Foreign human capital and the earnings gap between immigrants and Canadian-born workers[☆]

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HIGHLIGHTS

- More than half of young adult immigrants obtain their highest degree in Canada.
- Imputation method underestimates Canadian education for young adult immigrants.
- Country of highest education degree is the most important for immigrant earnings.
- Actual location of study reduces wage penalties associated with countries of birth.
- Portability of foreign human capital is heterogeneous across fields of study.

ARTICLE INFO

ABSTRACT

We use new information on the location of study of immigrants available in the 2006 Canadian Census to estimate returns to Canadian and foreign human capital. We find that controlling for the source of human capital (Canadian versus foreign) helps account for a large share of the immigrant/native-born wage gap. We show that commonly-used imputation procedures (e.g. Friedberg, 2000) that assign domestic and foreign education based on age at arrival tend to overestimate the returns to foreign education and underestimate the returns to foreign work experience. We also find that the immigrant/native-born wage gap is highly heterogeneous across places of birth even after including location of study fixed effects, although this inclusion markedly reduces the negative country of origin effects for countries like China, Pakistan, and India. Finally, we note substantial heterogeneity in the portability of human capital across fields of study.

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1. Introduction

Immigrants have not fared well in the Canadian labour market recently. Over the last three decades a number of studies have documented a steady decline in their earnings relative to those of the Canadian born (see for instance Grant, 1999; Green and Worswick, 2012; Frenette and Morissette, 2005 and Aydemir and Skuterud, 2005).[1] Immigrants to Canada in the 1990s earned around 30 to 40 percent less than Canadian-born workers upon arrival. By contrast,

[1] Baker and Benjamin (1994) and Bloom et al. (1995) are among the first to show the deterioration of immigrant earnings in Canada.

cohorts arriving in the late 1970s faced an initial wage gap of 13 to 20%.[2] This paper draws on the 2006 Canadian Census and uses explicit information on the location of study of the highest post-secondary degree attained to better understand the sources of the current immigrant/native-born wage gap.

Starting with Chiswick (1978), studies have suggested that the lack of transferability of human capital is a key reason why immigrants tend to earn less than the native born. Borjas (1985, 1995) argues that in the case of the United States, these findings could reflect changes in the skill levels or ability of recent immigrant cohorts from new source countries. Indeed, while most immigrants in the 1960s were from countries culturally similar to Canada (Western Europe and the United States), about two thirds of immigrants arriving in the 1980s and 1990s were from Asia, Africa, and Central and South America. Friedberg (2000) uses the 1983 Israeli Census to analyze how differences in the returns to foreign and native schooling, and to work experience contribute to the immigrant/native-born wage gap. The study also highlights the level of heterogeneity of the returns to foreign schooling by source country; returns to education abroad are higher for immigrants from Europe and the Western Hemisphere, compared to those from Asia and Africa.[3]

The Canadian literature (Ferrer and Riddell, 2008; Ferrer et al., 2006; Aydemir and Skuterud, 2005 among others) also suggests that years of schooling and experience accumulated prior to arrival are much less valued than those acquired in the host country. Ferrer and Riddell (2008) focus on the effect of credentials (degrees and diplomas) on the earnings of immigrants to Canada, holding constant the number of years of education. Using public-use Census files from 1981 to 2001, they find substantially lower returns to foreign education and experience compared to Canadian education and experience. Aydemir and Skuterud (2005) also use the Canadian Census files (1981–2001) to analyze the decline in entry earnings of recent immigrants. Their analysis assesses the relative importance of previous explanations suggested in the literature. The results suggest that about a third of the decline in immigrants' entry earnings is due to the decrease in the return to foreign work experience.[4]

To explore the potential skill gaps behind the lower returns to foreign education, Ferrer et al. (2006) combine data from the 1994 International Adult Literacy Survey (IALS) and the 1998 Ontario Immigrant Literacy Survey (OILS) to compare the (usable) cognitive levels of male immigrants and the Canadian born, and analyze any differences in returns. They do not find any difference in the returns to literacy between immigrants and the Canadian born, but because the native-born literacy distribution dominates that of immigrants, literacy skills are found to be a significant factor explaining the immigrant wage gap. For example, among the university educated, the inclusion of literacy skills helps explain about two thirds of the earnings differential between immigrants and the Canadian born.

In Census data more generally, estimating the contribution of foreign education and experience to the immigrants/native-born wage gap presents a substantial challenge given that the information on the country where the highest degree was obtained is typically unavailable. Researchers have, thus, attempted to infer the location of study by comparing the age at which an immigrant should have completed the highest degree she reported to her age upon entering the country.[5] For example, Friedberg (2000) imputes immigrants' years of schooling in the home country based on the assumption that children begin schooling at age 7 and attend school without interruption until their departure. Bratsberg and Ragan (2002) follow a similar strategy using the 1990 U.S. Census to estimate differences in the returns to education for immigrants with and without U.S. schooling.[6] Their principal findings are similar to Friedberg's findings for Israel.[7] This approach may fail, however, to correctly identify the country where education was acquired. Immigrants may have worked in Canada for a number of years before starting to study for their final degree. For instance, a 40-year-old immigrant with a MBA who arrived in Canada at age 25 may very well have completed that degree at a Canadian university after the age of 25.

Additionally, in the case of Canada, foreign-born individuals may complete their studies prior to being officially classified as immigrants. In the Canadian Census, age at immigration is the age at which an individual becomes a permanent resident of Canada. Foreign students who attend university in Canada and become permanent residents after finishing school would, therefore, be misleadingly classified as recipients of a foreign degree.

Fortunately, the long form of the 2006 Canadian Census included a question asking where the respondent's highest degree was obtained. The location is recorded either as a country, in the case of those who studied abroad, or as a province, in the case of those who studied in Canada.[8] While direct information on location of study has been used in other studies, here we can perform a much more detailed analysis (by country of origin, age at arrival, and gender) owing to the large sample available in the master files of the 2006 Canadian Census (covering 20% of the Canadian population). Ferrer et al. (2006) also have information on immigrants' level of education achieved before coming to Canada and their highest level of schooling completed. Nonetheless, the statistical power of their analysis is limited by the size of their sample (2015 observations, mostly from Ontario). This makes it difficult, for instance, to estimate country of origin effects, or differences in the returns to foreign human capital by country of origin. As a result, Ferrer et al. (2006) only include two country of origin dummies (for immigrants born in the US/UK, and in continental Europe, respectively) in their analysis.[9] Furthermore, they still need to impute the precise location of study for immigrants arriving with more than a secondary education.[10]

In addition, the 2006 Canadian Census also includes information on field of study, which enables us to investigate whether education in some fields (e.g. math and computer science) is more portable than

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[2] Frenette and Morissette (2005) used Canadian Census data from 1980 to 2000 to calculate these figures. They also show that the wages of immigrants who arrived in the 1970s had almost converged to those of their native-born counterparts fifteen years after their arrival. For cohorts arriving in subsequent years, such a convergence did not happen.

[3] The paper also suggests that acquiring further education in the host country may increase the overall return to education.

[4] They also find that changes in knowledge of Canada's official languages (English and French) and regions of origin can explain at most a third of the deterioration in earnings.

[5] For instance, one may assume that an immigrant with a BA degree who came to Canada at age 30 completed her degree abroad prior to immigrating.

[6] Bratsberg and Ragan (2002) determine the age of graduation based on the reported years of education and the assumption that schooling begins at age 6. Immigrants arriving at an age younger than the presumed age at graduation (years of completed schooling plus six) are classified as having U.S. schooling.

[7] Bratsberg and Ragan (2002) find that immigrants with U.S. schooling earn higher wages than immigrants without U.S. schooling. Their results also indicate that returns to foreign schooling are significantly higher for immigrants who completed some of their studies in the United States. However, this last finding is based on the National Longitudinal Survey of Youth, a small (351 immigrants) and not representative survey of U.S. immigrants.

[8] Consider an immigrant with a high school diploma who comes to Canada at age 25 and then completes a two-year community college program. Since one would normally complete such a program at age 20, the imputation procedure would suggest that the immigrant received all her schooling abroad despite the fact the two-year community college program was actually completed in Canada. With the new information available we can distinguish both sources of human capital and correspondingly recalculate years of work experience abroad and in Canada.

[9] No statistical difference was found for the other country of origin dummies.

[10] The OILS has direct information regarding the highest level of schooling attained before arriving to Canada, but not where it was obtained. It only has a question on the precise location of study for secondary education.

in others (e.g. education) depending on the location of study.[11] Our research, thus, complements earlier studies (particularly in Canada) by identifying more precisely the human capital source and adding other dimensions to the analysis (such as field of study). The paper also compares the results obtained using the explicit information on the location of study with those obtained using an imputation procedure.

Depending on specifications, direct information on location of study helps explain up to 70% of the immigrant/native-born wage gap. The results also indicate that there is a large and negative wage premium on educational degrees obtained in Asian countries. We find that the wage premium is also negative, but not as large, for degrees from South America, Africa, and Eastern Europe. There is only a small negative premium on degrees from most Western countries (Oceania, the United States, and the rest of continental Europe) and a small positive premium on degrees from the United Kingdom. Consistent with earlier studies, we find that returns to foreign work experience are much lower than returns to Canadian experience. We also find that the commonly used procedure to impute immigrants' foreign human capital tends to overstate the return to foreign education and understate the returns to foreign work experience.

The immigrant/native-born wage gap is found to vary greatly across countries and regions of birth. Although adding the location of study reduces the size of the country of origin fixed effects, immigrants from Asia (with the exception of South-East Asia and Hong Kong) tend to have larger wage gaps than immigrants from Europe. The reduction in the country of origin effects is sizeable for China, Pakistan, India, the Philippines, West and Central Asia, and the rest of Asia, but these coefficients remain negative. Finally, human capital in some fields of study appears to be considerably more portable than in others. For example, "Health Assistance" is quite portable regardless of the location of study. To some extent the same holds true for "Computer Sciences, Mathematics, Physical Sciences and Science-based Technologies", and "Humanities and Visual and Performing Arts ".

The remainder of the paper proceeds as follows. Section 2 describes the data used and presents some summary statistics. Section 3 presents the empirical earnings equation framework used to estimate the foreign/native-born wage gap. The empirical findings along with various robustness checks are presented in Section 4. Finally, we conclude in Section 5.

