire sample to the ICT definitions. Not only do those in ICT occupations have higher basic ICT scores, as expected, but also higher literacy and numeracy test scores.

Figure 3.1 shows the kernel density plots of the data used in Table 3.2 and compares the distributions of ICT scores for men and women under the two definitions of ICT. The distribution of women's scores is denser around the mean and less so in the tails, regardless of the definition of ICT occupations. The two distributions for men are also skewed to the right, indicating that men are more likely to have the highest ICT scores, especially when the ICTC definition is used.

Returning to Table 3.2, mean hourly wages tend to increase as one moves from left to right, although the biggest increase is for ICT occupations defined by ICTC compared with the overall male average ($39.01 versus $30.99). Women's wages follow the same pattern as men's wages but are uniformly lower. Average age ranges from 39 to 41 years, with no obvious difference between genders or occupational definitions. Compared with the entire sample, more ICT workers reside in urban areas.

[55] Distribution plots comparing ICT scores using both definitions of ICT to the scores in all occupations for both men and women were also generated. The results mirror those in Table 3.2 with both men and women in ICT occupations (using either ICT definition) having distributions to the right of those in all occupations.
[56] Differences in average test scores between men and women are statistically significant, except for differences in literacy scores in both definitions of ICT occupations, and the difference in basic ICT scores in the broader category of ICT occupations.

Those who are in ICT occupations have a higher level of education compared with the entire sample: up to 51 percent of men and 56 percent of women in ICT hold at least a bachelor's degree in comparison to 32 percent of men and 35 percent of women in the entire sample. The proportion of individuals with a STEM degree in ICT occupations exceeds that for all individuals in the sample. Table 3.2 also shows that approximately 13 percent of men and four percent of women are employed in ICT occupations defined using the broader list of ICT occupations, whereas eight percent of men and two percent of women are employed in ICT using the narrow definition.

3.4. EMPIRICAL FRAMEWORKS

We begin by examining the covariates contributing to differences in basic ICT skills among men and women. We further consider earnings gaps between men and women and quantify how these gaps change when controlling first for basic ICT skills and then for all three test scores. We also use the linear probability model to study differences in the probability of being employed in these occupations between men and women. In all analytical steps, we subsequently introduce different sets of covariates to understand the associated gaps.

First, we estimate the following model using ordinary least squares (OLS) for all individuals who are included in the sample:

$$ICTSCORE = \alpha_0 + \alpha_1 Gender + \alpha_2 Characteristics + \epsilon, \quad (3.1)$$

where the dependent variable is the problem-solving in technology-rich environment (PSTRE) score for individual i and $Gender$ is a dummy variable that equals one if the respondent is female and zero otherwise. Test scores have been standardized to a mean of

zero and a variance of one. $Characteristics$ is a vector of covariates that changes across specifications. These control variables include age and its square, education (below high school, high school diploma (omitted group), post-secondary school below Bachelor's degree, and at least a Bachelor's degree), and geographical indicators (11 provincial indicators – one for each of the provinces and a common variable for the three territories – and four urban/rural indicators, with the Ontario and large urban area indicators being omitted).[57] We also control for whether an individual is an adult immigrant (who migrated to Canada at age 13 or older) or a young immigrant (who migrated to Canada at age 12 or younger).[58] An indicator of whether an individual completed their highest qualification outside of Canada is included. Moreover, we control for individuals who have graduated with a STEM degree at a post-secondary level of education. In some specifications, we interact the female variable with various measures of interest. In the regressions, all test scores are standardized to the entire sample's mean and standard deviations. Thus, the interpretation of relevant coefficients should be standard deviations of the test scores.

We further our analysis by examining the differences in the probability of being employed in the ICT occupations for both sexes, as follows:

$$EmployedICT = \beta_0 + \beta_1 ICTSCORE + \beta_2 Gender + \beta_3 Characteristics + \mu, \qquad (3.2)$$

where we employ a linear probability model (LPM) to estimate the coefficients in equation (3.2). The dependent variable is a binary variable that is equal to one if employed in ICT

[57] For the ease of interpretation, we deviate the age variable to the sample mean of age, which is approximately 42.

[58] The delineation of immigrants into these categories is quite common in the immigration literature and is done to differentiate those who likely obtained their secondary schooling in Canada from those who did not.

occupations. We estimate equation (3.2) for both definitions of ICT occupations. In some specifications, standardized test scores of each individual ($ICTSCORE$) and selected $Characteristics$ covariates are added to see if the estimated coefficient on the gender variable changes. The interpretation of a change in β_1 is in the likelihood of being employed in ICT occupations with a one standard deviation increase in basic ICT scores.

In the last part of the analysis, we look at differences in earnings gaps between men and women using the following individual-level wage regression:

$$ln(hourlywage) = \theta_0 + \theta_1 ICTSCORE + \theta_2 Gender + \theta_3 Characteristics + \omega, \quad (3.3)$$

where $\ln(hourlywage)$ is natural log of gross hourly wage and θ_1 is interpreted as the approximate percentage change in hourly wage as ICT scores increase by one standard deviation.[59] Because we are using one cross-section in our analysis, we are not able to distinguish between aging and cohort effects. It is also relevant to note that all individuals have ten plausible values of each test score. These test scores are not meant to imply any proficiency at the individual-level, but they are used to provide information about the proficiency in a certain category of tests for the populations of interest. Thus, standard errors derived from all regressions are jackknifed using all ten plausible values and 80 replicated weights provided in PIAAC 2012.[60]

[59] Self-employed respondents and individuals with missing hourly wage information are excluded in the earnings regressions.

[60] According to OECD (2013), estimated coefficient, $\overline{coeff}$, is an equally weighted average of all ten ordinary least squares (OLS), $\overline{coeff_t}$, estimates that are estimated using the t^{th} plausible value and the final sample weights. Standard errors for these estimates are calculated as follows:

$$Var\left(\overline{coeff}\right) = \frac{1}{T}\sum_{t}^{T=10} Var\left(\overline{coeff_t}\right) + \frac{T+1}{T(T-1)}\sum_{t}^{T=10} Var\left(\overline{coeff_t} - \overline{coeff}\right),$$

where $Var\left(\overline{coeff_t}\right)$ is calculated using the delete-one Jackknife method and taking into account 80 replicated weights provided by Statistics Canada, and $T = 10$ is the number of plausible values.

PIAAC 2012 and the estimation procedure have two limitations. The first is that the PSTRE – which we use as a proxy for ICT skills – captures mainly basic or foundational ICT skills and thus may not be an accurate indicator of the advanced ICT skills that are often required in ICT occupations. We make the (reasonable) assumption that basic and advanced skills are positively correlated, and thus the former is a reasonable proxy for the latter. Second, endogeneity is a potential problem in these types of estimation (e.g., ICT skills affect the probability of employment in ICT occupations, and employment affects ICT skills). However, the structure of the models being estimated implicitly assumes that any bias will equally affect both men and women and, insofar as this restriction is valid, the comparison of men and women will also remain valid.

3.5. RESULTS

3.5.1. ICT Test Scores

Table 3.3 presents the first set of regressions results.[61] In particular, we are interested in the relationship between the variables shown and the ICT scores which, as we have seen, are consistently lower for women than for men, and are higher for those in ICT occupations. The coefficient estimates represent a number of standard deviations away from the mean ICT score.

Columns 1 through 4 show that women have ICT scores comparable to those of men when we control for everything but literacy or numeracy scores, and they have higher scores when we control for these other two tests. According to the results, we find no evidence that numeracy or literacy scores are more influential on ICT scores for women

[61] Similar results without the female interaction terms are in Appendix Table A.3.5.

compared to men. Indeed, very few of the female interaction terms are statistically significant. This could be because in these estimates we do not control for differing fields of study compared with men (with the exception of broad STEM fields). There is no evidence of gender differences in ICT scores among those in ICT occupations once numeracy and literacy scores are controlled.[62]

In sum, we find that women do have marginally lower ICT scores in our sample, but these are partially the result of lower literacy and numeracy scores compared to men, both of which tend to be highly and positively correlated with ICT scores. The positive effect of numeracy and literacy on ICT scores, however, is not different between men and women. Once we control for these test scores, women on average score higher on the basic ICT skills test, equivalent to about 0.15 standard deviations.

