

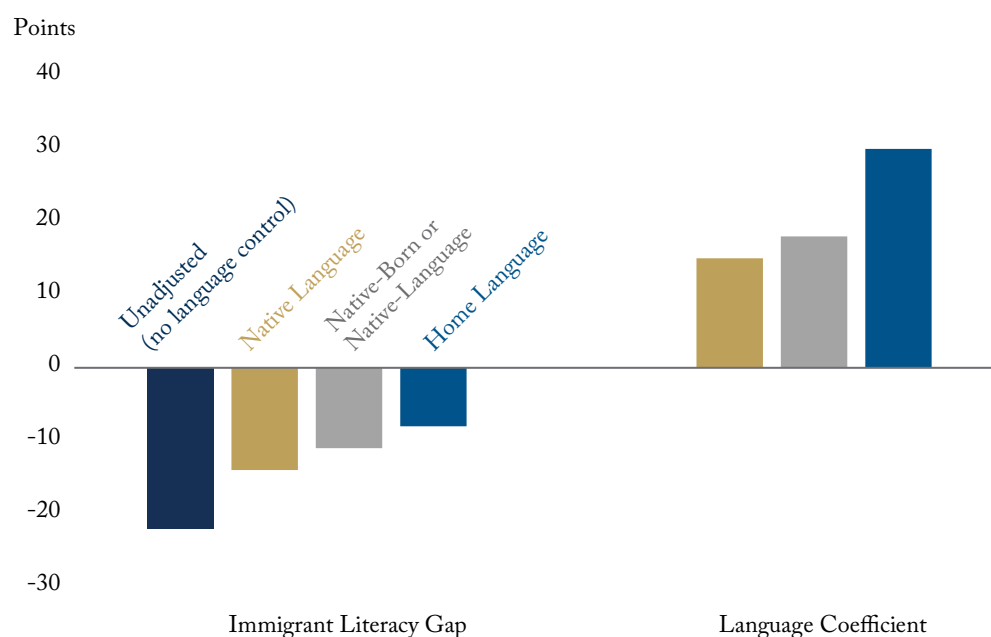
A MATTER OF DEGREES: UNDERSTANDING IMMIGRANT SKILLS AND LABOUR-MARKET OUTCOMES

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ONLINE APPENDIX

APPENDIX A

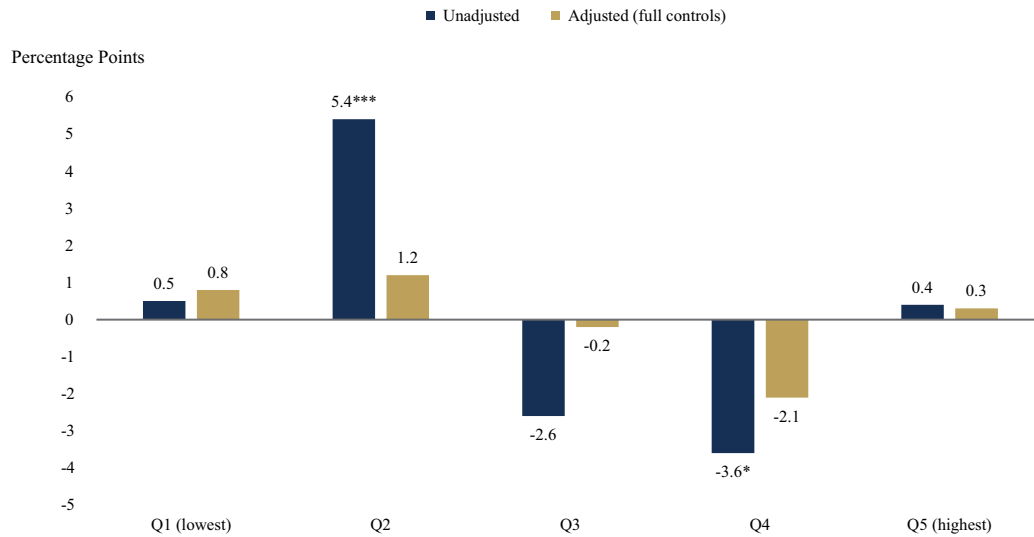
Figure A1: Immigrant Literacy Gap and Language Coefficient by Language Variable (Ages 25-65)



Notes: Native language represents whether the test language (French or English) is the same as the respondent's native language. Home language represents whether the test language is the same as the language spoken most often at home. Native-born or native language represents whether the respondent is either native-born or speaks a native language, as opposed to foreign-born with foreign language respondents who do not. All estimated parameters are statistically significant at the 1 percent level.

Source: Author's estimates using PIAAC 2023 Canada Public Use File.