2. Data and descriptive statistics

2.1. The 2006 Canadian Census

Our data comes from the 2006 long form Canadian Census. Conducted by Statistics Canada, it surveyed individuals residing in private dwellings as of May 16, 2006 (the reference day) between the months of February and August of that year.[12] It enumerates Canadian citizens, landed immigrants, and non-permanent residents.[13] One in five households received the long form questionnaire which, in addition to the eight standard questions on household members' age, gender, marital status and mother tongue, contained 53 questions on various topics such as education, immigration, income and employment.

We focus on individuals between the ages of 20 and 64 with an education level higher than high school, and who were full-time workers with a positive wage income in 2005.[14] In the case of immigrants, our main specification focuses on those old enough to have had difficulty adapting to the host country but young enough to invest in education around the time of migration. Therefore, the majority of our analysis focuses on immigrants who arrived in Canada between the ages of 15 and 29. Unlike Public Use Microdata files, the long form Census provides detailed information on the date of birth and year of immigration, allowing a precise definition of these variables. To make our findings more comparable to those of previous studies, we also estimate some specifications using a sample of immigrants 15 years of age or older at the time of arrival.

Our dependent variable is the logarithm of weekly wages, derived by dividing total wage and salary income in 2005 by the number of weeks worked in that year. Since the Census does not record weekly hours of work in 2005, we limit our analysis to full-time workers to have a more accurate measure of the price of labor. To minimize the problem of low-wage outliers, we exclude individuals who are paid less than half of the prevailing minimum wage. Since we do not observe hourly wages, we assume a minimum work week of 30 hours, and remove observations with weekly earnings of less than 15 times the minimum wage. Other restrictions are imposed to exclude observations with inconsistencies in key explanatory variables such as unspecified country of origin ("Other"), location of study ("Outside Canada" or "Distance Learning") or year of immigration (for the foreign born).[15] Our final sample includes over one million (unweighted) observations. Following Statistics Canada guidelines, all statistics reported in the paper use the Census weights. We also have to report the weighted number of observations in the tables, which is approximately 5 times the unweighted number of observation since the long form Census is a 20% sample of the Canadian population.

We follow the standard Mincer approach to calculate potential labour market experience as the difference between age and years of education assuming that children start school at age six. Given that the 2006 Census no longer asks for the number of years of schooling, this variable is imputed based on the highest degree or diploma (see Appendix C for the imputation rules).

We distinguish between work experience in Canada and abroad using age at migration (available in single years of age in the Census master files). Under the assumption that landed immigrants who completed their studies abroad start working upon arrival, we calculate their potential work experience in Canada as the difference between their age at the time of the Census and their age at arrival. Foreign-born individuals who completed their studies in Canada are divided into three groups according to their age at arrival and highest degree attained. For those arriving at age 18 or younger, Canadian work experience is assumed equal to the total work experience. For those arriving between the ages of 19 and 22, Canadian work experience is calculated as age (in 2006) minus age at arrival minus the imputed years of education in Canada assuming that those with a

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[11] Relatively recent studies (such as Clark and Jaeger, 2006 and Hartog and Zorlu, 2009) have also directly identified the origin of immigrants' education. For example, Clark and Jaeger (2006) distinguish between immigrants who earned an additional degree in the host country (a GED in particular) and immigrants who did not. They find that immigrants with a host country degree earn more than those without one but with similar foreign schooling. Still, their study relates more to a sheepskin effect (or signaling) than to the undervaluation of foreign education. Hartog and Zorlu (2009) follow refugees to The Netherlands for their first five years (1995 to 2000) and use the administrative immigration records to measure their education level. Their main finding is that returns to higher education are not significant. Their study, however, limits itself to refugees during their first five years in the host country and does not identify their location of study.
[12] The master files of the long form Census data are made available by the Research Data Centre Program of Statistics Canada.

[13] Non-permanent residents were not included in the analysis since they are not comparable to landed immigrants, and are not asked the date of arrival in Canada. Non-permanent residents are defined as persons living in Canada who have a Work or Study Permit, or who are claiming refugee status.
[14] The question on where the highest degree was obtained applies only to those with more than a high school degree.
[15] Appendix A shows the minimum hourly wage by province in 2005. The exclusions are listed in Appendix B.

bachelor's degree or higher did not start their programs until arriving in Canada.[16] Lastly, for those who arrived after age 22, work experience is calculated as age minus age at arrival minus imputed years of education in Canada. In this case, however, we assume that individuals with a postgraduate degree completed their bachelor's degree before arriving in Canada. Individuals born in Canada are simply assumed to have obtained all their work experience in Canada. For immigrants, foreign work experience is computed as the difference between total work experience and work experience in Canada.

Since the education section in the 2006 Census records the highest degree or diploma achieved, it is natural to include a dummy variable for each education level in the wage regressions. This approach better captures possible non-linearities in the returns to education than a specification with imputed years of education entered linearly.[17] We simplify the empirical model by grouping the educational degrees into four categories: trade certificate, college or university diploma below the level of a bachelor's degree, bachelor's degree, and post-graduate degree. We use "trade certificate" as the base category in all estimations. It includes: registered apprenticeship certificates; college, CEGEP or non-university certificates (of 3 to 12 months); and other trade certificates or diplomas. As indicated in Appendix C, we assign 13 years of education to all the sub-categories. To identify differences in the returns to education obtained in Canada and abroad, the education dummies and the foreign education indicator are interacted, yielding six binary variables, three for education attainment in general and three interaction terms. For instance, if a person received a bachelor's degree outside Canada, we would observe the effect of having a bachelor's degree in general and the premium from obtaining it abroad.[18]

The countries of birth and countries where the highest diploma was obtained (location of study) are grouped in 22 and 19 categories, respectively. We identify the top ten countries of origin and combine the rest in relatively homogenous geographic areas. We apply a similar procedure to the location of study countries. To preclude location of study dummies becoming proxies for country of origin effects, we make the classification of countries of origin as detailed as the classification for the locations of study. Specifically, we include two more country of origin dummies for Pakistan and Romania.[19] Including Canada, we have a total of thirteen countries in the country of origin list (the original top ten plus Canada, Pakistan and Romania) and nine regions (details are available in Appendix D).

Additionally, the 2006 Census contains information on the field of study for the highest post-secondary degree.[20] The original data was coded using the Classification of Instructional Programs (CIP, Canada 2000). We combine several subcategories across broad CIP categories to obtain eleven major fields of study, as shown in Appendix E. We can then explore the extent to which the field of study affects the portability of foreign education in the Canadian labour market. For example, while a bachelor's degree in education may be valued differently depending on the country of origin, its counterparts in a mathematics-related field are likely more portable given that their underlying concepts might be less influenced by cultural and linguistic factors.

Despite all the advantages the Census offers, its cross-sectional feature has clear limitations. First, it is impossible to disentangle the effects of time spent in Canada from the macro effects of the year of arrival of the respective cohort. Work experience could be picking up the macro effect of arriving in a particular year or of the lower skill levels of recent immigrant cohorts (unrelated to education levels). Unlike Ferrer et al. (2006), our data has no measures of cognitive skills beyond educational attainment. This affects the interpretation of our findings as we do not know whether lower returns to foreign education reflect differences in skills acquired (relative to Canadian education), or discrimination/lack of recognition for foreign credentials. The results of Ferrer et al. (2006) suggest that the former is more likely than the latter (immigrants have less literacy skills than the Canadian born, but benefit from comparable returns to these skills).

Another potential shortcoming of the Census is that our calculation of years of work experience is based on years of education imputed from categories of educational attainment. Any imprecision in the imputation rule could affect our work experience estimates.[21] These potential problems would arise for individuals who failed to complete a graduate program; for example, those who began but did not complete a master's degree would be assigned only 16 years of education (the number of years to complete a bachelor's degree). The resulting noise in the experience variable may lead to a small downward bias in the estimated effect of this variable in the regression models.

2.2. Descriptive statistics

Table 1 shows the distribution of immigrants by country/region of origin and the percentage of immigrants in each location of study using direct information and a Friedberg-type imputation procedure. The top ten countries account for 51% of all immigrants in our sample. With the exception of the United Kingdom, the first five countries of origin are located in Asia.[22] Close to 56% of all immigrants in our sample received their highest diploma in Canada. In general, the share of those who received their education outside their home country (excluding Canada) is small yet significant (6.7%). However, for some specific countries and regions (such as Hong Kong, Jamaica, Vietnam, South-East Asia) the share is higher (more than 15%).

For the comparison with the imputation method used by Friedberg (2000), we created a variable indicating where the highest level of education was likely acquired. We assume that Canadians have no years of education abroad and that immigrants obtained a Canadian degree only if their age at arrival minus six is less or equal than their calculated years of education.[23] For immigrants with a Canadian degree, years of education abroad are calculated as age at arrival minus six. Years of education in Canada represent the difference between total years of education and years of education obtained abroad. Immigrants are assumed to have obtained their foreign education in their home countries. When using the imputation procedure, the estimated fraction of immigrants with a Canadian degree, shown in Table 1, is markedly different. Only 23% of immigrants are

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[16] This implicitly assumes that there is no transfer mid-program.

[17] This set of dummies captures both the return to years of education and the sheepskin effect of achieving a degree.

[18] Appendix G shows estimations with an alternative specification. Following Friedberg, it divides years of education in Canada and abroad, distinguishing between education beyond both high school and bachelor's degrees.

[19] These two countries are in the top 15 countries of origin.

[20] The public use files codebook defines the "field of study" as *"the predominant discipline or area of learning or training of a person's highest postsecondary degree, certificate or diploma"*.

[21] Even though we use six possible values of years of education for the eight educational categories above that of trade certificates, we cannot assign, and hence do not add years of education to individuals who started but never completed an undergraduate degree. Our sample, nevertheless, includes workers who completed at least one additional level of education above high school.