3.5.2. Probability of employment in ICT occupations

This section addresses the probability that women are employed in ICT occupations using the broader definition of ICT.[63] Table 3.4 shows a series of linear probability models that are built up in a way that is similar to the previous table, including the female interaction variables. Here, the coefficient estimates on female are consistently negative and highly statistically significant, showing that women are less likely to work in ICT occupations. However, as expected, a one-standard-deviation increase in ICT scores is

[62] Separate regressions comparable to those in Table 3.3 were also executed with numeracy and literacy scores as the dependent variables. Estimates show that women tend to score lower than men in numeracy (about 0.20 standard deviations) and higher in literacy (about 0.15 standard deviations). The latter result is interesting because numeracy is included as a control variable and (since literacy and numeracy are positively correlated) it is these lower numeracy scores that are negatively related to the lower literacy scores, although there is no differential effect for women.

[63] Appendix Table A.3.2 contains similar results using the much narrower ICTC definition of ICT occupations.

associated with a higher probability of working in ICT of between 0.039 and 0.074, depending on model specification. The female interactions with the PIAAC scores (column 6) show that although numeracy and literacy scores do not have a differential influence for women, higher basic ICT scores are associated with a lower probability of employment in ICT for women. The estimate in column 6 suggests that women with a one-standard-deviation advantage in ICT scores have a lower probability of 0.049 of being employed in this field, and this essentially eliminates the 0.063 advantage for those with higher ICT scores. The result suggests that women who perform as well as men on the ICT tests are still less likely to be employed in this sector. Thus, there are some unobservable factors which result in lower female participation in ICT jobs (e.g., lack of interest, perceptions of hostility in these fields).

3.5.3. Differences in log-hourly wages

Whether these lower ICT scores penalize women in the labour market is addressed next. Table 3.5 contains estimates of log hourly wage equations.[64] Overall, women tend to earn about 18 percent less than their male counterparts (0.178 to 0.196 log points, depending on model specification). Female interaction variables indicate that there is no

[64] Two separate estimates without controlling for the test scores and without the female interactions are in Appendix Tables A.3.6 and A.3.7. In both cases, the results are similar to those presented here. Wage regressions similar to those in Table 3.5 were also run with six categorical ICT score variables: three variables for the range of ICT score (< 241 (omitted from the regressions), 241- < 290, ≥ 291); no computer experience (and therefore did not write the test); failed the ICT core test (i.e., a pretest to the ICT and therefore did not write); and refused to take the ICT test. This allows us to see the relationship between not having a valid ICT test score and wage. Those in the latter three categories – those who did not have a valid ICT scores – did not have hourly wages statistically different than those who scored poorly on the ICT test (i.e., < 241) once regressors were added to the model. Nor were there any statistically significant differences between male and women within each of these categories. This does not change the main results presented here. These results are in Appendix Table A.3.4.

differential effect of the variables on female hourly wages; we note that there are earnings differences between education categories but no difference between men and women in the same category of education, except for the post-secondary education below university.

In terms of those in ICT occupations, hourly wages tend to be higher, up to 0.199 log points depending on the specification. However, coefficient estimates on the female interaction show that there is no statistical difference between men and women in ICT occupations. In other words, there is an hourly wage penalty to being female, but this penalty is no higher or lower in ICT occupations. The premium to being in ICT occupations for women is eliminated by the overall female wage penalty. In column 5, for example, the wage premium for being in an ICT occupation defined by ICTC is 0.199 log points, but the penalty to being female averages 0.179 log points.

Whether these results differ between the genders is the purpose of adding the female interaction terms in Table 3.5. ICT scores are positively related to hourly wages, but coefficient values again decrease and become statistically zero once the literacy and numeracy scores are added to the model, with only the latter having a statistically significant and positive relationship with wages. The female interaction terms are almost all statistically zero, indicating that no important differences between the genders exist in terms of the correlation of the variables and wages. The female coefficient itself, however, does remain statistically negative at -0.179 log points in the fully loaded model. The female interactions with the two definitions of ICT, however, have coefficient values that are essentially zero. Again, although the gender wage differential does exist, there is no evidence that it differs in ICT occupations more than in the general labour market.

3.6. CONCLUSION AND POLICY IMPLICATIONS

Using the PIAAC and two definitions of ICT occupations, we provide several interesting insights into gender differences in basic ICT test scores, employment, and hourly wages, making comparisons between ICT occupations and other occupations.

First, consistent with other research using standardized tests, we find that women tend to have lower basic ICT scores than men. They also have lower literacy and numeracy scores in all occupations, including ICT. However, women with the same literacy and numeracy scores tend to outperform their male counterparts on the ICT test. Thus, it is lower literacy and numeracy abilities among women that are related to lower ICT abilities, at least as measured by the PIAAC. Those with more education also perform better on the ICT test, but that relationship is reversed after controlling for numeracy and literacy.

The second result relates these basic ICT scores to the probability of employment in ICT occupations. Although women are generally less likely to be in ICT occupations, those with higher ICT scores do have a higher probability of working in these professions. However, there is a stark difference between the genders: men who score one standard deviation above the mean are 6.3 percentage points more likely to be in ICT, but otherwise similar women are only about 1.4 percentage points more likely.

The third result is that ICT occupations are well paid compared with all occupations, but women are paid less in both cases; they are not at any more of an earnings disadvantage in ICT occupations. Also, while numeracy scores are positively related to earnings, basic ICT scores and literacy scores are not, and there is no difference between men and women in compensation for these test scores.

Taken together, these results cast doubt on the hypothesis of a gender imbalance in skill explaining away the gender gap in ICT occupations. Even those women with high ICT skills are less attracted than men to ICT occupations, suggesting that there are unobserved social and cultural factors that create an employment gap. Our findings regarding differences in wages show that women in ICT occupations do not have a wage gap that is greater than that in the general labour market, suggesting that pay-related issues are an unlikely driver of the ICT employment gap.

Over the past two to three decades, women have been increasingly likely to enter historically male-dominated occupations, but that cannot be said of ICT occupations. Our work suggests that the failure to enter such occupations is not explained by skill levels and earnings potential. The exploration of other possible causes is outside the scope of this chapter, but possible explanations range from a general lack of interest in entering ICT-related fields to work environments that are outright hostile to women. It is evident that the factors that dissuade women from careers in ICT need to be understood in order to tap into this pool of potential talent.

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Table 3.1. Percentage of population across various levels of basic ICT, by gender

	All individuals		ICT occupations		ICT occupations by ICTC	
	Male	Female	Male	Female	Male	Female
Proportion not taking ICT tests	16.37	15.17	4.38	4.61	3.53	3.25
Level of ICT scores						
Low (< 241 points)	13.99	14.79	5.88	7.41	4.20	5.97
Medium (241 to < 291 points)	29.53	32.17	23.93	20.58	22.25	18.69
High (≥ 291 points)	40.11	37.87	65.81	67.40	70.02	72.10

Source: PIAAC (2012) and authors' calculations.

Notes: The sample includes 16,440 individuals, aged 22 to 59. The sample excludes the Indigenous population and individuals who were listed as "uncategorized" in the reasons for not taking the ICT core test. These are weighted averages using the final sample weights provided by Statistics Canada. ICT occupations are defined in Appendix Table A1. ICTC occupations defined by the Information and Communication Technology Council (ICTC) are 15 digital economy occupations as stated in ICTC (2016b).