Figure A2: Difference in the Share of Immigrant and Non-Immigrant Employees in Each Earnings Quintile, Unadjusted and Adjusted



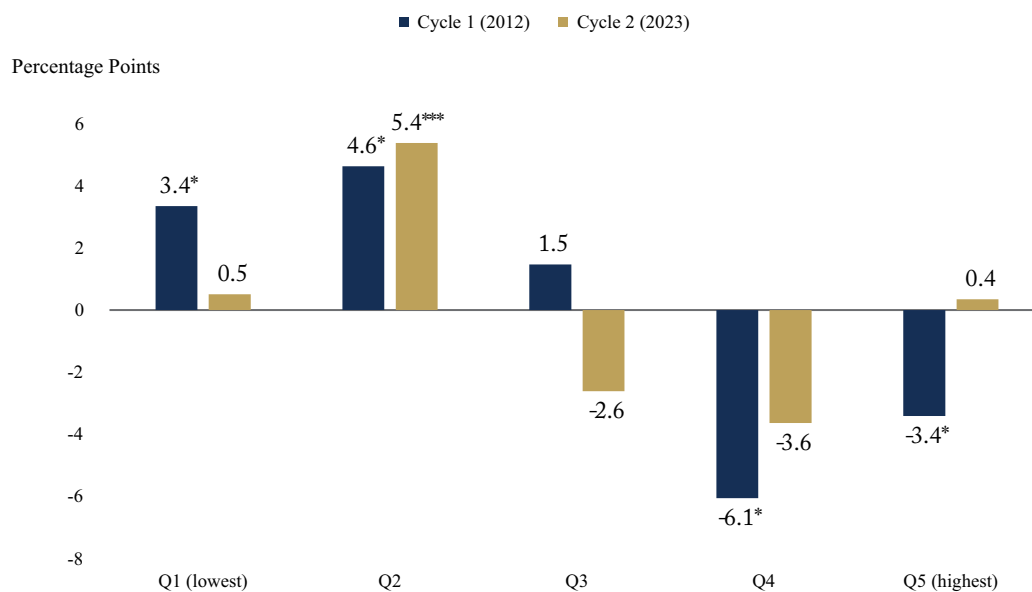
Note: Bars show the difference in the probability of immigrants and non-immigrants being in each quintile of the Canadian earnings distribution, in percentage points. Positive values indicate that immigrants are over-represented in that quintile.

Estimates are from linear probability models for employees aged 25-65, excluding the self-employed (N = 6,633). Adjusted estimates control for literacy, numeracy, adaptive problem-solving scores, education, home language, age, gender, parental education, training, and whether the highest credential was obtained abroad.

* $p < 0.10$, *** $p < 0.01$.

Source: Author's estimates using PIAAC 2023 Canada Public Use File.

Figure A3: Difference in the Share of Immigrant and Non-Immigrant Employees in Each Earnings Quintile, PIAAC 2012 and 2023



Note: Sample is of employees aged 25-65, excluding the self-employed. Each cycle's quintiles are defined within that year's Canadian earnings distribution, so the comparison concerns relative position rather than dollar amounts. Stars indicate significance of the gap within each cycle.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Author's estimates using PIAAC 2012 and 2023 Canada Public Use Files.

APPENDIX B

Table B1: Descriptive Statistics for Skills, Demographics, and Outcomes (Ages 16-65)

	All (Full PIAAC Sample)	Non-Immigrant	Immigrant	Non-Immigrant	Immigrant
	Ages 15-65			Ages 25-65	
Panel A: Skills (scale score)					
Literacy score	270.8	279.2	259.0	279.1	256.9
	(0.9)	(0.9)	(1.7)	(1.1)	(1.8)
Numeracy score	270.7	274.4	267.3	274.6	266.1
	(0.9)	(1.0)	(1.7)	(1.2)	(1.7)
Problem-solving score	259.4	266.0	250.0	264.8	248.4
	(0.7)	(0.8)	(1.5)	(1.0)	(1.5)
Observations	11,697	9,087	2,519	8,001	2,229
Panel B: Demographics and Language (percent)					
Home language = official language	81.3	95.9	48.9	96.7	49.5
	(0.8)	(0.7)	(1.7)	(0.5)	(2.0)
Native language = official language	76.2	94.1	36.3	94.6	36.5
	(0.6)	(0.6)	(1.7)	(0.7)	(1.7)
Foreign-born and foreign language	19.7	0.0	63.7	0.0	63.5
	(0.6)	(.)	(1.7)	(.)	(1.7)
Below high school	9.5	10.9	6.2	6.8	5.0
	(0.4)	(0.5)	(0.8)	(0.5)	(0.9)
High school	36.6	42.4	23.9	40.0	21.0
	(0.8)	(1.0)	(1.4)	(1.2)	(1.6)
College	18.4	19.3	16.5	22.1	17.0
	(0.5)	(0.7)	(1.4)	(0.7)	(1.5)
University	35.5	27.4	53.4	31.1	57.0
	(0.4)	(0.8)	(1.4)	(0.9)	(1.6)
Parent: below upper secondary	11.9	11.0	13.8	12.7	14.9
	(0.6)	(0.5)	(1.3)	(0.6)	(1.4)
Parent: upper secondary	31.2	32.3	28.8	33.5	29.7
	(0.8)	(1.0)	(1.4)	(1.1)	(1.5)