[22] Given the age restrictions in our sample, the earliest year of arrival is 1956. From there on the distribution of source countries changes dramatically over time. Most of the immigrants who arrived between 1956 and 1970 are from the UK and continental Europe (21.9% from the UK, 2.4% from France, 1.2% from Poland, 7.7% from Eastern Europe and 25.9% from the rest of the continent), whereas the majority of immigrants who arrived after 1990 are from Asia. India, the Philippines, China, Hong Kong, and Vietnam made up 37% and 39% of all immigrants who arrived between 1991 and 2000, and after 2000, respectively.

[23] The number of years of education is imputed for each category as shown in Appendix C.

Table 1
Immigrant's top countries of origin and location of study.

	Total source country distribution	Share of immigrants			Comparing with imputation procedure	
		Study in home country	Study in Canada	Study abroad	Study in home country	Study in Canada
Top ten countries						
India	9.3	59.0	34.9	6.1	84.4	15.6
UK	7.8	51.0	47.2	1.8	81.2	18.8
Philippines	7.6	65.0	33.9	1.1	84.7	15.3
China	5.9	40.3	51.7	8.0	83.1	16.9
Hong Kong	5.1	.	83.5	16.5	56.2	43.8
US	3.9	38.3	60.5	1.2	73.1	26.9
Poland	3.2	49.6	47.8	2.6	82.1	17.9
Jamaica	3.0	.	83.8	16.2	65.8	34.2
Vietnam	2.8	.	83.6	16.4	59.2	40.8
France	2.3	55.5	41.5	3.0	86.4	13.6
Two other countries						
Pakistan	1.8	48.9	40.2	10.9	80.4	19.6
Romania	1.7	62.2	33.7	4.1	87.9	12.1
Rest of the World						
Africa	7.8	27.7	61.1	11.3	78.7	21.3
Rest of America	7.3	21.2	74.9	4.0	74.9	25.1
Rest of Europe	7.1	34.7	60.4	4.9	72.5	27.5
Eastern Europe	5.9	50.6	43.8	5.6	80.4	19.6
W. and C. Asia	5.2	30.1	61.0	8.9	71.8	28.2
South America	5.0	28.6	67.9	3.6	75.3	24.7
Rest of Asia	4.4	31.8	58.4	9.7	71.9	28.1
South-East Asia	1.8	15.9	70.8	13.3	72.1	27.9
Oceania	1.3	40.9	56.3	2.9	80.9	19.1
Total	100	37.4	55.9	6.7	76.8	23.2
Weighted numb. of obs.	651,750	243,715	364,385	43,655	500,555	151,195

Note: Column 1 shows the distribution across the indicated countries/regions of immigrants who arrived to Canada between the ages of 15 and 29. The subsequent columns indicate the percentage of immigrants from each source countries/regions who acquired their highest post-secondary degree in the indicated location according to direct information available in the Census 2006 in columns 2 to 4, and with the imputation method in columns 5 and 6. A missing value "." indicates that the cell has less than 100 unweighted observations. In countries with these missing cells, the share of immigrants who studied in Canada or abroad is only computed for observations in these two categories.

classified as having obtained the highest degree in Canada, compared to 56% with the direct measure. All the other immigrants (77%) are classified as having studied in their country of origin, since the imputation procedure cannot identify the 6.7% of immigrants who have studied in a country other than Canada or their country of origin (the "study abroad" column in Table 1).

Fig. 1 displays the share of immigrants with a Canadian degree by age at arrival. It clearly shows that the imputation procedure underestimates the fraction of immigrants arriving after age 18 who have obtained a Canadian degree. The Census information on location of study shows that obtaining a Canadian diploma largely depends on the age at arrival. Of those who arrived at age 19, 91.6% obtained their highest degree in Canada, compared to only 29% for those who arrived at age 29. By contrast, the imputation procedure indicates that the share of immigrants with a Canadian degree declines to less than 10% for people arriving at age 22 or older. No immigrant arriving at age 27 or older has imputed Canadian education. The underestimation is particularly large for immigrants arriving between the ages of 20 and 24. For those arriving at age 29, the difference declines to about 29 percentage points (28.7% versus 0%). Thus, Fig. 1 shows that the imputation method is underestimating the number of years of Canadian education for immigrants and overestimating their number of years of foreign education. To the extent that returns to Canadian education are larger than returns to foreign education, this measurement problem should result in an upward bias in returns to foreign education.[24] Furthermore, the mismeasurement of foreign

vs. Canadian education may contaminate the measures of Canadian and foreign experience. This could in turn bias the estimated returns to foreign experience. We discuss these issues in more details in Section 4.5.

Summary statistics of the key variables are reported in Appendix A. The mean of log weekly wages for the Canadian born is only slightly larger than for immigrants (4 log points difference), but immigrants are both older (average age of 42.37 versus 40.37) and more educated than the Canadian born (15.14 years of education versus 14.68). Immigrants work as many weeks per year as the Canadian born (around 47) and have more years of work experience (21.23 versus 19.7), though understandably less Canadian work experience (17.26 versus 19.7) than the Canadian born.

The distribution of Canadian born individuals and immigrants by field of study, shown in Table 2, reveals that the immigrants are relatively over represented in fields that require more quantitative skills, such as "Computer Science, Mathematics, Physical Sciences" (11% vs. 5%) and "Architecture, Engineer and Engineer Technicians" (17% vs. 9%). Conversely, immigrants are under-represented in fields that require a greater ability to communicate, such as "Education" (4% vs. 7%) and "Social and Behavioural Sciences" (8% vs. 10%). They are also underrepresented in fields that involve an intensive use of manual labor, such as "Construction Trade, Mechanics and Woodwork" (10% vs. 15%). Limitations in the portability of human capital for some diplomas and/or Canadian immigration policy may be affecting the distribution of fields of study of the newcomers.[25] The table also shows that immigrants tend to acquire education in Canada

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[24] Since education is captured by dummy variables in our empirical specifications, a mix of immigrants with foreign and Canadian education will be coded as having "foreign education" when the imputation procedure is used instead of the direct measure of location of study. This will overstate the returns to foreign education under the assumption that the true return to foreign education is lower than the Canadian return to education.

[25] Chiswick and Miller (2007) suggest that immigrants with language mismatches tend to be penalized by the labour market, while immigrants who fulfill the language requirements have better possibilities of moving to jobs that suit better their skills.
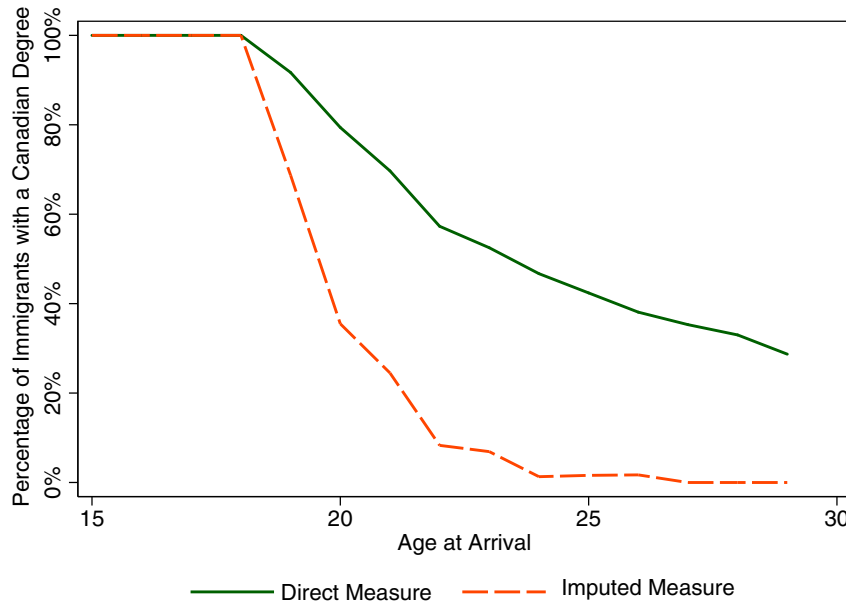
Fig. 1. Percentage of immigrants with a Canadian post-secondary degree by age at immigration.

regardless of their discipline; for most fields of study, more than 50% of immigrants obtain their highest degree in Canada.

3. Empirical strategy

Following the existing literature, we estimate the immigrant/native-born wage gap as the coefficient of a foreign-born dummy in a regression of the logarithm of the weekly wage on a wide set of human capital and other variables,

$$w_i = \alpha_C + \alpha_I I_i + X_i'\beta + \mu_i, \tag{1}$$

where w_i is the logarithm of the weekly wage; I_i is a dichotomous variable indicating whether person i is an immigrant; α_C and α_I are the constant and the adjusted earnings gap between immigrants and the Canadian born, respectively; X_i is a vector of covariates (including gender, work experience and education), and μ_i is an error term that satisfies the usual orthogonality assumption ($E(\mu_i|I_i, X_i) = 0$). The mean earnings gap between the immigrants and the Canadian born ($\bar{w}_I - \bar{w}_C$) can be expressed as the sum of the difference in the average value of covariates times the coefficients β, $(\bar{X}_I' - \bar{X}_C')\beta$, and the unexplained part of the earnings gap (α_I).

More detailed specifications distinguish education and experience acquired in Canada (denoted CAN) from education and experience obtained abroad (denoted FOR) using interactions with a dummy variable indicating where the human capital was acquired,

$$w_{is} = \alpha_C + \alpha_I I_i + X_i'\beta_C(1 - D_i) + X_i'\beta_I D_i + \gamma_s + \mu_{is}, \tag{2}$$

where γ_s represents the location of study fixed effect and D_i is an indicator for where the human capital was acquired (equal to one when acquired outside Canada and zero otherwise). As shown in Table 1, our direct information on the location of the highest level of education gives us more precise information than generally available in the literature. We go further and break up the immigrant dummy into several country/area of origin dummies. This way each country/area of origin fixed effect measures the unexplained wage gap between immigrants from that country and the Canadian born. Additionally, we incorporate controls for language skills (two dummies for English and French as mother tongues), metropolitan area of residence (Toronto being the omitted CMA) and province of residence (with Ontario as the base case). Moreover, in some specifications we add dummies for the field of study.

It is important to underline that our goal is to account for the immigrant/native-born wage gap and explore the extent to which income penalties faced by immigrants arise from different sources of human capital. While we do not claim to identify the causal effect

Table 2
Distribution of fields of study.