Table 3.2. Average characteristics of individuals who have valid basic ICT scores

	All occupations		ICT occupations		ICT occupations by ICTC	
	Male	Female	Male	Female	Male	Female
Average test scores						
Literacy	284.43	280.65	301.99	299.56	304.32	298.52
s.d.	46.19	45.51	41.11	39.27	40.25	36.34
s.e.	(0.91)	(0.99)	(2.30)	(3.71)	(3.36)	(4.05)
Numeracy	285.82	268.96	308.22	293.84	309.72	290.00
s.d.	49.85	48.44	43.41	42.70	42.81	38.00
s.e.	(0.94)	(1.06)	(2.34)	(4.42)	(3.37)	(4.59)
Basic ICT	284.94	281.73	305.92	300.97	309.83	300.50
s.d.	46.01	44.78	41.10	38.91	39.86	34.47
s.e.	(0.94)	(1.16)	(2.32)	(4.19)	(2.91)	(4.57)
Demographic characteristics						
Average hourly wage	30.99	25.68	37.16	31.56	39.01	31.03
Average age	40.07	40.23	40.09	39.71	39.45	41.35
Proportion of individuals living in						
Rural	0.16	0.15	0.09	0.06	0.07	0.06
Urban	0.84	0.85	0.91	0.94	0.93	0.94
Proportion of young immigrants	0.05	0.05	0.08	0.07	0.10	0.05
Proportion of adult immigrants	0.19	0.18	0.27	0.25	0.33	0.22
Proportion of Canadians	0.76	0.77	0.65	0.68	0.57	0.73
Education characteristics						
PSE < university level	0.40	0.39	0.40	0.39	0.39	0.35
≥ bachelor's	0.32	0.35	0.48	0.53	0.51	0.56
Individuals obtained foreign education degree	0.14	0.14	0.17	0.17	0.19	0.18
PSE < university level and graduates with STEM diploma	0.23	0.04	0.33	0.19	0.31	0.18
≥ Bachelor's and graduates with STEM degree	0.13	0.06	0.39	0.31	0.42	0.31
Proportions of individuals being employed in						
ICT occupations	0.13	0.04	--	--	--	--
ICT occupations defined by ICTC	0.08	0.02	0.57	0.57	--	--

Source: PIAAC (2012) and authors' calculations.

Notes: Standard errors are in parentheses. The sample includes 13,597 individuals, aged 22 to 59, with valid information on education, year of immigration, place of birth, and parental place of birth. These individuals have passed the information communication technology core tests and have valid problem-solving in technology-rich environment or basic ICT test scores (10 plausible values) from the PIAAC 2012. The sample excludes the Indigenous population and individuals who are categorized as "Uncategorized" in the reasons for not taking the PSTRE or basic ICT tests. We are not able to report the weighted percentages for high school graduates and high school drop-outs because the unweighted cell counts do not meet the standard set out by Statistics Canada. Young immigrants are defined as individuals who are born overseas and migrated to Canada at age 12 or younger. ICT occupations are defined in Appendix Table A.3.1. ICTC occupations defined by the Information and Communication Technology Council (ICTC) are 15 digital economy occupations as stated in ICTC (2016b).

Table 3.3. Determinants of basic ICT scores

	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.032	0.039	0.075	0.061	0.159**	0.153**
	(0.045)	(0.072)	(0.072)	(0.073)	(0.053)	(0.054)
Literacy					0.606***	0.605***
					(0.027)	(0.027)
Literacy x Female					-0.002	-0.002
					(0.034)	(0.034)
Numeracy					0.218***	0.220***
					(0.031)	(0.031)
Numeracy x Female					0.019	0.017
					(0.035)	(0.035)
Age-42	-0.021***	-0.021***	-0.020***	-0.020***	-0.013***	-0.013***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
(Age-42) x Female	-0.002	0.000	-0.000	-0.000	-0.001	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
$(\text{Age-42})^2$	-0.039	-0.026	-0.016	-0.017	0.003	0.003
	(0.021)	(0.019)	(0.019)	(0.019)	(0.014)	(0.014)
$(\text{Age-42})^2$ x Female	-0.034	-0.031	-0.040	-0.039	-0.029	-0.028
	(0.030)	(0.027)	(0.027)	(0.027)	(0.022)	(0.022)
Highest educational attainment						
< High school		-1.051***	-1.057***	-1.047***	-0.453	-0.449
		(0.290)	(0.289)	(0.290)	(0.288)	(0.288)
PSE < university level		0.175*	0.184**	0.175*	0.006	0.002
		(0.071)	(0.070)	(0.070)	(0.042)	(0.042)
≥ Bachelor's degree		0.655***	0.662***	0.659***	-0.040	-0.042
		(0.064)	(0.064)	(0.064)	(0.060)	(0.060)
< High school x Female		-0.052	-0.061	-0.058	0.037	0.037
		(0.121)	(0.121)	(0.122)	(0.077)	(0.077)
PSE < university level x Female		-0.061	-0.071	-0.061	-0.061	-0.057
		(0.085)	(0.084)	(0.084)	(0.052)	(0.052)
≥ Bachelor's degree x Female		-0.173*	-0.181*	-0.176*	-0.107	-0.105
		(0.075)	(0.075)	(0.075)	(0.058)	(0.058)
Individuals obtained degrees abroad		-0.329***	-0.311***	-0.311***	-0.044	-0.042
		(0.071)	(0.071)	(0.071)	(0.054)	(0.054)
PSE < university level and graduates with STEM diploma		0.066	0.010	0.036	-0.006	0.002
		(0.071)	(0.068)	(0.069)	(0.042)	(0.042)
Female x PSE < university level and graduates with STEM diploma		0.176	0.197	0.188	0.124	0.114
		(0.108)	(0.110)	(0.108)	(0.072)	(0.071)
≥ Bachelor's degree and graduates with STEM degree		0.209**	0.074	0.115	0.016	0.028
		(0.071)	(0.072)	(0.074)	(0.055)	(0.056)
Female x ≥ Bachelor's degree and graduates with STEM degree		0.098	0.196	0.173	0.053	0.038
		(0.101)	(0.103)	(0.102)	(0.075)	(0.076)

(continued)

Table 3.3. continued

	(1)	(2)	(3)	(4)	(5)	(6)
Individuals with missing field of study		0.335	0.352	0.338	0.314	0.309
		(0.289)	(0.287)	(0.288)	(0.280)	(0.280)
Immigration Status						
Young immigrants		-0.114	-0.129	-0.129	0.024	0.023
		(0.088)	(0.088)	(0.088)	(0.071)	(0.071)
Adult immigrants		-0.538***	-0.549***	-0.553***	-0.094	-0.096
		(0.067)	(0.067)	(0.067)	(0.055)	(0.055)
Employed in						
ICT Occupations			0.391***		0.147***	
			(0.052)		(0.041)	
ICT Occupations x Female			-0.187		-0.122	
			(0.102)		(0.074)	
ICT Occupations defined by ICTC				0.435***		0.177**
				(0.071)		(0.055)
ICT Occupations defined by ICTC x Female				-0.241*		-0.105
				(0.122)		(0.079)
Constant	0.042	-0.009	-0.055	-0.041	0.003	0.007
	(0.030)	(0.058)	(0.057)	(0.058)	(0.043)	(0.043)
Other control variables						
Provinces	N	Y	Y	Y	Y	Y
Rural/urban	N	Y	Y	Y	Y	Y
N	13597	13597	13597	13597	13597	13597
R^2	0.056	0.246	0.255	0.253	0.723	0.723

Source: PIAAC 2012. Authors' calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<.001. The sample includes a total of 13,597 individuals, aged 22 to 59, who have valid information on age at immigration, place of birth, and valid basic ICT scores. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) and footnote 57 for more information on how to calculate the error of variance.

Table 3.4. Probability of being employed in ICT occupations

	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.112***	-0.056***	-0.053***	-0.132***	-0.114***	-0.110***
	(0.010)	(0.009)	(0.010)	(0.015)	(0.027)	(0.027)
Basic ICT	0.049***	0.039***	0.038**	0.074***	0.059***	0.063***
	(0.006)	(0.006)	(0.013)	(0.008)	(0.010)	(0.019)
Basic ICT x Female				-0.055***	-0.039**	-0.049*
				(0.010)	(0.012)	(0.020)
Literacy			-0.012			-0.023
			(0.019)			(0.029)
Literacy x Female						0.021
						(0.028)
Numeracy			0.014			0.019
			(0.016)			(0.027)
Numeracy x Female						-0.009
						(0.027)
Age-42	0.000	0.000	0.000	0.001	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
(Age-42) x Female				-0.001	-0.000	-0.000
				(0.001)	(0.001)	(0.001)
$(Age-42)^2$	-0.022***	-0.018***	-0.018***	-0.030***	-0.027***	-0.027***
	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)
$(Age-42)^2$ x Female				0.017*	0.018*	0.018*
				(0.008)	(0.008)	(0.008)
Highest educational attainment						
< High school		0.090***	0.088**		0.106**	0.103*
		(0.026)	(0.028)		(0.041)	(0.044)
PSE < university level		-0.015	-0.015		-0.046*	-0.045*
		(0.011)	(0.010)		(0.020)	(0.020)
≥ Bachelor's degree		-0.031**	-0.032**		-0.066**	-0.064**
		(0.010)	(0.011)		(0.024)	(0.024)
< High school x Female					-0.006	-0.005
					(0.031)	(0.031)
PSE < university level x Female					0.055**	0.053*
					(0.021)	(0.021)
≥ Bachelor's degree x Female					0.066*	0.061*
					(0.028)	(0.029)
Individual obtained degree abroad		-0.049*	-0.049*		-0.048	-0.047*
		(0.024)	(0.024)		(0.024)	(0.024)
PSE < university level and graduates with STEM diploma		0.149***	0.147***		0.156***	0.152***
		(0.022)	(0.022)		(0.026)	(0.026)
Female x PSE < university level and graduates with STEM diploma					0.043	0.045
					(0.055)	(0.055)
≥ Bachelor's degree and graduates with STEM degree		0.336***	0.332***		0.386***	0.381***
		(0.026)	(0.026)		(0.031)	(0.032)