Table B1: Continued

	All (Full PIAAC Sample)	Non-Immigrant	Immigrant	Non-Immigrant	Immigrant
	Ages 15-65			Ages 25-65	
Parent: tertiary	49.8	48.6	52.4	45.5	50.8
	(0.9)	(1.0)	(1.6)	(1.2)	(1.8)
Parent: education not reported	7.1	8.1	5.0	8.3	4.6
	(0.6)	(0.7)	(0.8)	(0.7)	(0.8)
Age under 25	13.2	15.1	8.8	—	—
	(0.5)	(0.6)	(1.0)		
Age 25-34	24.0	23.9	24.4	28.1	26.7
	(0.4)	(0.7)	(1.4)	(0.8)	(1.5)
Age 35-44	23.7	22.3	26.8	26.3	29.4
	(0.5)	(0.5)	(1.5)	(0.6)	(1.5)
Age 45-54	21.1	19.9	23.7	23.4	26.0
	(0.4)	(0.6)	(1.2)	(0.8)	(1.4)
Age 55+	18.1	18.8	16.3	22.2	17.9
	(0.5)	(0.7)	(1.1)	(0.8)	(1.2)
Female	47.8	48.4	46.6	47.7	45.5
	(0.5)	(0.8)	(1.3)	(0.9)	(1.5)
Participated in training	61.8	61.6	62.0	63.5	61.7
	(0.8)	(1.0)	(1.8)	(1.0)	(1.8)
Self-employed	13.4	13.4	13.5	14.4	14.4
	(0.7)	(0.9)	(1.4)	(0.8)	(1.5)
Observations	8,804	6,820	1,984	6,121	1,805
Panel C: Employment (percent)					
Employed (full sample)	76.8	76.4	77.6	79.2	80.9
	(0.7)	(0.7)	(1.4)	(0.7)	(1.4)
Observations	11,595	9,079	2,515	7,993	2,226

Table B1: Continued

	All (Full PIAAC Sample)	Non-Immigrant	Immigrant	Non-Immigrant	Immigrant
	Ages 15-65			Ages 25-65	
Panel D: Labour Market Outcomes (% , self-employed excluded)					
Overqualified	29.8	28.1	33.7	27.9	33.9
	(0.9)	(1.0)	(1.9)	(1.0)	(1.9)
High-skill occupation	53.3	51.2	57.9	57.5	62.1
	(0.9)	(1.1)	(2.0)	(1.1)	(2.0)
Foreign credential	17.2	1.9	51.6	2.1	53.2
	(0.8)	(0.3)	(2.2)	(0.4)	(2.3)
Earnings: lowest quintile and zero income	17.5	18.8	14.7	9.8	10.2
	(0.9)	(0.9)	(1.6)	(0.8)	(1.6)
Earnings: next lowest	20.4	18.7	24.4	17.9	22.9
	(0.9)	(0.9)	(1.7)	(1.0)	(1.7)
Earnings: mid-level	21.4	22.0	20.2	24.4	21.7
	(0.9)	(1.0)	(2.0)	(1.2)	(2.2)
Earnings: next to highest	21.2	21.8	20.0	25.4	22.0
	(1.0)	(0.9)	(1.9)	(1.1)	(2.2)
Earnings: highest quintile	19.4	18.7	20.8	22.5	23.2
	(0.9)	(0.9)	(1.8)	(1.0)	(1.9)
Observations	7,468	5,793	1,675	5,031	1,442
Panel E: Immigrant-Only Characteristics (percent)					
Credentialed in Canada	—	—	48.7	—	45.4
			(1.8)		(1.8)
Credentialed in NA/W. Europe, outside Canada	—	—	10.5	—	11.9
			(0.9)		(1.1)
Credentialed outside NA/W. Europe	—	—	40.7	—	42.7
			(1.6)		(1.6)