Field of study for the highest post-secondary degree	Native	Immigrant	Share of imm. with highest degree in Canada
Education	7%	4%	52%
Humanities and Visual and Performing Arts	7%	7%	44%
Social and Behavioural Sciences and Law	10%	8%	56%
Business, Finance and Marketing	13%	13%	59%
Small Businesses, Accounting and Business Support	8%	9%	60%
Computer Sc., Math., Physical Sc. And Sc. Technologies	5%	11%	62%
Architecture and Engineering and Engineer Technicians	9%	17%	49%
Construction Trade, Mechanics and Woodwork	15%	10%	57%
Health Practitioners and Life Science	4%	5%	54%
Health Assistance	9%	9%	62%
Others	13%	7%	58%

Note: Columns 1 and 2 show the distribution across fields of study for the highest degree, for Canadian and foreign born individuals who arrived in Canada between the ages of 15 and 29. Column 3 shows the percentage of these immigrants who obtained their highest post-secondary degree in Canada by field of study.

Table 3
Regression results on log weekly earnings.

	(1)	(2)	(3)	(4)
Immigrant	−.1096***	−.0580***	−.0603***	−.0283***
	(0.002)	(0.0025)	(0.0025)	(0.0039)
Below bachelor	0.1652***	0.1653***	0.1667***	0.1657***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Bachelor	0.4456***	0.4494***	0.4557***	0.4542***
	(0.0017)	(0.0017)	(0.0017)	(0.0017)
Above bachelor	0.5906***	0.5908***	0.5991***	0.5986***
	(0.0022)	(0.0022)	(0.0023)	(0.0023)
Below bachelor — FOR			−.0667***	−.0462***
			(0.0082)	(0.0082)
Bachelor — FOR			−.1525***	−.1152***
			(0.0088)	(0.0088)
Above bachelor — FOR			−.1441***	−.1165***
			(0.009)	(0.0091)
Work exp.	0.0518***	0.0520***	0.0521***	
	(0.0002)	(0.0002)	(0.0002)	
Work exp. square (/100)	−.0879***	−.0889***	−.0891***	
	(0.0005)	(0.0005)	(0.0005)	
Work exp. — CAN				0.0522***
				(0.0002)
Work exp. square (/100) — CAN				−.0910***
				(0.0005)
Work exp. — FOR				0.0077***
				(0.002)
Work exp. square (/100) — FOR				−.0139
				(0.0207)
Male	0.2922***	0.2918***	0.2919***	0.2920***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Loc. of study F.E.	No	Yes	Yes	Yes
Weighted numb. of obs.	6,323,125	6,323,125	6,323,125	6,323,125
R^2	0.2137	0.2167	0.217	0.2178

Note: Robust standard errors are in parentheses. The omitted category in the location of study fixed effects is "Canada". The omitted category for the education dummies is "trade certificate". The age of arrival of immigrants is restricted between 15 and 29.
* Denotes significance at 10% level.
** Denotes significance at 5% level.
*** Denotes significance at 1% level.

of education (or experience) on earnings, the available evidence (e.g. Card (1999)) suggests that biases in OLS estimates of the returns to education are modest. Furthermore, the estimated effect of location of study will be valid as long as the correlation between education and unobserved ability (the usual source of failure of the assumption that education is exogenous) is the same for immigrants and the Canadian born. We recognize, however, that this assumption is not testable in our cross-sectional data.[26] Despite these shortcomings, we believe that the information we have improves the separation of the sources (domestic or foreign) of human capital, and helps better understand (relative to existing studies) how earnings depend on the location of study, country of origin, and field of study.

4. Empirical results

4.1. Base specifications

We report some base estimates of the earnings equation in Table 3. Column (1) shows that the immigrant/native-born wage gap is around 11% after adjusting for standard covariates like education and experience. The remainder of the table reports results from a number of specifications where we include a variety of controls for the source of human capital (location of study and foreign experience). The magnitude of the immigrant effect (the coefficient on the immigrant dummy) declines by 47% to 75% depending on the specification. For instance, the immigrant effect is less than 3% in the richest

specification reported in column (6). Although the estimated effect remains statistically different from zero, the change (from 11% to 3%) is quite substantial in economic terms. Note that, following most of the literature, we indicate (using asterisks) whether coefficient estimates are statistically different from zero. These tests are not particularly informative, however, due to the small size of the standard errors in our very large samples. In light of this, we focus our discussion on the economic significance, as opposed to the statistical significance, of the results.

Column (2) shows that the immigrant effect declines by almost a half when a set of controls is included for the location of study, with Canada being the omitted category. In Fig. 2, we graph the coefficients of the location of study dummies estimated in column (2). The figure indicates a large negative gap for most countries relative to Canada. Pakistan has the largest negative effect, followed by India, China, and the rest of Asia (South East Asia, Western and Central Asia). By contrast, the estimated effects for the United States, Oceania and continental Western Europe are very small, indicating that degrees obtained in these countries are as valuable in the labour market as those obtained in Canada. In the case of the United Kingdom, there even appears to be a positive premium relative to Canadian degrees.

In column (3) we add interactions between the education dummies and whether education was obtained abroad. In principle, we could fully interact the location of study country dummies with the three education dummies. To keep the results more tractable, we only interact the education dummies with an indicator for having studied in other country besides Canada, but include the full set of country dummies as main effects. The results reported in column (3) indicate that, as expected, the negative premium linked to foreign education grows with the education level. For instance, the

[26] Ferrer et al. (2006) are able to partly relax the assumption that education is exogenous (unrelated to unobserved ability). They instead invoke alternative assumptions under which education is exogenous conditional on their measures of literacy skills.
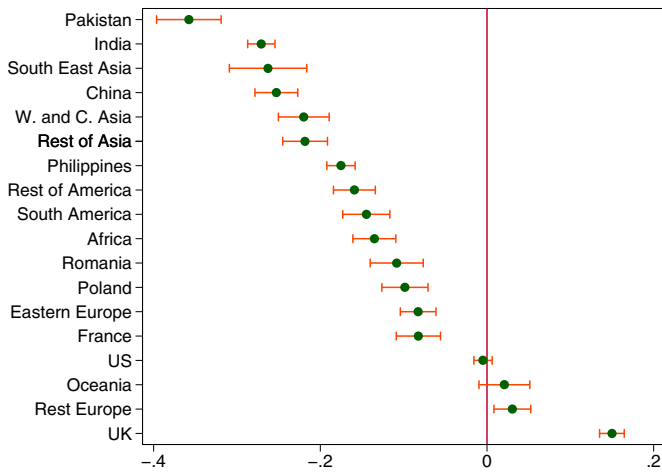
Fig. 2. Location of study fixed effects (Table 3, column 2).

4.2. Including immigrants arriving at an older age

To make our results more comparable with those of other studies, in Table 4 we add to the sample immigrants who arrived in Canada at age 30 or older. That is, we consider all immigrants arriving at age 15 or older.[27] The estimated immigrant effect reported in column (1) (−0.23) is twice as large as the corresponding effect for the restricted sample used in Table 3.[28] As before, the inclusion of location of study fixed effects in column (2) reduces the immigrant effect by about a half, from −0.23 to −0.10. Remarkably, allowing the returns to foreign and Canadian experience to differ in column (3) drives down the immigrant effect to essentially zero.

In columns (4) to (6), we show how the immigrant/native-born gap depends on age at arrival, and how location of study and differential returns to Canadian and foreign experience help explain the gap. As expected, column (4) shows that the size of the gap is an increasing function of age at arrival. The gap for immigrants who arrived in Canada as teenagers is only 2 log points, while immigrants who arrived at age 50 or over face a substantial earnings penalty of 62 log points. Not surprisingly, controlling for location of study and differential returns to Canadian and foreign experience in column (5) has essentially no effect on the immigrant/native-born gap for teenagers, as most of these workers have studied in Canada (as shown in Fig. 1) and hardly have any foreign experience. As age at arrival increases, however, a decreasing fraction of immigrants have a Canadian degree, and foreign experience accounts for an increasing share of total experience. The source of human capital is, therefore, a promising explanation for differences in the immigrant/native-born gap as a function of age at arrival.

Comparing the estimates in columns (4) and (5) shows that the contribution of location of study to the immigrant/native-born gap (the difference between the coefficients in columns (4) and (5)) steadily increases as a function of age of arrival. For instance, it goes from zero for teenagers to around 0.10 for immigrants who arrived at age 25 to 34, and about 0.15 for immigrants who arrived at age 40 or over. Remarkably, most of the remaining gap vanishes, and even turns positive for some groups, once we allow for differential returns to Canadian and foreign experience.

So while our results confirm the importance of the low returns to foreign experience in accounting for the immigrant/native-born wage gap, they indicate that location of study is also an important part of the explanation. This finding is robust to the choice of sample (Table 4 vs. Table 3), and location of study effects also helps account for some of the growth in the gap as a function of age at arrival.

4.3. Immigrant wage gap by gender

We next re-estimate our main specifications separately by gender. The results reported in Table 5 indicate that the immigrant effect is lower for females (9%) than males (12%).[29] However, including location of study dummies in columns (2) and (5) reduces the immigrant effect considerably more for women than men. In the case of women, only about a fifth of the gap (−0.020 relative to −0.093) is left after controlling for location of study. By contrast, controlling for location of study only reduces the gap from −0.118 to −0.080 in the case of men. In other words, location of study helps account for 78% of the gap for women, but only 29% of the gap for men.

return to a bachelor's degree relative to a trade certificate is about a third (0.15) smaller for a degree obtained abroad relative to one obtained in Canada (return of 0.45). The difference is smaller in the case of a university certificate below the bachelor's level, suggesting that workers with lower levels of education may have more easily transferable skills.

Consistent with the existing literature (Aydemir and Skuterud, 2005; Ferrer et al., 2006 and Green and Worswick, 2012), we find that the immigrant effect further declines once we allow for different returns to Canadian and foreign experience in column (4). The return to foreign experience is much smaller than the return to Canadian experience. This more general specification indicates that, conditional on Canadian experience, immigrants with a Canadian degree only earn three percent less than comparable native-born individuals. In other words, close to three quarters of the 11% gap shown in column (1) can be accounted for by differences in the source (Canadian vs. foreign) of human capital.