(continued)

Table 3.4. continued

	(1)	(2)	(3)	(4)	(5)	(6)
Female x ≥ Bachelor's degree and graduates with STEM degree					-0.155**	-0.152**
					(0.058)	(0.058)
Individuals with missing field of study		-0.086***	-0.084***		-0.101**	-0.098**
		(0.021)	(0.023)		(0.032)	(0.036)
Immigration Status						
Young immigrants		0.056*	0.057*		0.060*	0.061*
		(0.025)	(0.025)		(0.024)	(0.024)
Adult immigrants		0.057*	0.057*		0.056*	0.055*
		(0.024)	(0.024)		(0.024)	(0.024)
Constant	0.188***	0.124***	0.124***	0.197***	0.152***	0.151***
	(0.010)	(0.017)	(0.017)	(0.012)	(0.026)	(0.026)
Other control variables						
Provinces	N	Y	Y	N	Y	Y
Rural/urban	N	Y	Y	N	Y	Y
Rural/urban x female interaction terms	N	N	N	N	Y	Y
Rural/urban x basic ICT scores interactions terms	N	N	N	N	Y	Y
Rural/urban x female x basic ICT scores interaction terms	N	N	N	N	Y	Y
N	9573	9573	9573	9573	9573	9573
R^2	0.063	0.176	0.177	0.071	0.188	0.190

Source: PIAAC 2012. Authors' calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<.001. The sample includes 9,573 individuals aged 22 to 59 who have valid information on age at immigration, place of birth, valid ICT scores, and self-reported that they are employed at the time of the survey. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) and footnote 57 for more information on how to calculate the error of variance.

Table 3.5. Determinants of log hourly wages

	(1)	(2)	(3)	(4)	(5)
Female	-0.187***	-0.194***	-0.196***	-0.178***	-0.179***
	(0.022)	(0.039)	(0.039)	(0.041)	(0.040)
Basic ICT	0.131***	0.054***	0.054***	-0.007	-0.008
	(0.012)	(0.016)	(0.016)	(0.023)	(0.023)
Basic ICT x Female	0.021	-0.002	-0.001	0.001	0.001
	(0.015)	(0.020)	(0.019)	(0.031)	(0.031)
Literacy				0.003	0.001
				(0.033)	(0.033)
Literacy x Female				0.023	0.025
				(0.045)	(0.045)
Numeracy				0.083***	0.086***
				(0.025)	(0.025)
Numeracy x Female				-0.029	-0.030
				(0.038)	(0.038)
Age-42	0.015***	0.013***	0.013***	0.013***	0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
(Age-42) x Female	-0.005**	-0.003	-0.003	-0.003	-0.003
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
$(Age-42)^2$	-0.078***	-0.067***	-0.067***	-0.067***	-0.067***
	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)
$(Age-42)^2$ x Female	-0.001	0.001	0.000	0.001	0.000
	(0.015)	(0.013)	(0.013)	(0.014)	(0.014)
Highest educational attainment					
< High school		-0.201	-0.191	-0.215	-0.206
		(0.189)	(0.188)	(0.202)	(0.201)
PSE < university level		0.049	0.045	0.042	0.038
		(0.038)	(0.037)	(0.040)	(0.039)
≥ Bachelor's degree		0.364***	0.362***	0.330***	0.328***
		(0.040)	(0.039)	(0.042)	(0.041)
< High school x Female		0.001	0.000	-0.001	-0.001
		(0.078)	(0.077)	(0.078)	(0.077)
PSE < university level x Female		0.100*	0.107*	0.096*	0.103*
		(0.044)	(0.043)	(0.045)	(0.044)
≥ Bachelor's degree x Female		0.046	0.049	0.047	0.050
		(0.050)	(0.050)	(0.052)	(0.052)
Individuals obtained degrees overseas		-0.172***	-0.173***	-0.168***	-0.169***
		(0.038)	(0.037)	(0.038)	(0.038)
PSE < university level and graduates with STEM diploma		0.134***	0.143***	0.120***	0.129***
		(0.032)	(0.031)	(0.032)	(0.031)
Female x PSE < university level and graduates with STEM diploma		-0.136*	-0.127*	-0.129*	-0.120*
		(0.057)	(0.055)	(0.057)	(0.056)
≥ Bachelor's degree and graduates with STEM degree		-0.008	0.005	-0.023	-0.011
		(0.037)	(0.035)	(0.037)	(0.035)
Female x ≥ Bachelor's degree and graduates with STEM degree		-0.006	0.005	-0.001	0.010
		(0.062)	(0.064)	(0.064)	(0.065)

(continued)

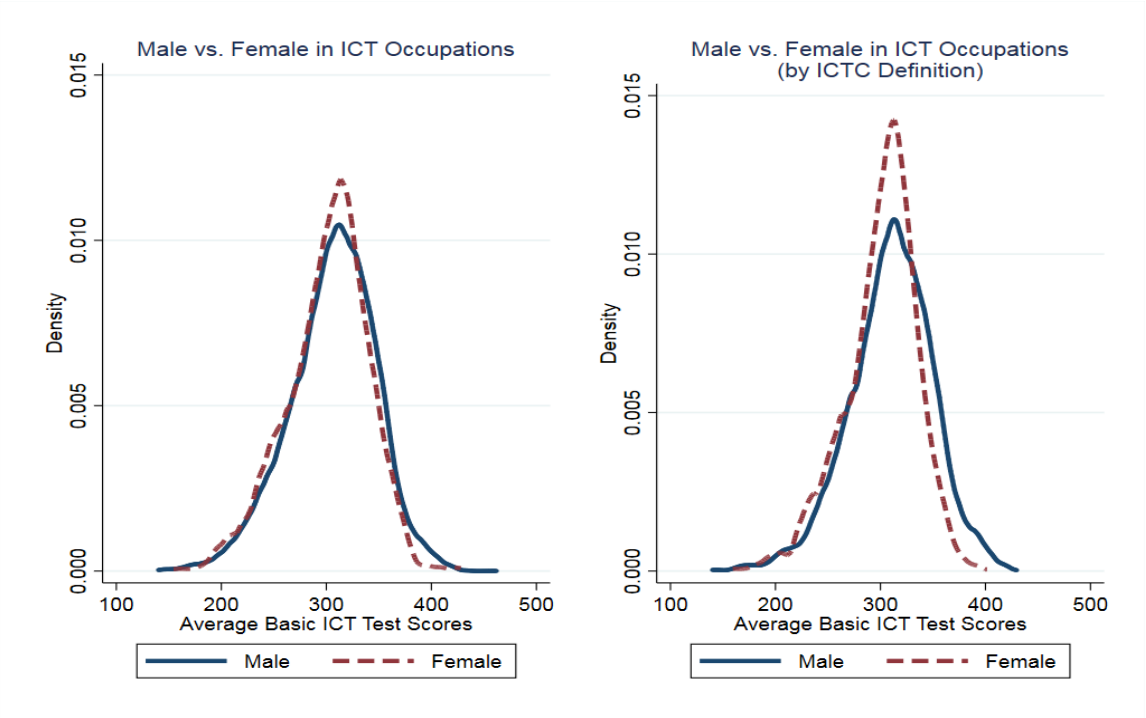
Table 3.5. continued

	(1)	(2)	(3)	(4)	(5)
Individuals with missing field of study		0.148	0.139	0.173	0.165
		(0.188)	(0.187)	(0.202)	(0.200)
Immigration Status					
Young immigrants		0.040	0.039	0.051	0.050
		(0.040)	(0.040)	(0.039)	(0.039)
Adult immigrants		-0.116***	-0.117***	-0.108**	-0.109**
		(0.035)	(0.035)	(0.035)	(0.035)
Employed in					
ICT Occupations		0.155***		0.153***	
		(0.031)		(0.031)	
ICT Occupations x Female		0.025		0.023	
		(0.046)		(0.046)	
ICT Occupations defined by ICTC			0.199***		0.199***
			(0.030)		(0.030)
ICT Occupations defined by ICTC x Female			-0.033		-0.032
			(0.055)		(0.056)
Constant	3.402***	3.248***	3.251***	3.252***	3.256***
	(0.015)	(0.034)	(0.033)	(0.034)	(0.033)
Other control variables					
Provinces	N	Y	Y	Y	Y
Rural/urban	N	Y	Y	Y	Y
Rural/urban x female interaction terms	N	Y	Y	Y	Y
Rural/urban x basic ICT scores interactions terms	N	Y	Y	Y	Y
Rural/urban x female x basic ICT scores interaction terms	N	Y	Y	Y	Y
N	9573	9573	9573	9573	9573
R^2	0.186	0.302	0.301	0.31	0.309