Table B1: Continued

	All (Full PIAAC Sample)	Non-Immigrant	Immigrant	Non-Immigrant	Immigrant
	Ages 15-65			Ages 25-65	
Years Since Immigration					
0-5 years in Canada	—	—	23.2	—	20.1
			(1.4)		(1.4)
6-10 years	—	—	15.1	—	13.4
			(1.0)		(1.2)
11-15 years	—	—	15.8	—	16.1
			(1.3)		(1.4)
16+ years	—	—	45.9	—	50.4
			(1.7)		(1.8)
Birth Region					
Arab States	—	—	9.8	—	9.1
			(0.9)		(1.0)
South and West Asia	—	—	22.3	—	21.2
			(1.4)		(1.5)
Latin America and the Caribbean	—	—	12.6	—	12.6
			(1.1)		(1.2)
Sub-Saharan Africa	—	—	8.1	—	8.1
			(0.8)		(0.8)
East Asia and the Pacific (poorer countries)	—	—	20.4	—	20.7
			(1.3)		(1.2)
East Asia and the Pacific (richer countries)	—	—	3.4	—	3.6
			(0.6)		(0.6)
Central and Eastern Europe	—	—	6.9	—	7.4
			(0.8)		(0.9)
North America and Western Europe	—	—	16.6	—	17.2
			(0.9)	—	(1.1)
Observations	—	—	2,519	—	2,137

Note: Standard errors in parentheses. Percentages and means are survey-weighted, using PIAAC replicate weights.

Source: Author's estimates using PIAAC 2023 Canada Public Use File.

Table B2: The Regression Outcomes for Literacy Skills (Ages 16-65)

	No Controls	Control for Language	Control for Education	All Characteristics (full control)
Immigrant	-21***	-8***	-31***	-18***
Language	—	28***	—	27***
Education: University (vs. Less than HS)	—	—	85***	67***
Education: College (vs. Less than HS)	—	—	63***	50***
Education: High School (vs. Less than HS)	—	—	49***	37***
Other Demographic Controls	—	—	—	✓
R^2	0.04	0.06	0.23	0.35
N	11,266	11,266	11,266	11,266

Note: Above includes adults aged 16-65 with complete information on all characteristics; all specifications are estimated on the same respondents. Most respondents aged 16-24 who were still in formal education are excluded because the training question was not asked of them. Variables and interpretation are as in Table 2. Compared with Table 3, the immigrant gaps are 1-3 points smaller, with no change in sign or significance.

*** $p < 0.01$.

Source: Author's estimates using PIAAC 2023 Canada Public Use File.

Table B3: Blinder-Oaxaca Decomposition of Skills Gaps, Full Detail (Ages 25-65)

	Literacy	Numeracy	APS
Non-immigrant Mean Score	279***	275***	265***
Immigrant Mean Score	257***	266***	248***
Overall Gap	22***	9***	16***
Explained (composition)	3*	-4**	1
Language	14***	9***	10***
Education	-9	-11	-8
Parental Education, Age, Gender, Training (combined)	-2	-2	-2
Unexplained (returns)	19***	13***	16***
Language	-22***	-11*	-14**
Baseline Difference (constant)	47***	31**	38***
All Other Characteristics (combined)	-6	-7	-8
Observations	10,195	10,195	10,195

Notes: “Explained” and “unexplained” are statistical terms and do not imply that the characteristics cause the differences. Combined rows are sums of individual components; significance is not tested for combined rows. Components may not sum to totals because of rounding. Detailed unexplained components for categorical variables depend on the choice of reference category and should not be interpreted individually.

* p<0.10, ** p<0.05, *** p<0.01.

Source: Author’s estimates using PIAAC 2023 Canada Public Use File.

Table B4: The Regression Outcomes for Adaptive Problem-Solving (APS) Skills (Ages 25-65)

	No Control	Control for (screening out the effect of)		
		Language	Education	All Characteristics (Full Control)
Immigrant	-16***	-6**	-26***	-16***
Language	—	21***	—	22***
Education: University (vs. Less than HS)	—	—	75***	56***
Education: College (vs. Less than HS)	—	—	56***	42***
Education: High School (vs. Less than HS)	—	—	40***	30***
Other Demographic Controls	—	—	—	✓
R^2	0.03	0.05	0.23	0.34
N	10,195	10,195	10,195	10,195

Note: “Language” indicates whether the test language matched the language spoken most often at home. Demographic controls include parental education, age, gender, and training.

*** indicates the estimated parameter is statistically significant at the 1 percent level.

Source: Author’s estimates using PIAAC 2023 Canada Public Use File.

Table B5: The Regression Outcomes for Numeracy Skills (Ages 25-65)

	No Control	Control for (screening out the effect of)		
		Language	Education	All Characteristics (Full Control)
Immigrant	-9***	0	-22***	-13***
Language	—	17***	—	19***
Education: University (vs. Less than HS)	—	—	97***	78***
Education: College (vs. Less than HS)	—	—	70***	55***
Education: High School (vs. Less than HS)	—	—	49***	39***
Other Demographic Controls	—	—	—	✓
R^2	0.01	0.02	0.25	0.34
N	10,195	10,195	10,195	10,195

Note: “Language” indicates whether the test language matched the language spoken most often at home. Demographic controls include parental education, age, gender, and training.