In the Appendix, we show that the main results of Table 3 are robust to alternative sample restrictions and measures of income. For instance, Appendix J shows that the estimates are very similar when we trim the bottom and top 1% of the earnings distribution. The results are also very similar when we use total earnings (wages and salaries plus self-employment income) rather than the typical wage and salary earnings concept used in Table 3.

One potential caveat is that the decision to acquire education in Canada is likely influenced by different factors, including time available and unobserved skills. Immigrants who have spent more time in Canada are more likely to have a Canadian degree. Likewise, immigrants who come to Canada with lower quality foreign education may feel the need to acquire more education. More generally, immigrants who would particularly benefit from investments in education (because of higher unobserved ability) may also be more likely to invest in Canadian education.

In those circumstances, location of study effects may capture unobserved differences across immigrant workers (or selection effects) instead of a true earnings penalty linked to lower quality foreign degrees, or limited portability of human capital. The pattern of results shown in Fig. 2 suggests, however, that location of study effects are closely linked to differences in school quality, as there is little earnings penalty for studying in countries with schooling systems similar to the one of Canada. We also show below that differences in location of study effects by a field of study are consistent with differences in the portability of human capital by a field.

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[27] Friedberg makes a similar argument when explaining the selection criteria for her sample.

[28] Appendix J presents the estimations for the extended sample using the separation of years of education above high school and above bachelor's degree for Canadian and foreign education.

[29] Appendix G also presents the analysis for male and female workers separating years of education above high school degree and above bachelor's degree for Canadian and foreign education.

Table 4
Regression results adding immigrants arriving after age 29.

	(1)	(2)	(3)	(4)	(5)	(6)
Immigrant	−.2336***	−.1006***	−.0155***			
	(0.0016)	(0.0022)	(0.0031)			
Below bachelor	0.1617***	0.1655***	0.1643***	0.1648***	0.1664***	0.1645***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Bachelor	0.4178***	0.4529***	0.4512***	0.4299***	0.4549***	0.4515***
	(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0017)
Above bachelor	0.5596***	0.5951***	0.5966***	0.5829***	0.5993***	0.5954***
	(0.0021)	(0.0023)	(0.0023)	(0.0021)	(0.0023)	(0.0023)
Below bachelor — FOR		−.0802***	−.0508***		−.0697***	−.0537***
		(0.0062)	(0.0062)		(0.0062)	(0.0063)
Bachelor — FOR		−.2244***	−.1628***		−.2013***	−.1679***
		(0.0065)	(0.0065)		(0.0065)	(0.0068)
Above bachelor — FOR		−.2302***	−.1692***		−.1904***	−.1746***
		(0.0068)	(0.0068)		(0.0068)	(0.0074)
Age at immigration: 15–19				−.0226***	−.0242***	−.0215***
				(0.0042)	(0.0042)	(0.0042)
Age at immigration: 20–24				−.0770***	−.0510***	0.0019
				(0.0033)	(0.0035)	(0.0053)
Age at immigration: 25–29				−.1720***	−.0898***	0.0422***
				(0.0029)	(0.0035)	(0.0086)
Age at immigration: 30–34				−.2927***	−.1768***	0.065***
				(0.0033)	(0.0039)	(0.0122)
Age at immigration: 35–39				−.3999***	−.2604***	0.0702***
				(0.0042)	(0.0048)	(0.0156)
Age at immigration: 40–44				−.5144***	−.3629***	0.0232***
				(0.0058)	(0.0063)	(0.0192)
Age at immigration: 45–49				−.5994***	−.4398***	−.0178
				(0.0091)	(0.0093)	(0.0241)
Age at immigration: 50 plus				−.6218***	−.4723***	−.0241
				(0.0149)	(0.0144)	(0.0343)
Loc. of study F.E.	No	Yes	Yes	No	Yes	Yes
Separating Canadian & foreign work exp.	No	No	Yes	No	No	Yes
Weighted numb. of obs.	6,880,170	6,880,170	6,880,170	6,880,170	6,880,170	6,880,170
R^2	0.194	0.2083	0.2142	0.2048	0.2128	0.2143

Note: Robust standard errors are in parentheses. The omitted category in the location of study fixed effects is "Canada". The omitted category for the education dummies is "trade certificate". The immigrant sample is restricted to individuals arriving at age 15 or older.
  * Denotes significance at 10% level.
 ** Denotes significance at 5% level.
*** Denotes significance at 1% level.

Adding interactions between the education dummies and a foreign education indicator and freeing up the returns to foreign and Canadian experience in column (3) explain the remaining part of the gap for women. In the case of men, however, close to half of the −0.118 gap remains even after controlling for these two factors. A closer examination of the results indicates a noticeable gender difference in the negative penalty to foreign human capital. Consistent with existing studies (e.g. Boudarbat et al., 2010), Table 5 shows that returns to education are substantially higher for women than men. For instance, women with a bachelor's degree earn 56 log points more than those with a trade certificate (column 1), compared to a 37 log points difference in the case of men (column 4).

The results from our more general specifications in columns (3) and (6) indicate, however, that women with a foreign education face a much greater penalty than men. The penalty for having a foreign bachelor's degree rather than a Canadian one is 22 log points for women compared to only 3 log points for men. For the above bachelor's degree category, the difference is also substantial, 19 log points versus 6 log points for men.

4.4. Disaggregating the immigrant wage gap by country of origin

The immigrant effect (coefficient on the foreign-born dummy) in Table 3 represents an average wage gap between Canadian-born and immigrant workers adjusted for differences in other characteristics. Since the distribution of immigrants' source countries changed significantly over the last five decades, we re-estimate our main models in columns 1 and 2 of Table 6 adding dummies for country/area of birth. Instead of reporting the immigrant effect for an arbitrary base country like the United States or the United Kingdom, we show at the bottom of the table a weighted average of the country/area of origin coefficients, i.e. a weighted average of the immigrant effects across countries. The weights come from the first column of Table 1 and refer to the share of immigrants across countries (or areas) of origin in our sample.

Including country (or area) of origin effects in the regression models addresses the important concern that location of study effects may be in part proxying for country of origin effects. For instance, as the vast majority of immigrants with a Pakistani degree were likely born in Pakistan, the location of study effect for Pakistan may be capturing both a foreign degree effect and a country of origin effect in the models reported in earlier tables. Given the patterns found in Fig. 2, we regroup locations of study into broader areas, namely: Canada; the West (including Oceania); Eastern Europe (including Romania and Poland); China and West and Central Asia (including Hong Kong); India, Pakistan and the rest of Asia; Latin America; South-East Asia (including the Philippines) and Africa. A more manageable number of categories facilitates the interpretation of the results while sacrificing little in terms of the identification of location of study premiums.[30]

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[30] To test that the incorporation of country/area of origin fixed effects, instead of a foreign-born dummy, still captures the average negative premium for immigrants and does not affect the coefficients of other variables, we replicate some of the columns of Table 3 changing only the foreign-born dummy. Appendix H presents the results. The changes in the coefficients on education, work experience and gender are fairly minor. Moreover, the weighted average of the country/area of birth dummy coefficients is very similar to the foreign-born dummy coefficient in Table 3.

Table 5
Regression results — immigrant wage gap by gender.

	Females			Males		
	(1)	(2)	(3)	(4)	(5)	(6)
Immigrant	−.0933***	−.0202***	0.0091*	−.1184***	−.0839***	−.0546***
	(0.0028)	(0.0033)	(0.0052)	(0.0029)	(0.0036)	(0.0057)
Below bachelor	0.2508***	0.2519***	0.2538***	0.1212***	0.1210***	0.1206***
	(0.0021)	(0.0021)	(0.0022)	(0.0019)	(0.0019)	(0.0019)
Bachelor	0.5589***	0.5639***	0.5721***	0.3677***	0.3711***	0.3730***
	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)
Above bachelor	0.7167***	0.7209***	0.7295***	0.5041***	0.5016***	0.5084***
	(0.003)	(0.003)	(0.0031)	(0.0032)	(0.0033)	(0.0034)
Below bachelor — FOR			−.1032***			−.0131
			(0.0126)			(0.0109)
Bachelor — FOR			−.2175***			−.0329***
			(0.0132)			(0.012)
Above bachelor — FOR			−.1914***			−.0580***
			(0.0137)			(0.0122)
Work exp.	0.0469***	0.0470***		0.0578***	0.0581***	
	(0.0003)	(0.0003)		(0.0003)	(0.0003)	
Work exp. square (/100)	−.0805***	−.0811***		−.0981***	−.0995***	
	(0.0007)	(0.0007)		(0.0007)	(0.0007)	
Work exp. — CAN			0.0474***			0.0581***
			(0.0003)			(0.0003)
Work exp. square (/100) — CAN			−.0837***			−.1010***
			(0.0007)			(0.0007)
Work exp. — FOR			0.0057**			0.0101***
			(0.0027)			(0.0029)
Work exp. square (/100) — FOR			0.0086			−.0386
			(0.0279)			(0.0301)
Loc. of study F.E.	No	Yes	Yes	No	Yes	Yes
Weighted numb. of obs.	2,909,150	2,909,150	2,909,150	3,413,970	3,413,970	3,413,970
R^2	0.2077	0.2118	0.2137	0.1628	0.1658	0.1665

Note: Robust standard errors are in parentheses. The omitted category in the location of study fixed effects is "Canada". The omitted category for the education dummies is "trade certificate". The age of arrival of immigrants is restricted between 15 and 29 years old.
  * Denotes significance at 10% level.
 ** Denotes significance at 5% level.
*** Denotes significance at 1% level.

Fig. 3 graphs the country/area of origin wage premiums estimated in the models reported in columns 1 to 2 of Table 6. Column 1 shows that immigrants from Asia (aside from South-East Asia or Hong Kong) tend to have the largest negative premiums; and among them, workers from Pakistan get the lowest coefficient (−0.35). The next group includes immigrants from South and Central America, Africa, and Eastern Europe with coefficients ranging from −0.2 to −0.1.

Immigrants from the US, France, Oceania, South-East Asia, Hong Kong, and the rest of Europe have coefficients around −0.10. Immigrants from the United Kingdom are the only group with a positive and significant wage premium, close to 0.04.