Source: PIAAC 2012. Authors' calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<.001. The sample includes 9,573 individuals aged 22 to 59 who have valid information on age at immigration, place of birth, valid ICT scores, and positive self-reported earnings. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) for more information on how to calculate the error of variance.

Figure 3.1. Distributions of men's and women's ICT scores, by ICT occupational definition



Source: Authors' calculations using PIAAC 2012.

APPENDIX

Table A.3.1. Information Communication Technology occupations in the 2011 National Occupational Classification

NOC 2011 (4-digit code)	Description
0131	**Telecommunication carriers' managers**
0211	Engineer managers
0212	Architecture and science managers
0213	**Computer and information systems managers**
1254	Statistical officers and related research support occupations
2111	Physicists and astronomers
2114	Meteorologists and climatologists
2115	Other professional occupations in physical sciences
2131	Civil engineering technologists and technicians
2132	Mechanical engineering technologists and technicians
2133	**Electrical and electronics engineers**
2134	Chemical engineers
2141	Industrial and manufacturing engineers
2142	Metallurgical and material engineers
2143	Mining engineers
2144	Geological engineers
2145	Petroleum engineers
2146	Aerospace engineers
2147	**Computer engineers (except software engineers and designers)**
2148	Other professional engineers, n.e.c.
2151	Architects
2152	Landscape architects
2154	Land surveyors

2161	Mathematicians, statisticians, and actuaries
2171	**Information systems analysts and consultants**
2172	**Database analysts and data administrator**
2173	**Software engineers and designers**
2174	**Computer programmers and interactive media developers**
2175	**Web designers and developers**
2211	Chemical technologists and technicians
2212	Geological and mineral technologists and technicians
2221	Biological technologists and technicians
2223	Forestry technologists and technicians
2231	Civil engineering technologists and technicians
2232	Mechanical engineering technologists and technicians
2233	Industrial engineering and manufacturing technologists and technicians
2241	**Electrical and electronics engineering technologists and technicians**
2243	Industrial instruments technicians and mechanics
2244	Aircraft instrument, electrical and avionics mechanics, technicians, and inspectors
2251	Architectural technologists and technicians
2253	Drafting technologists and technicians
2255	Technical occupations in geomatics and meteorology
2261	Non-destructive testers and inspection technicians
2262	Engineering inspectors and regulatory officers
2281	**Computer network technicians**
2282	**User support technicians**
2283	**Information systems testing technicians**
5224	**Broadcast technicians**
5225	Audio and video recording technicians

5226	Other technical and coordinating occupations in motion pictures, broadcasting and the performing
5241	**Graphic designer and illustrators**
6221	Technical sales specialists – wholesale trade
7315	Aircraft mechanics and aircraft inspectors

Source: O*NET (2017) and ICTC (2016b).

Note: Bolded items are ICT occupations defined by the Information and Communications Technology Council

Table A.3.2. Probability of being employed in ICT occupations defined by ICTC

	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.061***	-0.031***	-0.031***	-0.077***	-0.071**	-0.070**
	(0.008)	(0.008)	(0.008)	(0.011)	(0.022)	(0.022)
Basic ICT	0.031***	0.027***	0.030**	0.048***	0.044***	0.050**
	(0.004)	(0.005)	(0.010)	(0.006)	(0.009)	(0.017)
Basic ICT x Female				-0.037***	-0.028**	-0.034*
				(0.007)	(0.010)	(0.017)
Literacy			-0.004			-0.009
			(0.010)			(0.017)
Literacy x Female						0.009
						(0.018)
Numeracy			-0.000			0.001
			(0.009)			(0.016)
Numeracy x Female						-0.003
						(0.016)
Age-42	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
(Age-42) x Female				0.000	0.001	0.001
				(0.001)	(0.001)	(0.001)
$(\text{Age-42})^2$	-0.015***	-0.013***	-0.013***	-0.023***	-0.022***	-0.022***
	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
$(\text{Age-42})^2$ x Female				0.015*	0.016**	0.016**
				(0.006)	(0.006)	(0.006)
Highest educational attainment						
< High school		0.032*	0.032*		0.031	0.032
		(0.014)	(0.015)		(0.022)	(0.024)
PSE < university level		-0.007	-0.007		-0.012	-0.011
		(0.009)	(0.009)		(0.018)	(0.018)
≥ Bachelor's degree		-0.024**	-0.022*		-0.044*	-0.041*
		(0.008)	(0.009)		(0.018)	(0.019)
< High school x Female					-0.004	-0.004
					(0.014)	(0.014)
PSE < university level x Female					0.010	0.009
					(0.018)	(0.018)
≥ Bachelor's degree x Female					0.039	0.036
					(0.022)	(0.023)
Individual obtained degree abroad		-0.033	-0.033		-0.031	-0.031
		(0.018)	(0.018)		(0.018)	(0.018)

(continued)

Table A.3.2. continued

	(1)	(2)	(3)	(4)	(5)	(6)
PSE < university level graduates with STEM diploma		0.075***	0.075***		0.074***	0.073***
		(0.014)	(0.014)		(0.019)	(0.019)
Female x PSE < university level and graduates with STEM diploma					0.031	0.032
					(0.038)	(0.038)
≥ Bachelor's degree graduates with STEM degree		0.192***	0.192***		0.232***	0.231***
		(0.025)	(0.025)		(0.032)	(0.032)
Female x ≥ Bachelor's degree graduates with STEM degree					-0.125*	-0.124*
					(0.055)	(0.055)
Individuals with missing field of study		-0.033*	-0.034*		-0.033	-0.034
		(0.014)	(0.016)		(0.023)	(0.026)
Immigration Status						
Young immigrants		0.047*	0.047*		0.051*	0.051*
		(0.023)	(0.023)		(0.023)	(0.023)
Adult immigrants		0.050**	0.049**		0.050**	0.049**
		(0.019)	(0.019)		(0.019)	(0.019)
Constant	0.107***	0.082***	0.082***	0.114***	0.100***	0.099***
	(0.008)	(0.015)	(0.015)	(0.010)	(0.022)	(0.022)
Other control variables						
Provinces	N	Y	Y	N	Y	Y
Rural/urban	N	Y	Y	N	Y	Y
Rural/urban x female interaction terms	N	N	N	N	Y	Y
Rural/urban x basic ICT scores interactions terms	N	N	N	N	Y	Y
Rural/urban x female x basic ICT scores interaction terms	N	N	N	N	Y	Y
N	9573	9573	9573	9573	9573	9573
R^2	0.039	0.112	0.112	0.046	0.125	0.126

Source: PIAAC 2012. Author's calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<.001. The sample includes 9,573 individuals aged 22 to 59 who have valid information on age at immigration, place of birth, valid ICT scores, and self-reported that they are employed at the time of the survey. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) and footnote 57 for more information on how to calculate the error of variance.