*** indicates the estimated parameter is statistically significant at the 1 percent level.

Source: Author’s estimates using PIAAC 2023 Canada Public Use File.

Table B6: Top and Bottom Earnings Quintile by Years Since Immigration (Ages 25-65)

	0-5 years	6-10 years	11-15 years	16+ years
Panel A: Top earnings quintile				
Unadjusted	-0.060	-0.070*	0.03	0.044
Adjusted	-0.042	-0.057	0.037	0.01
Panel B: Bottom earnings quintile				
Unadjusted	0.041*	0.014	-0.014	-0.005
Adjusted	0.046	0.023	-0.001	0.007
Observations	6,620			

Notes: Coefficients are differences, relative to non-immigrants, in the probability of being in the top (Panel A) or bottom (Panel B) quintile of annual earnings, from linear probability models (e.g., -0.070 = 7 percentage points lower). “Unadjusted” includes only years-since-immigration indicators. “Adjusted” additionally controls for literacy, numeracy, and adaptive problem-solving scores, education, home language, age, gender, parental education, training, and whether the highest credential was obtained abroad.

Results are similar when each skill domain is entered separately. “Years since immigration” refers to years since the respondent first came to live in Canada, which may predate obtaining permanent residence. Because the data are cross-sectional, differences across groups may reflect differences between arrival cohorts as well as time spent in Canada.

The table is for employees aged 25-65, excluding the self-employed.

* p<0.10.

Source: Author’s estimates using PIAAC 2023 Canada Public Use File.

Table B7: Immigrant-Non-immigrant Differences in Employment and Top-Earnings-Quintile Rates by Literacy Level (Ages 25-65, Percentage Points)

Literacy Level	Employment: Unadjusted	Employment: Adjusted	Top earnings Quintile: Unadjusted	Top Earnings Quintile: Adjusted
Level 1 or below	10.0**	3.8	-6.1**	-9.5**
Level 2	3.4	-1.5	0.9	-6.6
Level 3	4.5*	0.0	9.6**	3.0
Level 4/5	-0.5	0.9	11.5	11.5*

Note: The differences between immigrants and non-immigrants at each literacy level are from linear probability models. Adjusted differences control for education, home language, age, gender, parental education, training, and whether the highest credential was obtained abroad.

Employment is for adults aged 25-65; top earnings quintile: employees aged 25-65, excluding the self-employed. Proficiency levels are assigned from the first plausible value.

* p<0.10, ** p<0.05.

Source: Author’s estimates using PIAAC 2023 Canada Public Use File.

Table B8: Returns to Skills by Immigrant Status (Ages 25-65)

	Literacy	Numeracy	APS
Panel A: Top earnings quintile (linear probability model)			
Immigrant gap at average skill level	-0.011	-0.011	-0.017
Skill association (non-immigrants)	0.045***	0.058***	0.025
Additional skill association for immigrants	0.068***	0.052**	0.067**
Total skill association for immigrants	0.113	0.11	0.092
Panel B: Earnings-quintile position (ordered probit)			
Immigrant gap at average skill level	-0.051	-0.053	-0.078
Skill association (non-immigrants)	0.164***	0.209***	0.113*
Additional skill association for immigrants	0.129*	0.089	0.176**
Total skill association for immigrants	0.293	0.298	0.289
Observations	6,633	6,633	6,633

Notes: Each column in each panel is a separate model of the outcome on immigrant status, the skill score, their interaction, and full controls (education, home language, age, gender, parental education, training, and whether the highest credential was obtained abroad). Skill scores are standardized using the mean and standard deviation for all Canadian adults aged 16-65 (one standard deviation $\approx$ 55 points in literacy, 56 in numeracy, and 46 in adaptive problem-solving).

The immigrant gap is the difference between immigrants and non-immigrants at the average skill level. "Skill association" is the change in the outcome associated with a one-standard-deviation increase in the skill score. "Additional skill association for immigrants" is how much larger (or smaller) this change is for immigrants than for non-immigrants, and the total for immigrants is the sum of the two (significance not tested).

Panel A is estimated with linear probability models, and coefficients are differences in probability (e.g., 0.068 = 6.8 percentage points); Panel B is estimated with ordered probit models, and coefficients indicate direction and relative strength rather than percentage points. Employees are aged 25-65, excluding the self-employed (N = 6,633).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Author's estimates using PIAAC 2023 Canada Public Use File.