Including location of study fixed effects and freeing up the returns to Canadian and foreign work experience, and education in column 2 reduce the size of the country of origin dummies. The second panel of Fig. 3 indicates that the country of origin effect declines for most countries. The decline is particularly large for China, Pakistan, India, the Philippines, West and Central Asia and the rest of Asia.[31] Smaller reductions in the estimated effects for Oceania, South-East Asia, most of Europe, and the United States drive these effects to zero.

The important message to draw from Table 6 is that a sizeable part of usual country of origin effects reflects the fact that human capital acquired in foreign countries is often of limited value in Canada. For example, the large drop in the country effect for Pakistan and India indicates that Pakistani or Indian immigrants do much better in the Canadian labour market when they hold a Canadian degree. Note also that the location of study fixed effects reported in column 2 of Table 6 are substantially smaller than those reported in Fig. 2.

Nonetheless, looking at the average country of origin effect at the bottom of Table 6 indicates that including controls for foreign human capital still accounts for a substantial part of the immigrant/native-born gap. The gap declines by more than half, from −0.154 to −0.073, when controls for foreign human capital are included in column (2).

4.5. Results based on imputed measures of foreign human capital

An important contribution of the paper is to highlight the difference between results based on our direct measure of location of study as opposed to standard imputations à la Friedberg that have been used in most of the existing literature. Column 4 of Table 6 shows what happens to the estimates when we use this imputation procedure. For the comparison reported in Table 6, we also impute the source of work experience. Immigrants are assigned foreign work experience only if, under the imputed calculations, they would have finished their studies before coming to Canada.[32] The number of years of foreign work experience would be the difference between the age at immigration and the assumed age at which immigrants complete their studies (years of education plus six). Given the imputation procedure, no immigrant could have both foreign work experience and Canadian education. For the sake of comparison with Friedberg (2000), we also report results for a more limited sample of immigrants who arrived in Canada between the ages of 20 and 29 in columns 3 and 5.

We find that the wage penalty for holding a foreign degree is only slightly smaller when imputed, as opposed to direct, measures of foreign human capital are used. For instance, for immigrants with a

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[31] There is also a significant reduction in the coefficients of Eastern Europe, Romania, France, and Africa.

[32] Canadians are given zero work experience abroad.

Table 6
Regression results: direct measure of location of study vs. imputation methods.

	Direct measurement			Friedberg method	
	Original base		Immigrants 20 and 29 at arrival	Original base	Immigrants between 20 and 29 at arrival
	(1)	(2)	(3)	(4)	(5)
Below bachelor	0.1452***	0.1456***	0.1460***	0.1453***	0.1457***
	(0.0014)	(0.0014)	(0.0014)	(0.0015)	(0.0015)
Bachelor	0.4108***	0.4170***	0.4167***	0.4153***	0.4150***
	(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0017)
Above bachelor	0.5535***	0.5602***	0.5598***	0.5576***	0.5571
	(0.0022)	(0.0023)	(0.0023)	(0.0023)	(0.0023)
Below bachelor — FOR		−.0266***	−.0258***	−.0187***	−.0189***
		(0.008)	(0.0082)	(0.0059)	(0.0061)
Bachelor — FOR		−.0834***	−.0824***	−.0706***	−.0708***
		(0.0085)	(0.0087)	(0.0069)	(0.0071)
Above bachelor — FOR		−.0863***	−.0843***	−.0693***	−.0683***
		(0.0088)	(0.009)	(0.0081)	(0.0083)
Work exp. — CAN		0.0526***	0.0525***	0.0530***	0.0530***
		(0.0002)	(0.0002)	(0.0002)	(0.0002)
Work exp. square (/100) — CAN		−.0911***	−.0910***	−.0918***	−.0918***
		(0.0005)	(0.0005)	(0.0005)	(0.0005)
Work exp. — FOR		0.0108***	0.0125***	0.0026	0.0028
		(0.0020)	(0.0028)	(0.0027)	(0.0028)
Work exp. square (/100) — FOR		−.0388*	−.0518**	0.0073	0.0047
		(0.0205)	(0.0256)	(0.0299)	(0.0305)
Region of study:					
West		0.049***	0.0477***	0.0527***	0.0349*
		(0.0076)	(0.0078)	(0.0116)	(0.0208)
Eastern Europe		−.0951***	−.1084***	−.022	−.0465
		(0.0121)	(0.0131)	(0.0158)	(0.0347)
China, W. and C. Asia		−.0846***	−.0799***	−.0548***	−.0611***
		(0.0136)	(0.0142)	(0.0160)	(0.0274)
Ind., Pak., Rest Asia		−.1632***	−.1627***	−.0549***	−.0499**
		(0.0111)	(0.0119)	(0.0120)	(0.0214)
Rest of America		−.0428***	−.0376***	−.0069	−.0131
		(0.0116)	(0.0122)	(0.0115)	(0.0242)
South East Asia		−.1241***	−.1263***	−.0575***	−.0810***
		(0.0132)	(0.015)	(0.0137)	(0.0309)
Africa		−.0126	−.0134	0.0213	0.0481
		(0.0159)	(0.0165)	(0.0189)	(0.0321)
Weighted numb. of obs.	6,323,125	6,323,125	6,193,890	6,323,125	6,193,890
R^2	0.2455	0.2473	0.248	0.247	0.2477
Country/area weighted ave.	−.1540***	−.0734***	−.0793***	−.0730***	−.0661***
	(0.0026)	(0.0042)	(0.0076)	(0.0043)	(0.0094)

Note: Robust standard errors are in parentheses. The omitted category in the groups of location of study is "Canada". The age of arrival of immigrants is restricted to be between 15 and 29 in columns (1), (2), and (4). All the estimations include country/area of origin effects (with Canada as the omitted category), CMA/province fixed effects (Toronto/Ontario) and French or English mother tongue. Column (1) includes controls for total work experience and work experience square (divided by 100).
  * Denotes significance at 10% level.
 ** Denotes significance at 5% level.
*** Denotes significance at 1% level.

foreign bachelor's degree or higher, using the direct measure yields a wage penalty of around 8–9% (column 2) compared to 7% (column 4) when the imputed measure is used instead. The results also indicate a small but important difference in the estimated returns to foreign work experience. The estimated effect of an additional year of work abroad is about 1% when the direct measure is used, which is substantially lower than in the case of Canadian experience. Columns 4 and 5 show, however, that the estimated return to foreign experience is even lower, and not significantly different from zero (the coefficient of the linear effect ranges between 0.0026 and 0.0028) when the imputed measure is used instead.

These findings are consistent with the discussion of possible biases linked to imputed measures of human capital in Section 2.2. In particular, since many immigrants with some Canadian education are incorrectly imputed as having no Canadian education (see Table 1 and Fig. 1), we expect the negative penalty for foreign education to be smaller when the imputed measure is used instead of the direct measure. The discrepancy is substantially larger for the estimated coefficients of the locations of study. With the direct measure, the coefficients are negative and significant (with the exception

of the West and Africa). With the imputed procedure, most coefficients are substantially smaller in absolute terms. In particular, the effect of having a degree from India, Pakistan, and the rest of Asia is three times smaller (5 as opposed to 16 log points) when the imputed measure is used instead of the direct measure.

Using the imputed measure can, therefore, dramatically understate how large and negative the location of study premium is for some countries, which, in turn, substantially affects the interpretation of the sources of the immigrant/native-born wage gap. While other data sets also include direct information on the location study, the large sample sizes available in the 2006 Census are essential to precisely estimate the location of study effect of different countries. For instance, Ferrer et al. (2006) show with a much smaller data set that location of study matters overall, but the lack of precision makes it impossible to identify the large differences across countries reported in this paper.

That said, even in the 2006 Census the precision of the country/area fixed effects can vary greatly depending on specifications. Table 6 shows that standard errors are generally lower when direct measures are used. These differences are quite substantial for the
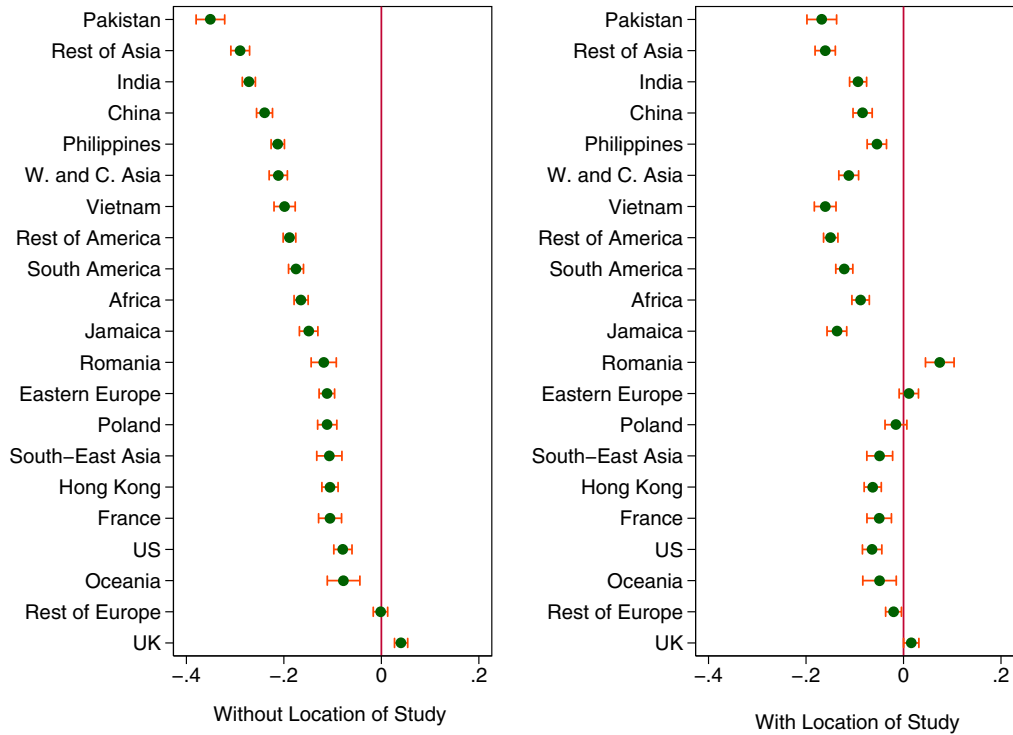
Fig. 3. Country of origin fixed effects. Note: Coefficients from Table 6, columns 1 and 2, estimated on a sample of immigrants who arrived between the ages of 15 and 29.