Table A.3.3. Determinants of basic ICT scores, without female interactions

	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.069*	-0.061*	-0.045	-0.051	0.076***	0.075***
	(0.029)	(0.026)	(0.026)	(0.026)	(0.022)	(0.022)
Literacy					0.605***	0.604***
					(0.020)	(0.020)
Numeracy					0.228***	0.229***
					(0.024)	(0.024)
Age-42	-0.023***	-0.020***	-0.020***	-0.020***	-0.013***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$(Age-42)^2$	-0.056***	-0.042***	-0.036**	-0.037**	-0.011	-0.011
	(0.014)	(0.012)	(0.012)	(0.012)	(0.010)	(0.010)
Highest educational attainment						
< High school		-1.067***	-1.076***	-1.068***	-0.433	-0.430
		(0.287)	(0.286)	(0.287)	(0.282)	(0.282)
PSE < university level		0.144***	0.147***	0.145***	-0.027	-0.028
		(0.041)	(0.041)	(0.041)	(0.029)	(0.030)
≥ Bachelor's degree		0.556***	0.557***	0.557***	-0.100*	-0.101*
		(0.044)	(0.044)	(0.044)	(0.046)	(0.046)
Individuals obtained degrees abroad		-0.326***	-0.308***	-0.310***	-0.043	-0.042
		(0.071)	(0.071)	(0.071)	(0.054)	(0.054)
PSE < university level graduates with STEM diploma		0.092	0.046	0.066	0.023	0.027
		(0.054)	(0.052)	(0.054)	(0.036)	(0.036)
Bachelor's degree and above graduates with STEM degree		0.269***	0.172**	0.206***	0.050	0.056
		(0.051)	(0.053)	(0.053)	(0.039)	(0.039)
Individuals with missing field of study		0.323	0.339	0.329	0.308	0.305
		(0.294)	(0.292)	(0.293)	(0.282)	(0.282)
Immigration status						
Young immigrants		-0.117	-0.128	-0.128	0.024	0.023
		(0.088)	(0.089)	(0.088)	(0.072)	(0.071)
Adult immigrants		-0.539***	-0.549***	-0.550***	-0.092	-0.093
		(0.067)	(0.067)	(0.067)	(0.055)	(0.055)
Employed in						
ICT Occupations			0.336***		0.111**	
			(0.048)		(0.039)	
ICT Occupations defined by ICTC				0.367***		0.148**
				(0.061)		(0.049)
Constant	0.061**	0.044	0.008	0.017	0.044	0.045
	(0.023)	(0.042)	(0.042)	(0.042)	(0.035)	(0.034)

(*continued)*

Table A.3.3. continued

	(1)	(2)	(3)	(4)	(5)	(6)
Other control variables						
Provinces	N	Y	Y	Y	Y	Y
Rural/urban	N	Y	Y	Y	Y	Y
N	13597	13597	13597	13597	13597	13597
R^2	0.055	0.245	0.252	0.25	0.722	0.722

Source: PIAAC 2012. Authors' calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<0.001. The sample includes 13,597 individuals, aged 22 to 59, who have valid information on age at immigration, place of birth, and valid PSTRE scores. The omitted group is a 42-year-old individual who is born in Canada, regardless of his/her parental place of birth, with a Canadian high school diploma as the highest educational attainment and lives in large urban in Ontario. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) and footnote 57 for more information on how to calculate the error of variance.

Table A.3.4. Determinants of log hourly wages, without controlling for test scores

	(1)	(2)	(3)	(4)	(5)
Female	-0.183***	-0.168***	-0.172***	-0.198***	-0.200***
	(0.018)	(0.018)	(0.018)	(0.039)	(0.038)
Age-42	0.009***	0.010***	0.010***	0.012***	0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
(Age-42) x Female				-0.003*	-0.003*
				(0.001)	(0.001)
$(Age-42)^2$	-0.088***	-0.071***	-0.071***	-0.070***	-0.070***
	(0.008)	(0.007)	(0.007)	(0.010)	(0.010)
$(Age-42)^2$ x Female				-0.000	-0.001
				(0.013)	(0.013)
Highest educational attainment					
< High school		-0.281	-0.273	-0.251	-0.241
		(0.189)	(0.188)	(0.195)	(0.194)
PSE < university level		0.117***	0.116***	0.057	0.052
		(0.025)	(0.025)	(0.038)	(0.037)
≥ Bachelor's degree		0.428***	0.428***	0.401***	0.400***
		(0.024)	(0.024)	(0.037)	(0.037)
< High school x Female				-0.022	-0.021
				(0.075)	(0.074)
PSE < university level x Female				0.101*	0.109*
				(0.043)	(0.043)
≥ Bachelor's degree x Female				0.046	0.049
				(0.049)	(0.048)
Individual obtained degree abroad		-0.184***	-0.187***	-0.184***	-0.186***
		(0.038)	(0.038)	(0.039)	(0.038)
PSE < university level graduates with STEM diploma		0.094***	0.106***	0.138***	0.150***
		(0.026)	(0.026)	(0.033)	(0.032)
Female x PSE < university level graduates with STEM diploma				-0.121*	-0.112*
				(0.056)	(0.055)
≥ Bachelor's degree graduates with STEM degree		-0.009	0.012	-0.006	0.011
		(0.030)	(0.028)	(0.037)	(0.035)
Female x ≥ Bachelor's degree graduates with STEM degree				0.003	0.012
				(0.063)	(0.065)
Individual with missing field of study		0.183	0.174	0.156	0.146
		(0.190)	(0.190)	(0.194)	(0.193)
Immigration status					
Young immigrants		0.032	0.032	0.030	0.029
		(0.041)	(0.041)	(0.041)	(0.041)

(continued)

Table A.3.4. continued

	(1)	(2)	(3)	(4)	(5)
Adult immigrants		-0.152***	-0.153***	-0.152***	-0.154***
		(0.034)	(0.034)	(0.034)	(0.034)
Being employed in					
ICT occupations		0.180***		0.178***	
		(0.025)		(0.030)	
ICT occupations x Female				0.015	
				(0.046)	
ICT occupations defined by ICTC			0.206***		0.225***
			(0.026)		(0.031)
ICT occupations defined by ICTC x Female					-0.049
					(0.054)
Constant	3.409***	3.232***	3.237***	3.247***	3.251***
	(0.014)	(0.028)	(0.027)	(0.033)	(0.032)
Other control variables					
Provinces	N	Y	Y	Y	Y
Rural/urban	N	Y	Y	Y	Y
Rural/urban x Female interaction terms	N	N	N	Y	Y
N	9573	9573	9573	9573	9573
R^2	0.118	0.285	0.283	0.288	0.287

Source: PIAAC 2012. Authors' calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<.001. The sample includes 9,573 individuals aged 22 to 59 who have valid information on age at immigration, place of birth, valid ICT scores, and self-reported that they are employed at the time of the survey. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) and footnote 57 for more information on how to calculate the error of variance.

Table A.3.5. The economics returns to basic ICT scores, without female interactions

	(1)	(2)	(3)	(4)	(5)
Female	-0.175***	-0.165***	-0.168***	-0.147***	-0.150***
	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)
Basic ICT	0.141***	0.064***	0.066***	0.004	0.005
	(0.009)	(0.010)	(0.010)	(0.018)	(0.018)
Literacy				0.014	0.013
				(0.022)	(0.022)
Numeracy				0.070***	0.072***
				(0.017)	(0.017)
Age-42	0.012***	0.012***	0.012***	0.011***	0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$(Age-42)^2$	-0.079***	-0.068***	-0.069***	-0.068***	-0.068***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Highest educational attainment					
< High school		-0.221	-0.212	-0.231	-0.224
		(0.182)	(0.182)	(0.197)	(0.196)
PSE < university level		0.107***	0.106***	0.098***	0.097***
		(0.025)	(0.025)	(0.026)	(0.025)
≥ Bachelor's degree		0.390***	0.389***	0.357***	0.356***
		(0.026)	(0.025)	(0.027)	(0.027)
Individual obtained degree abroad		-0.169***	-0.171***	-0.164***	-0.165***
		(0.038)	(0.038)	(0.038)	(0.038)
PSE < university level graduates with STEM diploma		0.091***	0.101***	0.081**	0.090***
		(0.026)	(0.026)	(0.025)	(0.025)
≥ Bachelor's degree graduates with STEM degree		-0.018	0.001	-0.030	-0.013
		(0.030)	(0.028)	(0.029)	(0.027)
Individual with missing field of study		0.168	0.161	0.190	0.183
		(0.184)	(0.183)	(0.199)	(0.198)
Immigration Status					
Young immigrants		0.043	0.043	0.054	0.054
		(0.040)	(0.040)	(0.039)	(0.039)
Adult immigrants		-0.112**	-0.112**	-0.104**	-0.104**
		(0.035)	(0.035)	(0.035)	(0.035)
Employed in					
ICT occupations		0.158***		0.156***	
		(0.026)		(0.026)	
ICT occupations defined by ICTC			0.180***		0.182***
			(0.025)		(0.025)
Constant	3.395***	3.231***	3.236***	3.237***	3.241***
	(0.014)	(0.029)	(0.028)	(0.028)	(0.028)

(continued)

Table A.3.5. continued

	(1)	(2)	(3)	(4)	(5)
Other control variables					
Provinces	N	Y	Y	Y	Y
Rural/Urban	N	Y	Y	Y	Y
N	9573	9573	9573	9573	9573
R^2	0.183	0.296	0.295	0.304	0.303

Source: PIAAC 2012. Authors' calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<.001. The sample includes 9,573 individuals aged 22 to 59 who have valid information on age at immigration, place of birth, valid ICT scores, and self-reported that they are employed at the time of the survey. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) and footnote 57 for more information on how to calculate the error of variance.