Table B9: Association Between Skill Domains and Labour Market Outcomes (Ages 25-65)

	Adjusted for Demographic and Background Characteristics and Skills			
	Literacy Only	Numeracy Only	APS Only	All Three Skills
Employment				
Literacy	0.036***	—	—	-0.003
Numeracy	—	0.045***	—	0.061***
Adaptive Problem-solving	—	—	0.030***	-0.017
Top Earnings Quintile				
Literacy	0.072***	—	—	0.027
Numeracy	—	0.079***	—	0.092***
Adaptive Problem-solving	—	—	0.052***	-0.042
Earnings-Quintile Position				
Literacy	0.214***	—	—	0.021
Numeracy	—	0.245***	—	0.261***
Adaptive Problem-solving	—	—	0.183***	-0.042
High-Skill Occupation				
Literacy	0.099***	—	—	0.025
Numeracy	—	0.102**	—	0.067**
Adaptive Problem-solving	—	—	0.091***	0.019
Overqualification				
Literacy	-0.072***	—	—	0.02
Numeracy	—	-0.083***	—	-0.071**
Adaptive Problem-solving	—	—	-0.077***	-0.035

Notes: Coefficients are the change in each outcome associated with a one-standard-deviation increase in the skill score from the same models summarized in Table 4. Skill scores are standardized using the mean and standard deviation for all Canadian adults aged 16-65 (one standard deviation ≈ 55 points in literacy, 56 in numeracy, and 46 in adaptive problem-solving).

Each “Only” column reports the coefficient from a model with that single skill domain plus full demographic and background controls (education, home language, age, gender, parental education, training, and whether the highest credential was obtained abroad). The “All Three” column reports the same coefficients when literacy, numeracy, and adaptive problem-solving are entered simultaneously.

Employment, top earnings quintile, high-skill occupation, and overqualification are estimated with linear probability models (coefficients are differences in probability; e.g., 0.072 = 7.2 percentage points). Earnings-quintile position is estimated with an ordered probit (coefficients indicate direction and relative strength rather than percentage points). Employment: adults aged 25-65; other outcomes: employees aged 25-65, excluding the self-employed.

** p<0.05, *** p<0.01.

Source: Author’s estimates using PIAAC 2023 Canada Public Use File.

Table B10: Correlation Matrix of PIAAC Skill Domains

	Literacy	Numeracy	APS
Literacy	1.00	0.87	0.87
Numeracy	0.87	1.00	0.85
APS	0.87	0.85	1.00

Source: Author's estimates using PIAAC 2023 Canada Public Use File.

Table B11: Minimum Official-Language Requirements for Canada's Principal Express Entry Programs

Express Entry program	Current minimum first-official-language requirement
Federal Skilled Worker Program	CLB/NCLC 7 in all four abilities
Canadian Experience Class, Training, Education, Experience and Responsibilities (TEER) 0 or 1	CLB/NCLC 7 in all four abilities
Canadian Experience Class, TEER 2 or 3	CLB/NCLC 5 in all four abilities
Federal Skilled Trades Program	CLB/NCLC 5 in speaking and listening; 4 in reading and writing

Notes: CLB (Canadian Language Benchmarks) and NCLC (Niveaux de compétence linguistique canadiens) are the national standards used to measure English and French language ability, respectively.

Source: Immigration, Refugees and Citizenship Canada. n.d. "Express Entry: Language Test Results." <https://www.canada.ca/en/immigration-refugees-citizenship/services/immigrate-canada/express-entry/documents/language-test.html>.

APPENDIX C: DATA AND METHODOLOGY

This appendix describes the data, sample construction, variable definitions, estimation methods, robustness checks, and limitations underlying the analysis.

PIAAC Estimation

The analysis uses the 2023 Canadian PIAAC public-use file described in Box 1. Estimates use all 10 plausible values provided for each skill domain and PIAAC's replicate weights to account for uncertainty in measured proficiency and the survey's complex sampling design. Estimates are produced using Stata's `repest` command.

Analytical Samples

Age

Descriptive comparisons of skills with other countries and with PIAAC 2012 use respondents across PIAAC's full age range of 16 to 65 for consistency with OECD reporting. All regression analyses of skills and all labour-market analyses are restricted to respondents aged 25 to 65 who have largely completed their education. Among 16- to 24-year-olds, many are still in school, and their highest completed education understates their eventual attainment. As a sensitivity check, the skills-gap models were also estimated for respondents aged 16 to 65.

Immigrant Status

In PIAAC, immigrant status is defined solely by place of birth. Immigrants are identified as respondents born outside Canada, while respondents born in Canada are classified as non-immigrants. The immigrant group may, therefore, include temporary residents such as international students and temporary foreign workers, although they are likely underrepresented, as in most household surveys.

Cycle 2 of PIAAC also cannot distinguish foreign-born respondents by permanent or temporary status or by immigration admission category. The results, therefore, apply to the foreign-born population represented in PIAAC as a whole and cannot be separately estimated for economic immigrants selected through Express Entry, family class immigrants, refugees, or temporary residents.