sample of immigrants who arrived between the ages of 20 and 29. In the case of the location of study effects, the standard errors reported in column 5 (imputed measure) are 2–3 times larger than those in column 3 (direct measure). We also plot the country of origin dummies with 95% confidence bands in Fig. 4. It is clear from

the figure that the country of origin effects are less precisely esti-mated when the imputed measures (right panel) are used instead of the direct measures (left panel). The source of the problem is that country of origin is much more closely correlated with the coun-try where schooling was obtained when the imputation procedure
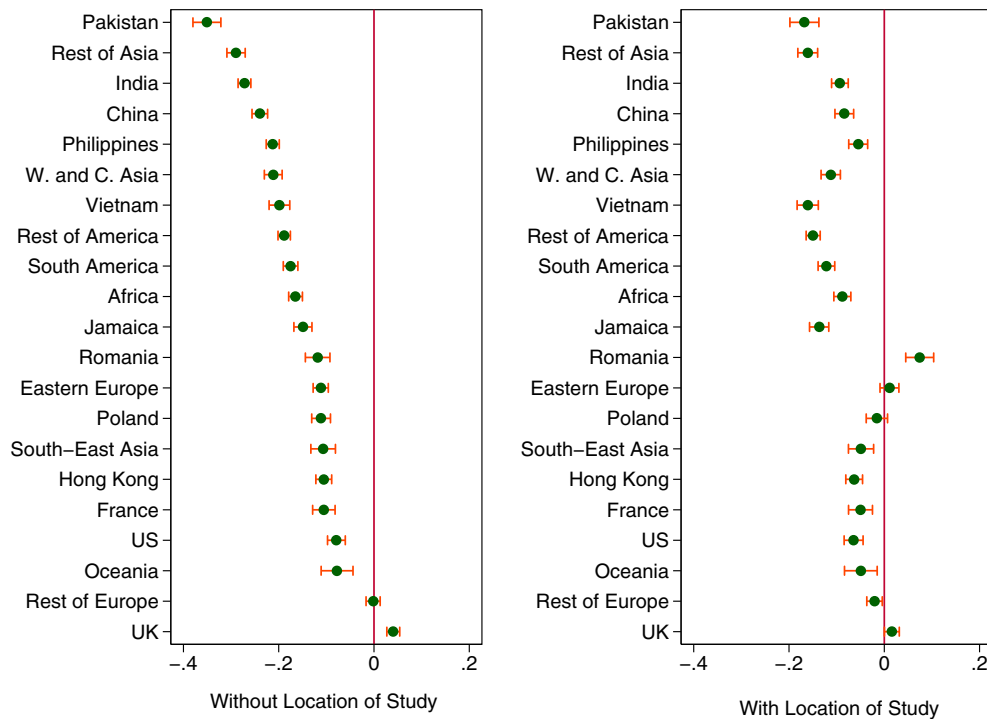

Fig. 4. Country of origin fixed effects using direct measure vs. Friedberg measure. Note: Coefficients from Table 6 col. 3 and col. 5 estimated on a sample of immigrants who arrived between the ages of 20 and 29.

is used instead of the direct procedure. Recall from Fig. 1 that there are very few immigrants who arrived after age 22 who get imputed a Canadian degree. So for immigrants who arrived after their early twenties, it is not really possible to separately identify the effect of country of origin and location of study. This collinearity problem is the source of the larger standard errors in Table 6 and Fig. 4 when imputed measures are used. By contrast, since a large number of immigrants who arrived in their mid-late twenties (or older) report having a Canadian degree when the direct measure is used, there is a lot a variation available to separately identify the effect of country of origin and location of study.

4.6. Interacting location and field of study

Using studies in "Humanities and Visual and Performing Arts" in Canada as the base category, Table 7 explores the heterogenous wage premiums by fields of study depending on the location of study, which is captured by interactions between the two variables. Column 1 shows that the fields with the largest wage premiums for workers with Canadian degrees are in applied sciences or construction trades.

Indeed, "Architecture, Engineering and Engineering Technicians" and "Construction Trade, Mechanics and Woodwork" are the only two fields with a premium of over 30 log points (controlling for education and experience).[33] The next three highest paying fields are, in descending order, "Business, Finance and Marketing", "Health Technicians" and "Computer Sciences, Mathematics, Physical Sciences and Sciences Technologies". The lowest paid fields (besides the base group, "Humanities and Arts") are "Education" and "Social and Behavioural Sciences and Law".

The remainder of the table shows the interactions between the location of study and the field of study categories. Note that all the estimates reported in Table 7 are based on a regression model that also includes country of origin fixed effects and separate controls for foreign and Canadian work experience. The models do not include location of study as main effects (or interactions between education categories and foreign education) to simplify the interpretation of the results. Thus, the interaction coefficients capture the wage penalty for holding a foreign degree in a given field of study, relative to holding a Canadian degree in the same field.

The results show considerable dispersion in the wage penalty for each field of study depending on where the education was acquired. Consistent with earlier results, the penalty for degrees acquired in other western countries is generally quite small and often not statistically significant. There is much more variation in the wage penalty for other locations of study. For example, the wage penalty in "Business, Finance and Marketing" is so large (31 log points) for workers who acquired their degrees in India, Pakistan, and the rest of Asia that it more than offsets the premium this field confers (27 log points) to workers with a Canadian degree. By contrast, the wage penalty is small and not statistically significant in the "Health Assistance" field. This suggests that, at least in the case of degrees acquired in India, Pakistan, and the rest of Asia, there is a much higher level of human capital portability in "Health Assistance" than in business.

A closer examination of the results indicates that, with the exception of Western countries, the wage penalties are surprisingly similar across different locations of study. For instance, the wage penalty in the field of "Education" is over 20 log points in 6 of the 7 groups of countries besides the "West". This suggests that education is one of the field of study for which human capital acquired in the home country is least portable. This is consistent with the view that education is a field in which country specific knowledge and language/communications skills are particularly important. Likewise,

the wage penalty in "Business, Finance and Marketing" tends to be quite large too, and exceeds 20 log points in five groups of countries.

By contrast, the results suggest that a degree in Health Assistance is highly portable, as the wage penalty does not exceed 10 log points in any location of study. "Computer Sciences, Mathematics, Physical Sciences and Sciences Technologies" is another field of study for which the wage penalty is relatively modest, and only exceeds 10 log points in two groups of countries. This is consistent with the view that a degree in broadly defined mathematical sciences provides a set of "universal" skills that are equally valued in the Canadian labour market, regardless of where the degree was acquired.

On balance, the results reported in Table 7 suggest that lack of portability of skills appears to be a more promising explanation for the negative premium on foreign education than simple differences in quality of schooling across countries. If quality of schooling was the main culprit, we would expect the wage penalty for a given set of countries to be similar across different fields of study. This idea can be formalized by running a regression of the penalties reported in Table 7 on a set of location and field of study dummies for countries other than the "West" (for which these penalties are all quite small). Regression results indicate that field of study effects account for 45% of the variation in the wage penalties, compared to 28% for location of study. If some countries were providing uniformly bad quality of education in all fields, we would expect location of study to account for much more of the variation than field of study. At a minimum, these findings suggest that limited portability of human capital is one of the important factors explaining why foreign education is not as highly valued in the market as Canadian education.

4.7. Educational path

Even though the 2006 Census provides direct information on where the highest degree was acquired, we do not know where each level of education was obtained. Immigrants who acquired their last level of education in Canada (e.g. a master's degree) may have obtained previous degrees abroad (e.g. a bachelor's degree). In Table 8, we try to assess the wage impact of where each degree, as opposed to just the last degree, was obtained. But before presenting a full configuration of possible educational paths, we need to decide how to attribute to each degree a Canadian or foreign origin.

These attributions are based on assumptions about the age at which workers completed their second highest level of education. This means that for most workers we need to impute the location where high school was completed (in Canada or abroad). For immigrants with a post-graduate degree, this implies an additional assumption regarding the location where the bachelor's degree was attained (again, in Canada or abroad). It could be argued that this assumption is less problematic when imputing secondary education, as most people do continue their studies until completion of a high school diploma.

We apply the same imputation rules to native-born and immigrants who arrived in Canada at age 18 or younger. In both cases, we assume that they obtained their high school diploma in Canada. No imputation is needed for individuals with a bachelor's degree or less, as we have direct information on the location of their post-secondary education. For individuals who have a post-graduate degree, we assume that they received their bachelor's degree in Canada, regardless of where the post-graduate degree was obtained.

We then assume that immigrants who arrived after the age of 18 have obtained their high school diploma abroad. Again, for those with a bachelor's degree or less we have direct information on their location of study. However, for those with a post-graduate degree we need to make some further assumptions. If immigrants arrived in Canada between the ages of 22 and 29 we assign them a foreign bachelor's degree, while their post-graduate degree comes from the direct information available in the Census. If they arrived between the ages

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[33] In 2006, with the oil boom picking up in Western Canada, it is not surprising to see higher premium in Trades as argued in Fortin and Lemieux (2015).

Table 7

Interactions between location of study and field of study.