Table A.3.6. Economics returns to different levels of basic ICT skills, without female interactions

	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.187***	-0.183***	-0.175***	-0.178***	-0.175***	-0.160***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Literacy						0.004
						(0.016)
Numeracy						0.067***
						(0.015)
Levels of basic ICT						
No computer experience	-0.244***	-0.100	-0.095	-0.099	-0.095	-0.082
	(0.052)	(0.054)	(0.054)	(0.054)	(0.054)	(0.053)
Failed ICT core stage 1	0.050	0.027	0.027	0.028	0.027	0.010
	(0.036)	(0.033)	(0.033)	(0.033)	(0.033)	(0.032)
Refused ICT tests	-0.022	0.006	0.008	0.006	0.008	-0.028
	(0.032)	(0.029)	(0.029)	(0.029)	(0.029)	(0.034)
Medium (241 - below 291)	0.220***	0.134***	0.130***	0.130***	0.130***	0.074**
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.025)
High (above 291)	0.397***	0.210***	0.195***	0.198***	0.195***	0.086**
	(0.023)	(0.025)	(0.025)	(0.025)	(0.025)	(0.033)
Age-42	0.012***	0.012***	0.011***	0.011***	0.011***	0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$(\text{Age-42})^2$	-0.074***	-0.068***	-0.066***	-0.066***	-0.066***	-0.066***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Highest educational attainment						
< high school		-0.150	-0.160	-0.153	-0.160	-0.158
		(0.129)	(0.130)	(0.129)	(0.130)	(0.129)
PSE < university level		0.105***	0.107***	0.106***	0.107***	0.097***
		(0.025)	(0.025)	(0.024)	(0.025)	(0.025)
≥ Bachelor's degree		0.377***	0.381***	0.381***	0.381***	0.345***
		(0.025)	(0.025)	(0.024)	(0.025)	(0.026)
Individual obtained degree abroad		-0.173***	-0.166***	-0.167***	-0.166***	-0.155***
		(0.036)	(0.036)	(0.035)	(0.036)	(0.036)
PSE < university level graduates with STEM diploma		0.107***	0.086**	0.094***	0.086**	0.082**
		(0.026)	(0.026)	(0.026)	(0.026)	(0.025)
≥ Bachelor's degree graduates with STEM degree		0.056*	0.002	0.022	0.002	0.002
		(0.028)	(0.031)	(0.029)	(0.031)	(0.028)
Individual with missing field of study		0.093	0.102	0.097	0.102	0.127
		(0.133)	(0.134)	(0.133)	(0.134)	(0.133)

(continued)

Table A.3.6. continued

	(1)	(2)	(3)	(4)	(5)	(6)
Immigration Status						
Young immigrants		0.034	0.027	0.027	0.027	0.040
		(0.038)	(0.037)	(0.037)	(0.037)	(0.036)
Adult immigrants		-0.119***	-0.125***	-0.126***	-0.125***	-0.108**
		(0.034)	(0.033)	(0.033)	(0.033)	(0.033)
Employed in						
ICT Occupations			0.156***		0.156***	
			(0.025)		(0.025)	
ICT Occupations defined by ICTC				0.180***		0.177***
				(0.025)		(0.024)
Constant	3.130***	3.111***	3.101***	3.104***	3.101***	3.180***
	(0.023)	(0.033)	(0.033)	(0.033)	(0.033)	(0.037)
Other control variables						
Provinces	N	Y	Y	Y	Y	Y
Rural/urban	N	Y	Y	Y	Y	Y
N	11107	11107	11107	11107	11107	11107
R^2	0.186	0.295	0.302	0.301	0.302	0.309

Source: PIAAC 2012. Authors' calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<.001. The sample includes 11,107 individuals aged 22 to 59 who have valid information on age at immigration, place of birth, and self-reported that they are employed at the time of the survey. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) and footnote 57 for more information on how to calculate the error of variance.

Table A.3.7. Economics returns to different levels of basic ICT skills, including female interaction terms

	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.189***	-0.159***	-0.155***	-0.154***	-0.139**	-0.136**
	(0.035)	(0.045)	(0.044)	(0.044)	(0.053)	(0.053)
Literacy					-0.011	-0.012
					(0.025)	(0.025)
Numeracy					0.082***	0.084***
					(0.023)	(0.023)
Literacy x female					0.034	0.035
					(0.038)	(0.038)
Numeracy x female					-0.035	-0.035
					(0.036)	(0.036)
Levels of basic ICT						
No computer experience	-0.268***	-0.091	-0.087	-0.090	-0.056	-0.058
	(0.054)	(0.096)	(0.095)	(0.095)	(0.098)	(0.098)
Failed ICT core stage 1	0.083	0.077	0.072	0.077	0.056	0.061
	(0.050)	(0.063)	(0.063)	(0.062)	(0.061)	(0.059)
Refused ICT test	-0.012	0.050	0.054	0.053	0.027	0.026
	(0.050)	(0.069)	(0.069)	(0.069)	(0.073)	(0.073)
Medium (241 - < 291)	0.241***	0.202***	0.191***	0.192***	0.137**	0.137**
	(0.027)	(0.043)	(0.042)	(0.042)	(0.043)	(0.043)
High ((≥ 291)	0.384***	0.229***	0.206***	0.206***	0.093*	0.092
	(0.028)	(0.041)	(0.041)	(0.041)	(0.047)	(0.048)
No computer experience x Female	0.048	0.115	0.115	0.117	0.084	0.085
	(0.111)	(0.175)	(0.174)	(0.175)	(0.178)	(0.179)
Failed ICT core stage 1 x Female	-0.084	-0.094	-0.086	-0.094	-0.096	-0.104
	(0.072)	(0.079)	(0.078)	(0.077)	(0.075)	(0.074)
Refused ICT test x Female	-0.020	-0.113	-0.116	-0.116	-0.127	-0.127
	(0.073)	(0.086)	(0.085)	(0.085)	(0.086)	(0.085)
Medium (241 - < 291) x Female	-0.040	-0.090	-0.079	-0.081	-0.082	-0.084
	(0.039)	(0.051)	(0.050)	(0.050)	(0.052)	(0.053)
High (≥ 291) x Female	0.025	-0.052	-0.038	-0.037	-0.037	-0.037
	(0.037)	(0.046)	(0.045)	(0.046)	(0.054)	(0.055)
Age-42	0.014***	0.013***	0.013***	0.013***	0.012***	0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
(Age-42) x Female	-0.005**	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$(Age-42)^2$	-0.074***	-0.072***	-0.069***	-0.068***	-0.068***	-0.068***
	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
$(Age-42)^2$ x Female	0.002	0.008	0.005	0.004	0.006	0.005
	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)

(continued)