Among immigrants, the analysis also considers years since immigration and where respondents obtained their highest educational credential. Because PIAAC is cross-sectional, differences by years since immigration should not be interpreted as changes experienced by the same individuals over time.

Doorstep Interviews

Ninety respondents (0.77 percent of the Canadian sample) completed PIAAC's abbreviated Doorstep Interview rather than the full assessment because they could not complete the standard assessment in English or French. These respondents provided only limited background information, and their proficiency scores are imputed. Their average imputed literacy score is substantially lower than that of respondents completing the standard assessment (185 compared with 273).

Country of birth is available for 86 of the 90 Doorstep Interview respondents. Of these, 85 were born outside Canada, and one was born in Canada. Because the Doorstep Interview does not provide the detailed information required for multivariate analysis, these respondents cannot be included in models requiring those characteristics. Consistent with OECD reporting, estimates for all respondents in Table 1 and Figure 1 include Doorstep Interview respondents, while all immigrant/non-immigrant comparisons exclude them. Because the Cycle 1 survey had no Doorstep Interviews, this also keeps the immigrant/non-immigrant gaps comparable across the two cycles.

Beyond excluding Doorstep Interview respondents, the PIAAC sample may under-represent immigrants more broadly due to non-random non-response. Canada's PIAAC sample was drawn from respondents to the 2021 Census long-form questionnaire (Statistics Canada 2022), so any under-representation of immigrants in the census long-form itself – a longstanding concern in the Canadian survey literature (Green and Milligan 2010) – is inherited by the PIAAC sampling frame before fieldwork begins. PIAAC's own technical documentation adds a second layer: participating countries, including Canada, reported particular difficulty reaching immigrant respondents during data collection (OECD 2024).

Survey weights are designed to correct for differential non-response on observed characteristics, but to the extent that non-response is concentrated among the least-integrated or lowest-literacy immigrants specifically – as the Doorstep Interview results suggest – weighting may not fully restore representativeness on unobserved dimensions correlated with both literacy and labour-market attachment.

Consistent Samples

Within each table, all specifications are estimated for the same respondents: those with complete information on every characteristic included in the most fully specified model. Differences across columns, therefore, reflect only the characteristics added, not changes in the sample. Respondents without information on participation in training are excluded; nearly all are aged 16 to 24 and were not asked the question because they were in formal education.

The regression samples comprise 10,195 adults aged 25 to 65 for the skills models; 10,149 for employment models; and 6,838 employees for other labour-market models, with slightly smaller samples for outcomes with missing information, such as earnings.

Other Sample Restrictions

Employment models include all adults aged 25 to 65. Models of earnings, occupational skill level, overqualification, and skill use at work are restricted to employees, excluding the self-employed, whose earnings and job requirements are defined or measured differently, and respondents whose employment type was not reported.

Measures

Skills. Literacy, numeracy, and APS are measured on PIAAC's continuous 0–500 scales. Where proficiency levels are used, the analysis follows OECD Cycle 2 cut-points, grouping Below Level 1 with Level 1, and Level 4 with Level 5 because of small cell sizes. Shares by proficiency level use all 10 plausible values; analyses of outcomes by proficiency level (Figure 5) assign levels using the first plausible value. Some models use standardized scores (mean 0, standard deviation 1), so that coefficients represent the change associated with a one-standard-deviation difference in skill (Table B8).

Labour-market outcomes. Employment indicates whether respondents were employed, including self-employed, at the time of the survey, based on PIAAC's derived labour-force status. Respondents who were unemployed or out of the labour force are classified as not employed, so the measure corresponds to an employment rate. The small number of respondents whose status was not known are excluded.

Earnings-quintile position is the quintile of annual earnings from the PIAAC earnings variable, with respondents reporting no earnings grouped with the lowest quintile; the top and bottom earnings quintiles are also analyzed as separate yes/no outcomes. The PIAAC yearly-income percentile-rank variable is not used because its categories do not correspond to quantiles of the earnings distribution among respondents with earnings.

High-skill occupation refers to managerial, professional, and technical occupations (International Standard Classification of Occupations major groups 1 to 3). Overqualification compares respondents' highest qualification with their own assessment of the qualification someone would need to get their type of job today, with both grouped into the same four International Standard Classification of Education-based levels (below high school, high school, college, university). Respondents whose qualification exceeds the assessed requirement are classified as overqualified. Skill use at work is measured with PIAAC indices of self-reported frequency of reading, writing, numeracy, and ICT tasks.