	Location of study Canada (Base)	West	Eastern Europe	China, W. & C. Asia	Ind., Pak. & Rest Asia	Rest of America	South East Asia	Africa
Education	0.1445***	−.0622***	−.2152***	−.2005***	−.2289***	−.2008***	−.2919***	−.0865*
	(0.0030)	(0.0085)	(0.0332)	(0.0506)	(0.0317)	(0.0349)	(0.0271)	(0.0497)
Humanities and Arts		−.0352***	−.0907***	0.0013	−.1485***	0.0723*	−.0168	−.0037***
		(0.0115)	(0.0281)	(0.0309)	(0.0158)	(0.0414)	(0.0420)	(0.0403)
Soc. and Behav. Sc. and Law	0.1201***	0.0522***	−.1983***	−.1415***	−.2277***	−.0825***	−.2089***	−.1064***
	(0.0030)	(0.0125)	(0.0243)	(0.0389)	(0.0219)	(0.0273)	(0.0294)	(0.0369)
Bus., Fin. and Mark.	0.2717***	0.0316***	−.2733***	−.2269***	−.3124***	−.1586***	−.3124***	−.1452***
	(0.0029)	(0.0119)	(0.0294)	(0.0333)	(0.0182)	(0.0227)	(0.0233)	(0.0388)
Small Bus. and Acc.	0.1742***	0.0257	−.1791***	−.1355***	−.1465***	−.0274	−.1433***	0.0095
	(0.0030)	(0.0160)	(0.0386)	(0.0316)	(0.0225)	(0.0273)	(0.0221)	(0.0292)
Comp. Sc., Math. and Phys.	0.2199***	0.0376***	−.0433*	−.0617**	−.1487***	0.0081	−.1303***	−.0698*
	(0.0033)	(0.0144)	(0.0241)	(0.0254)	(0.0220)	(0.0347)	(0.0282)	(0.0362)
Arch. and Eng. and Eng. Tech.	0.3307***	−.0001	−.2004***	−.2271***	−.1657***	−.0961***	−.2513***	−.0673*
	(0.0030)	(0.0116)	(0.0166)	(0.0195)	(0.0179)	(0.0271)	(0.0201)	(0.0344)
Const. Trade and Mech.	0.3160***	0.0028	−.0604***	−.1519***	−.0665**	−.0823***	−.1623***	−.1576***
	(0.0030)	(0.0125)	(0.0198)	(0.0511)	(0.0278)	(0.0217)	(0.0323)	(0.0522)
Health Pract. and Life Sc.	0.1931***	0.0484***	−.1520***	−.1214***	−.2152***	−.0714	−.2966***	0.1165**
	(0.0041)	(0.0167)	(0.0444)	(0.0432)	(0.0249)	(0.0452)	(0.0384)	(0.0515)
Health Assistance	0.2510***	−.0331**	−.0935***	0.0381	−.0112	−.0667	−.0305	0.0051
	(0.0029)	(0.0147)	(0.0343)	(0.0445)	(0.0325)	(0.0413)	(0.0202)	(0.0730)
Others	0.1425***	−.0342***	−.1757***	−.1021**	−.1378***	−.0985***	−.1812***	0.0127
	(0.0029)	(0.0120)	(0.0243)	(0.0470)	(0.0308)	(0.0362)	(0.0397)	(0.0494)

Note: Robust standard errors are in parentheses. All the estimations include country/area of origin fixed effects, CMA/province fixed effects, and French or English mother tongue. The omitted category for the education dummies is "trade certificate" and for country/area of origin fixed effect is "Canada". The omitted categories in the CMA and province fixed effects are Toronto and Ontario, respectively. The fields of study are Soc. and Behav. Sc. and Law = Social Behavioural Sciences and Law; Bus., Fin. and Mark. = Business, Finance and Marketing; Small Bus. and Acc. = Small Businesses, Accounting, and Business Support; Comp. Sc., Math. and Phys. = Computer Science, Mathematics, Physical Science and Sciences Technologies; Arch. and Eng. and Eng. Tech. = Architecture and Engineering and Engineer Technicians; and Const. Trade and Mech. = Construction Trade, Mechanics and Woodwork; Health Pract. and Life Sc. = Health Practitioners and Life Science including Doctors, Ophthalmology, Dentistry and Veterinary; and Health Assistance include Nursing and Health Technicians.

  * Denotes significance at 10% level.
 ** Denotes significance at 5% level.
*** Denotes significance at 1% level.

Table 8
Immigrant wage gap with different educational paths.

High school in Canada		High school abroad	
+Trade foreign	−.0827***	+Trade Canada	−.0249***
	(0.0237)		(0.0095)
		+Trade foreign	−.0034
			(0.0178)
+Below bachelor Canada	0.1450***	+Below bachelor Canada	0.1369***
	(0.0015)		(0.0088)
+Below bachelor foreign	0.0408**	+Below bachelor foreign	0.1146***
	(0.0201)		(0.0170)
+Bachelor Canada	0.4156***	+Bachelor Canada	0.4257***
	(0.0017)		(0.0100)
+Bachelor foreign	0.2849***	+Bachelor foreign	0.3285***
	(0.0189)		(0.0173)
+Bachelor Canada + above bachelor Canada	0.5572***	+Bachelor Canada + above bachelor Canada	0.5670***
	(0.0024)		(0.0162)
		+Bachelor foreign + above bachelor Canada	0.5901***
			(0.0116)
+Bachelor Canada + above bachelor foreign	0.4786***	+Bachelor foreign + above bachelor foreign	0.4319***
	(0.0173)		(0.0179)
Weighted numb. of obs.	6,323,125		
R^2	0.2474		

Note: Robust standard errors are in parentheses. The omitted category is "High School Canada and Trade in Canada". The estimation includes country/area of origin fixed effects ("Canada" is the omitted category), CMA/province fixed effects (Toronto/Ontario are the omitted categories), and French or English mother tongue. The specification also separates Canadian and foreign work experience and includes dummies for education levels.
  * Denotes significance at 10% level.
 ** Denotes significance at 5% level.
*** Denotes significance at 1% level.

of 19 and 21, we assume that they obtained their bachelor's degree in the same location as where they received their post-graduate education (in Canada or abroad). Although there is some arbitrariness in these assumptions, they appear reasonable in order to attribute a Canadian or foreign location of study to each level of education.

There are some, hopefully rare, educational paths that are ruled out by these assumptions. For example, no immigrant with a high school diploma and a Canadian post-graduate degree will be classified as having obtained a bachelor's degree abroad under our assumptions. Likewise no immigrant with a foreign high school diploma and a foreign post-graduate education will be classified as having obtained a bachelor's degree in Canada.

Table 8 reports the wage premiums associated with each educational path relative to the base case, which consists of workers with a Canadian high school and trade certificate. The results are interesting. We find that the negative premium from obtaining a high school and certificate abroad is not statistically significant. That is, there is no earnings difference between people who acquire up to a trade level of education abroad and those who acquire the same level of education in Canada. There are negative effects, however, for individuals with mixed sources of education. The negative wage premium for acquiring a high school diploma abroad and a trade certificate in Canada is −2%, and larger at −8% for the opposite education path. In the case of individuals with a university/college certificate below a bachelor's degree, we find that having obtained all degrees abroad results in an earnings disadvantage of 3% compared to having obtained all degrees in Canada. Furthermore, conditional on having a Canadian degree below a bachelor's degree, it does not matter much whether the individual went to secondary school in Canada (premium of 0.145) or abroad (0.137).

We find similar results at the bachelor's degree level. For workers who have obtained a bachelor's degree in Canada, where they obtained their high school diploma has little impact on their earnings (0.42 premium if their high school was in Canada and 0.43 if they finished high school abroad). There is, however, a 9 log points difference for immigrants who obtained their bachelor's degree abroad. In that case, the earnings premium is 33 log points, compared to 42 log points when all the education was obtained in Canada. The workers with the lowest return for a bachelor's degree are those who

completed their high school education in Canada but a bachelor's degree abroad (wage premium of 28 log points only).

In the case of workers with a Canadian post-graduate degree and a foreign high school education, it does not matter much whether they completed their bachelor's degree in Canada (57 log points premium) or abroad (59 log points premium). Likewise, workers with an all Canadian education get a premium of 56 log points. The wage premium declines substantially, however, when the final degree (post-graduate degree in this case) is obtained abroad.

While the results are somewhat mixed for lower levels of post-secondary education, a clear pattern emerges in the case of bachelor's degrees and above. Conditional on where the final degree was obtained, the rest of the educational path has little effect on the wage premium. We conclude from this exercise that the simpler models where we only consider where the highest level of education was obtained adequately capture the effect of the source of education (Canadian vs. foreign) on earnings.

5. Conclusions

This study uses a new question from the 2006 Canadian Census on where the highest level of education was obtained to better account for the earnings gap between immigrants and Canadian-born workers. This question provides more accurate information about the source of human capital than commonly used imputation approaches that are based on a comparison of the age at arrival and the age at which individuals typically complete a given education degree. The information on location of study helps account for a substantial share of the immigrant/native-born gap, up to 70% of the gap in some specifications. Allowing returns to Canadian and foreign work experience to differ helps explain most of the remaining immigrant/native-born gap.

The estimated location of study fixed effects indicate that there are large and negative wage premiums on educational degrees obtained in Asian countries. The wage premium is also negative, but not as large, for degrees from South America, Africa, and Eastern Europe. There is only a small negative premium on degrees from most Western countries (Oceania, the United States and the rest of

continental Europe) and a small positive premium on degrees from the United Kingdom.

As is well known, there are large wage differences across immigrants depending on their country of origin. Generally speaking, the immigrant/native-born wage gap is larger for Asian immigrants (with the exception of South-East Asia and Hong Kong) than European immigrants. We find that including controls for location of study reduces substantially these country of origin effects for China, Pakistan, India, Philippines, West and Central Asia, and the rest of Asia. Including location of study effects also helps account for most of the (smaller) country of origin effect for immigrants from Europe, Oceania, South-East Asia, the United States and Hong Kong.

We also compare our results to those obtained using a standard Friedberg-type imputation procedure. We find that using imputed instead of direct measures tends to overestimate the returns to education acquired abroad and to underestimate the returns to foreign work experience. More importantly, using imputed measures of location of study largely understates the negative wage premium on degrees from most foreign countries. For instance, the negative wage premium on degrees from India and Pakistan is 16 log points when the direct measures are used, but it goes down to only 5 log points when the imputed measures are used instead.

Finally, we show that the negative wage premium on foreign degrees varies greatly across different fields of study. This suggests that human capital acquired abroad is much more portable in some fields than others. For instance, degrees in "Health Assistance" appear to be quite portable (i.e. have small wage penalties) regardless of where they were obtained. To some extent the same holds true in several other fields of study such as "Computer Sciences, Mathematics, Physical Sciences and Sciences Technologies". By contrast, "Business, Finance and Marketing" and "Education" have large negative wage penalties, which suggests that degrees in these fields of study are not very portable across countries.

Appendix A. Supplementary material

Supplementary material to this article can be found online at http://dx.doi.org/10.1016/j.labeco.2016.05.021.

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