Table A.3.7. continued

	(1)	(2)	(3)	(4)	(5)	(6)
Highest educational attainment						
< high school		-0.146	-0.157	-0.149	-0.164	-0.158
		(0.134)	(0.136)	(0.135)	(0.134)	(0.133)
PSE < university level		0.042	0.047	0.044	0.040	0.037
		(0.037)	(0.036)	(0.036)	(0.038)	(0.037)
≥ Bachelor's degree		0.342***	0.352***	0.351***	0.315***	0.314***
		(0.038)	(0.037)	(0.037)	(0.039)	(0.039)
< high school x Female		-0.017	-0.017	-0.017	-0.017	-0.017
		(0.062)	(0.063)	(0.062)	(0.064)	(0.063)
PSE < university level x Female		0.111**	0.104**	0.110**	0.101*	0.106**
		(0.040)	(0.040)	(0.039)	(0.041)	(0.040)
≥ Bachelor's degree x Female		0.062	0.053	0.055	0.054	0.056
		(0.049)	(0.048)	(0.048)	(0.049)	(0.049)
Individual obtained degree abroad		-0.178***	-0.171***	-0.173***	-0.160***	-0.161***
		(0.036)	(0.035)	(0.035)	(0.036)	(0.035)
PSE < university level graduates with STEM diploma		0.153***	0.132***	0.140***	0.117***	0.123***
		(0.033)	(0.033)	(0.032)	(0.032)	(0.032)
Female x PSE < university level graduates with STEM diploma		-0.128*	-0.144**	-0.132*	-0.138*	-0.127*
		(0.053)	(0.055)	(0.054)	(0.056)	(0.055)
≥ Bachelor's degree graduates with STEM degree		0.081*	0.021	0.035	0.000	0.013
		(0.033)	(0.038)	(0.035)	(0.038)	(0.034)
Female x ≥ Bachelor's degree graduates with STEM degree		-0.045	-0.029	-0.015	-0.021	-0.008
		(0.059)	(0.060)	(0.061)	(0.061)	(0.061)
Individual with missing field of study		0.094	0.103	0.097	0.137	0.132
		(0.138)	(0.138)	(0.138)	(0.137)	(0.136)
Immigration Status						
Young immigrants		0.032	0.025	0.023	0.039	0.038
		(0.038)	(0.038)	(0.038)	(0.036)	(0.036)
Adult immigrants		-0.120***	-0.126***	-0.128***	-0.108***	-0.109***
		(0.033)	(0.032)	(0.032)	(0.032)	(0.032)
Employed in						
ICT Occupations			0.152***		0.145***	
			(0.031)		(0.031)	
ICT Occupations x Female			0.036		0.037	
			(0.045)		(0.044)	

(continued)

Table A.3.7. continued

	(1)	(2)	(3)	(4)	(5)	(6)
ICT Occupations defined by ICTC				0.200***		0.195***
				(0.030)		(0.030)
ICT Occupations defined by ICTC x Female				-0.036		-0.028
				(0.054)		(0.055)
Constant	3.131***	3.093***	3.086***	3.088***	3.161***	3.164***
	(0.024)	(0.043)	(0.042)	(0.042)	(0.047)	(0.047)
Other control variables						
Provinces	N	Y	Y	Y	Y	Y
Rural/urban	N	Y	Y	Y	Y	Y
Rural/urban x Female interaction terms	N	Y	Y	Y	Y	Y
Rural/urban x basic ICT scores interactions terms	N	Y	Y	Y	Y	Y
Rural/urban x Female x basic ICT scores interaction terms	N	Y	Y	Y	Y	Y
N	11107	11107	11107	11107	11107	11107
R^2	0.190	0.304	0.311	0.310	0.320	0.319

Source: PIAAC 2012. Authors' calculations.

Notes: Standard errors are in parentheses: * p<.05, ** p<.01, *** p<.001. The sample includes 11,107 individuals aged 22 to 59 who have valid information on age at immigration, place of birth, and self-reported that they are employed at the time of the survey. Standard errors are jackknifed using all replicate weights and plausible values. Please refer to OECD (2013) and footnote 57 for more information on how to calculate the error of variance.

CONCLUSION

This thesis consists of three chapters in the realm of labour economics and applied econometrics, with a focus on the effects of fundamental skills on the earnings of immigrants and non-immigrants in the Canadian labour market. All three chapters use the PIAAC 2012 to explore the inequality in foundational and "key information-processing" skills, which are necessary to build other complex skills, in Canadian society.

The first two essays employ self-reported admission categories in the Canadian PIAAC 2012 to study how immigrants and the Canadian-born differ in literacy, numeracy, and basic ICT skills, and how these skills are valued in the Canadian labour market. Unlike earlier research treating immigrants as a homogenous group, the PIAAC 2012 helps address the heterogeneity in skills among immigrants by allowing for the grouping of immigrants by admission category. Canadian-born individuals are grouped into the second- and third-generation based on their parental place of birth. This feature of the data is crucial as Canada is known as a major immigrant-receiving country and has a diverse set of immigration policies in relation to the admission of immigrants in four broad categories: economic immigrants, family-reunification class, refugees, and "other." In the last chapter, the underrepresentation of women in the ICT sector is examined. As Canada enters the digital and knowledge-based economy, it demands all aspects of ICT-related skills. Women represent a largely untapped pool of potential talent due to their low participation rate in ICT. Thus, chapter 3 contrasts the general-computer skills – measured by the PSTRE in the PIAAC 2012 – between men and women. The focus is on the rates of return to general

computer skills in the Canadian labour market as between men and women and the probability of women taking part in the ICT occupations.

In Chapter 1, although male points-based immigrants are more likely to have jobs involving complex ICT skills and computer programming, these individuals are on average less proficient in general-purpose technology skills than third-generation Canadians. Young immigrants have basic ICT skills comparable to those of the third-generation. The analysis suggests that a one-standard-derivation increase in basic ICT scores, on average, is associated with seven percent higher earnings for both genders. The Canadian labour market rewards general-purpose ICT skills proficiency at an equal rate between immigrants and Canadian non-immigrants groups within each gender. Even though the findings in the chapter are non-causal, the results point to the considerable economic value of ICT skills beyond the most basic skills levels for immigrants and the Canadian born. If the results in the first chapter reflect, even in part, a causal impact of these skills, then programs to provide very basic ICT skills could have sizable rates of return.

Chapter 2 shows that both adult and young immigrants are, on average, outperformed in literacy and numeracy by those born in Canada. Economic class immigrants have higher test scores and hourly wages among all immigration categories. Differences in literacy and numeracy scores between population subgroups are quantitatively unchanged across the distribution of skills for the class of immigrants who are highly educated, while classes of immigrants with lower levels of educational attainment experience as an increasing trend in test score gaps across quantiles. Controlling for literacy and numeracy (separately or jointly) reduces the earnings gap between groups

of immigrants and the Canadian-born. Controlling for these test scores also reduces the returns to a university degree obtained in Canada. Furthermore, numeracy scores can be independently enumerated in the Canadian labour market when both test scores are accounted for jointly in the earnings regression. Young immigrants face earnings disadvantages compared to the third generation in each respective gender, and these disadvantages could be linked with an intergenerational channel.

In the last chapter, several interesting insights into gender differentials in basic ICT scores, employment, and hourly wages are observed. Women at a similar level of proficiency in literacy and numeracy scores, on average, outperform their male counterparts on PSTRE tests. Even though women are less likely to be employed in ICT occupations, those with higher general-purpose technology skills tend to have a higher likelihood of working in these professions. The effects of basic ICT skills on the probability of being employed in the ICT occupations are starkly different between men and women. Men with a score of one standard deviation above the mean are 6.3 percentage points more likely to work in ICT, while women with the same score are only about 1.4 percentage points more likely to do so. Furthermore, the earnings gap between men and women in ICT occupations is similar to the gap in all other occupations, suggesting that pay-related issues are not a driver of the gender gap in ICT employment.

Overall, this thesis contributes to the current literature in multiple dimensions. The first two essays contrast diverse types of basic skills between immigrants (by immigration category) and Canadian-born individuals which is a first in the Canadian literature. They also extend the current literature studying the labour market outcomes of immigrants in the

host country to gain a deeper understanding of how basic skills are valued across immigration categories. Also, of relevance is the growing literature showing the importance of basic skills for earnings and the literature pointing to the importance of language skills on labour market outcomes. Understanding the skills differences and earnings gaps between immigrants and Canadian non-immigrants are crucial to inform policy-makers and to help them (re)shape relevant immigration and assimilation policies. Lastly, Chapter 3 extends the literature focusing on the underrepresentation of women in male-dominated occupations in general, and Canada's ICT sector in particular, by comparing their general-purpose technology skills, the probability of being employed in the ICT sector, and the earnings gap compared to their male counterparts.