Characteristics. Language background indicates whether the language spoken most often at home matches the language of assessment. Controls include educational attainment, parental education, age group, gender, language background, and participation in job-related training or non-formal education. Labour-market models also control for whether the highest credential was obtained outside Canada. Immigrant-only models additionally include years since immigration (zero-five, six-10, 11-15, and 16 or more years), region of birth, and the location of the highest credential (Canada; North America or Western Europe outside Canada; elsewhere).

Empirical Approach

The analysis proceeds in three stages. First, regression models estimate immigrant/non-immigrant differences in literacy, numeracy, and APS, and examine how those differences change after accounting for language background, education, and other characteristics. Gaps are also estimated separately by education level and among adults whose home language matches the test language, with tests of whether gaps differ across education levels in both points and logged scores. Immigrant-only models then examine

characteristics associated with measured skills, and pooled Oaxaca-Blinder decompositions separate the average gaps into components associated with differences in observed characteristics and a residual component.

The decomposition is descriptive, not causal. The residual component may reflect both differences in how characteristics are associated with skills and factors not measured in PIAAC. It should not be interpreted as a measure of discrimination, and its detailed components for categorical variables depend on the choice of reference category.

Second, labour-market models examine whether immigrants and non-immigrants experience different outcomes as measured skills, education, and other characteristics are introduced sequentially. Yes/no outcomes are estimated with linear probability models and earnings-quintile position with ordered probit.

Additional models separate immigrants by where their highest credential was obtained. They also estimate gaps in three further ways: in the probability of being in each earnings quintile, gaps by proficiency level, and by years since immigration. Finally, they interact immigrant status with standardized skill scores to test whether the association between skills and outcomes differs between immigrants and non-immigrants.

Third, comparisons with PIAAC 2012 use the Canadian public-use file from Cycle 1, estimated with the same methods. Tests of change between cycles treat the two samples as independent.

Statistical significance is reported at the 10, 5, and 1 percent levels.

Robustness Checks

The main findings were tested using alternative sample restrictions and model specifications, including estimating the skills models for respondents aged 16 to 65. Also, they were tested by using standardized, log-transformed, and categorical skill measures, entering each skill

domain separately and all three together and by using alternative language measures (Figure A1). Detailed results are reported in the supplementary tables.

Limitations

Several limitations should be kept in mind when interpreting the results.

Cross-sectional data. PIAAC provides a snapshot at one point in time rather than following individuals over time. Differences by years since immigration, therefore, cannot distinguish changes occurring after arrival from differences between immigrant cohorts. Relationships between characteristics and outcomes are associations, not causal effects. In particular, skills are measured after arrival and may themselves be shaped by immigrants' employment, language use, and training in Canada, so a change in the immigrant gap after accounting for skills does not show that skill differences caused the original gap.

Immigration information. Immigrant status is based solely on place of birth. The public-use data do not distinguish permanent from temporary residents or identify admission category, and temporary residents are likely underrepresented. The analysis, therefore, cannot establish whether relationships observed for the foreign-born population as a whole apply to economic principal applicants or immigrants selected through Express Entry who must meet language requirements and have their credentials assessed.

Language measures. PIAAC does not measure official-language proficiency on the Canadian Language Benchmarks. The language measure used here, whether the language spoken most often at home matches the test language, captures language background rather than proficiency. Because the assessment is administered only in English or French, measured skills for respondents whose strongest language is another language may partly reflect their proficiency in English or French as well as the skill being assessed.

Credentials. The analysis identifies where the highest credential was obtained, not its content, quality, or recognized equivalency, and it cannot match the timing of immigration precisely with when the credential was obtained. Associations with credential location should not be interpreted as evidence about the quality of education systems.

Survey participation. The Doorstep Interview addresses some literacy-related non-responses, but doorstep respondents lack the information needed for the regression analysis and are excluded. Because nearly all are immigrants with very low estimated proficiency, the reported gaps are likely lower bounds. Differences in survey participation across population groups cannot be fully ruled out.

Scope of skills and outcomes. PIAAC measures foundational skills (literacy, numeracy, and adaptive problem-solving) that support the use of other skills, but not the occupation-specific, technical, or workplace skills that employers seek, nor social and emotional skills. Differences in outcomes that remain after accounting for PIAAC skills may, therefore, reflect differences in these unmeasured skills, as well as employers' ability to recognize them. The assessment is an international instrument, and the extent to which it reflects particular educational or testing traditions cannot be assessed here. Overqualification and skill use at work are self-reported.

Geography. Province or territory of residence is not available in the public-use file, preventing the analysis from accounting directly for regional differences in immigrant populations and labour markets.

Timing and sample size. The survey was conducted during an exceptionally tight labour market, and results may differ under weaker conditions. Some subgroups, such as immigrants with less than high school or with credentials from North America and Western Europe outside Canada, are small, and estimates for them are imprecise.